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CONNECTION OF LOGISTICS COMPANY IN SMART FACTORY WITH EXTERNAL LOGISTIC CENTERS

Siyka Demirova[1]

Abstract: *This article discusses the integration capabilities of internal logistics in Smart Factory with external logistics centers. In-house logistics includes inbound, production, and outbound logistics. The aim of the report is to examine the structural nature of intelligent logistics in Smart Factory and on this basis to explore interconnections with external logistics centers in the future. This will create an opportunity to improve the functionality and efficiency of the logistics system and also save time across the logistics chain. The flexibility of the activities associated with these processes will also be greatly improved.*

Key words: *Intelligent Logistics, Logistics Centers, Production Logistics*

1. INTRODUCTION

Industrial systems are now set to work in a rapidly changing environment characterized by growing global competition, imposing the principles of the Fourth Technological Revolution and sharply reducing the time and cost of producing products. The growing demand for individualized industrial products and services, coupled with requirements for more resource-efficient and more flexible and faster manufacturing processes, further increases the complexity of today's manufacturing business. In order for companies to exist in this dynamic environment, they need not only to increase their productivity, competitiveness and process flexibility but also to fundamentally change their strategy of both technological and logistical development [10].

At present, the technological and business prospects of industrial firms are considered good. In the opinion of the majority of managers, they can find it much easier than ever to access software and information technology services. This is particularly typical for medium-sized industrial firms and new opportunities for both technological and business integration as well as production and logistics integration will be found. In addition, they will be able to integrate more easily into the process of internationalization of this process globally. In any case, this type of industrial company will benefit from the interdisciplinary transfer of both

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knowledge and technology, as well as the integration of internal logistics processes with external logistics centers [7-9].

In essence, a global reassessment of the influence of intelligent manufacturing components on the control and quality of their integration processes both inside and outside the logistics sector is carried out [1-4].

2. ESSENCE OF THE LOGISTICS INTERGRATION PROCESS IN SMART FACTORY

The essence of the logistic integration process (horizontal and vertical) defines the condition of integration stability of intelligent production activity including input, production and outbound logistics. This means that both real material flow and its virtual component are able to maintain in real time the optimal logistic level of production processes. And in terms of horizontal and vertical integration in logistics processes, the logistic level of the integration process according to the requirements of the Fourth Industrial Revolution is included and understood. Figure 1 shows the essence of the integration logistics process. Horizontal integration in logistics processes is the integration of various material and virtual systems for different stages of production that form the logistics system both inside the company (for example, inbound logistics, production logistics, outbound logistics) and external companies to find real-time optimal logistics solution. Vertical integration is the integration of logistics systems at different hierarchical levels in the production structure to find a constantly optimal management solution.

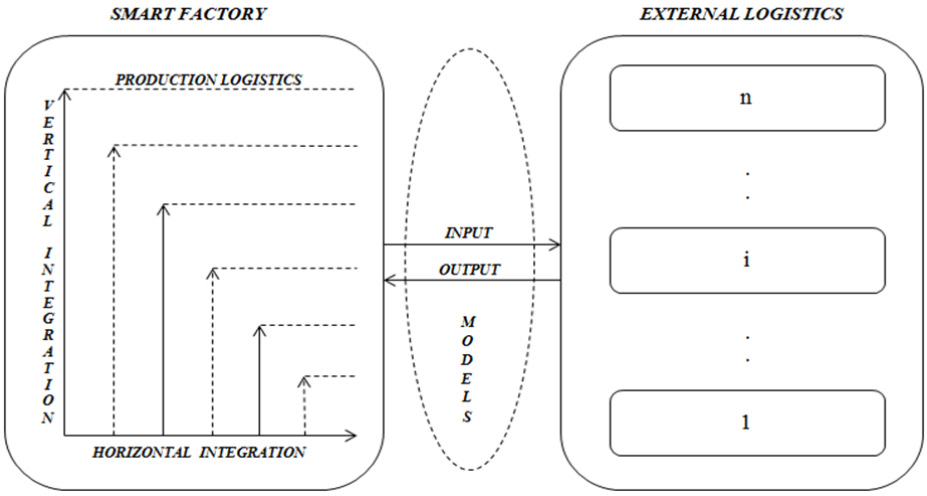

Fig.1.Integration Logistics Process

The vertical and horizontal integration fields will be linked to real and virtual logistic components. In production logistics, the distinction between technological and logistics processes in the future will become increasingly complex and increasingly difficult.

A well-built logistics environment is one of the conditions for the normal functioning of intelligent manufacturing systems. The logistics chain must fully satisfy the requirements of efficiency and functionality of the logistics processes in the industrial plant under the existing conditions. Studies have so far shown that this development process will have a number of factors, more important than:

- availability of financial resources for building a real and virtual logistic structure for conducting the integration processes;
- high economic risk;
- lack of qualified staff;
- insufficient information on technical achievements in this aspect;
- lack of flexibility of the regulatory base;
- lack of markets;
- Insufficient consumer interest in new technical achievements;
- Insufficient experimental verification and proof of some theoretical statements.

Research has shown that the need for resource input and cost is the factor that most hinders firms in their efforts to use advanced technologies in the process of introducing intelligent manufacturing with a modern logistics system. Next is the lack of qualified staff. This is one of the big obstacles for the growth of the companies, the most serious being the shortage of narrow specialists in the executive and maintenance staff.

In addition to increasing the internal complexity of introducing intelligent logistics systems is that most companies see a high risk of rising investment costs. The risk lies in the fact that their own product and services may be lagging behind or innovating before they have recovered their means of production. The levels of stress and low competency among employees is another important factor, as the greatest source of hazards. In this way, the impact of the components of intelligent productions, incl. and logistics on productivity and quality control of company products.

Besides these factors, other infrastructure impacts influence the integration logistics process. The necessary structural basis for future integration of logistics activities with intelligent production systems, and in particular with cyber-physical systems, is shown in Figure 2.

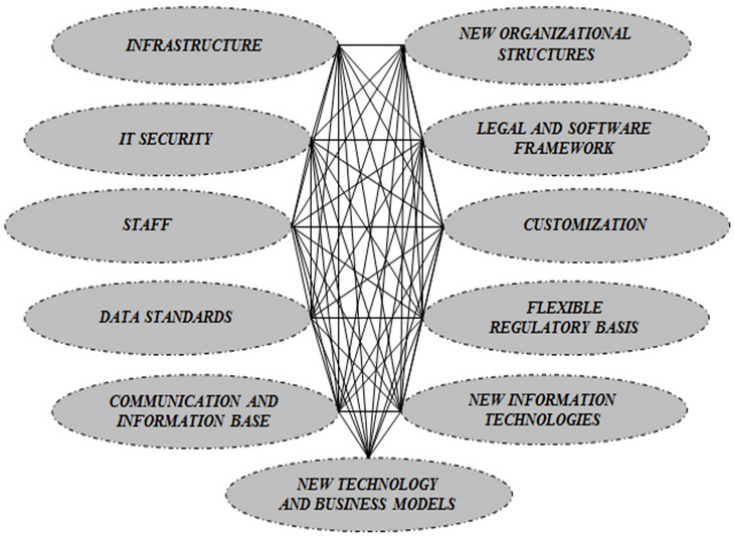

Fig.2. Structural basis of integrating the Logistics process with intelligent industries

3. LINKS TO EXTERNAL LOGISTICS CENTERS AND THE BUSINESS ENVIRONMENT

The structures of the modern systems for automation of the industrial activities in the manufacturing companies are constructed in a prami - diacal form, characteristic of the classic approaches of the automation of the technological and business processes. At its core are automated process control systems (SCADA), MES (Manufacturing Execution System), and ERP systems (Enterprise Resource Planning) at the top of the pyramid. They are mainly designed for resource planning. These systems, viewed from an organizational point of view, define limits of automation applications, mainly in the scope of processing and data transmission. In the future, with a change in the structure of the automation pyramid imposed by the development of intelligent manufacturing (CPS) and decentralized management, these relationships and requirements will change. Thus, with the development of smart productions and the built-in networking components that define the Internet of Things and Services (IoTS), the processing of information will influence both the volume and the type and size of these data. Growing data volumes (Big Data) for the needs of intelligent manufacturing (artificial intelligence) in the future will start to create business and corporate issues, including logistical links to external logistics centers. This is because the higher the intellectual level in this type of pyramidal structure, the more the speed of transmission and processing of their data is reduced.

Logistics (inbound, production and outbound) is an integral part of the intelligent system, it is

a real and virtual module of this system. These systems are synchronized with the dynamic technological and business processes that are part of flexible intelligent manufacturing. With them, the Internet of Things allows direct communication of the modern ERP system with Cyber Physical Systems (CPS) and Intelligent Products at Manufacturing level [5-6]. This means that the domestic production logistics system reacts as a module of the intelligent production system or technological and business processes are adapted to a single market service - products for the market. It is an intelligent ERP-system that uses service-oriented architecture (SOA). It enables the capabilities and services of other software vendors through standardized interfaces. Systems of this kind are suitable for use in rapidly changing process processes that are applied in flexible production. They can connect online with CPS (cyber-physical systems) and intelligent products at the production level stage. Using in-memory databases or large databases, CPS sensors can process all production information in real-time. Or, in the event of any changes in product manufacturing, simulation and optimization is performed using in-memory information technology, but in real time.

Throughout this process, the logistics component is the one that implements real-time external logistics centers. External logistics centers include "inbound logistics" and partly "outbound logistics". They are complex distribution centers for raw materials, basic and auxiliary materials, storage rooms and different types of transport means for logistic provisioning of these processes. So there is a certain interrelation and interdependence between the logistics system, the intelligent production system and the external logistics centers, which ensures their real-time operation in optimized process parameters mode.

The links of Logistics, ERP-systems and Cyber-Physical systems (CPS) are illustrated in Figure 3.

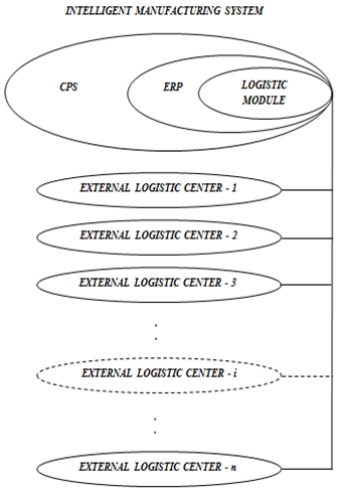

Fig.3 Links to the Logistics, ERP-system with the CPS-system

With changes in production processes, these changes can now be optimized much faster, better, and better. Direct access to production data from the ERP-system ensures greater transparency of technological and business processes in all individual orders. These solutions are easier to perform, as the simulations, optimizations and forecasts that the ERP- system creates are presented in a more user-friendly way of easily accessible mobile devices. In addition, the new ERP-system uses Cloud Computing for Internet Service Access (IOS) capabilities. This part of the Internet includes services and features that are executed as web-based software components and can be used in contact with external companies, such as transport logistics. The characteristic feature of these systems is that CPS sensors can handle all production information if changes occur in production and logistics, and real-time optimization is immediately performed. In this way, rapid and flexible optimization of all processes that need to be regulated due to changes in the process (replacement of materials, etc.) is achieved. Direct access to production data directly from the system ensures transparency of technological and business processes at all levels. So solutions become easier to implement because simulation and expected results are easier and more accessible for use on mobile devices like tablets or smartphones.

4. CONCLUSION

After the study can be drawn the following conclusions:

-The place of logistics and business processes in the intelligent production environment is clarified.

-The dependence and linking of the technological and business processes with the high degree of automation has been analyzed as a result of the introduction of new information and communication technologies in the industrial activities.

-Logistics (inbound, production and outbound) is an integral part of the intelligent system, it is a real and virtual module of this system.

-The Smart Factory hardware logistics chain is adapted to the structural nature of intelligent manufacturing and defines its manifestations in both technological and business processes.

-The logistic component is the one that connects with external logistics centers in real time

-You can use WEB-based software components to contact external logistics systems at Smart Factory.

REFERENCES

[1] Bauernhansl, T. (2017). Die Vierte Industrielle Revolution – Der Weg in ein wertschaffendes Produktionsparadigma. *Handbuch Industrie 4.0*, Bd.4, pp. 1-31

[2] Bauernhansl, Th. (2014). *Industrie 4.0 in Produktion, Automatisierung und Logistik*. Wiesbaden: Springer Vieweg, Berlin

[3] Burger, T., Tragl, K. (2014). SPS-Automatisierung mit den Technologien der IT-Welt verbinden. In: Bauemhansl, T.eds., 2014: lndustrie 4.0 in Produktion, Automatisierung und Logistik. Anwendung, Technologien und Migration, pp.559—569

[4] Deuse, J., Weisner, K., Hengstebeck, A., Busch, F. (2015). *Gestaltung von Produktionssystemen im Kontext von Industrie 4.0*. Zukunft der Arbeit in Industrie 4.0, pp. 99-109

[5] Fiedler, M. (2013). *Effizienzsteigerungen in der Logistik - dank CPS*. Fraunhofer IML

[6] Herterich, M.M., Uebernickel, F., Brenner, W. (2015). The Impact of Cyber-physical Systems on Industrial Services in Manufacturing. *Procedia CIRP*, Vol. 30, pp.323-328

[7] Hirsch-Kreinsen, H., Weyer, J. (2014). Wandel von Produktionsarbeit-"Industrie 4.0"

[8] Kagermann, H., (2017). Chancen von Industrie 4.0 nutzen. *Handbuch Industrie 4.0*, Bd.4, pp. 237-248

[9] Obermaier, R. (2017). *Industrie 4.0 als unternehmerische Gestaltungsaufgabe: Strategische und operative Handlungsfelder für Industriebetriebe*. Industrie 4.0 als unternehmerische Gestaltungsaufgabe, pp. 3-34

[10] Popova, D. (2016). Business and Interactions in Industry 4.0". *Izvestia - Journal of the Union of Scientists - Varna*, Economic Sciences Series, Issue 1, pp. 23-30

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METHODOLOGY FOR IMPLEMENTING KANBAN SYSTEM – CASE STUDY COMPANY ZINES, SKOPJE, MACEDONIA

Tome Jolevski, Zekirija Zekiri[1], Ivo Kuzmanov

Abstract: ***Kanban*** *is a scheduling system for lean manufacturing and just-in-time manufacturing (JIT). The system takes its name from the cards that track production within a factory. A goal of the kanban system is to limit the buildup of excess inventory at any point in production. Limits on the number of items waiting at supply points are established and then reduced as inefficiencies are identified and removed. Whenever a limit is exceeded, this points to an inefficiency that should be addressed.*

How KANBAN would be implemented and would function after the introduction into a production enterprise in the Republic of Macedonia is presented with spreadsheets and graphic representations for the company ZINES DOOEL.

Key words: *Kanban system, manufacturing, material flow*

1. INTRODUCTION

Kanban became an effective tool to support running a production system as a whole, and an excellent way to promote improvement. Problem areas are highlighted by measuring lead time and cycle time of the full process and process steps. A goal of the kanban system is to limit the buildup of excess inventory at any point in production. Limits on the number of items waiting at supply points are established and then reduced as inefficiencies are identified and removed. Whenever a limit is exceeded, this points to an inefficiency that should be addressed. One of the main benefits of kanban is to establish an upper limit to work in process inventory to avoid overcapacity.

Kanban aligns inventory levels with actual consumption. A signal tells a supplier to produce and deliver a new shipment when material is consumed. These signals are tracked through the replenishment cycle, bringing visibility to the supplier, consumer, and buyer. Kanban uses the rate of demand to control the rate of production, passing demand from the end customer up through the chain of customer-store processes.

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2. PROCEDURES OF IMPLEMENTING KANBAN – CASE STUDY COMPANY ZINES

In the next section will be presented a methodology for implementation of the KANBAN system in a furniture production company ZINES, which is existing on the Macedonian market since 2004. Zines DOOEL produces upholstered furniture made of leather, fabric or artificial leather, with different combinations of colors and sizes. More than 10 years their products successfully meet the needs of the European market.

In order to demonstrate the methodology of applying KANBAN in the production cycle of the enterprise of this type, the implementation procedure has been elaborated in seven main phases and more detailed which are contained in the separate phases.

2.1 COLLECTING AND PROCESSING OF DATA

In this phase, data collection and processing is carried out to define the existing situation in the company. This stage allows to calculate the factual-based KANBAN scale rather than wishes. It is very important at this phase to insist on obtaining objective and largely accurate results regardless of whether we liked it or not. This is because otherwise the entire project can be doomed due to the serious impact of such data on the next stages of implementation. The well-known method called VSM (Value-Stream-Mapping) can be used to represent visually and clearly the activities that add value throughout the company.

The production process in company Zines consists of 8 stages: Cutting-Leveling-Tailoring, Montage, Curbing, Sticking on the sponge, Cutting/Sewing, Upholstery, Packing and Storage.

The following important information are on the focus of the first phase of collecting and processing data:

- Information about the process (description of the process, the cycle time of the process, percentage of the blemish);
- Information about the time needed to change and set-up;
- Information about time units in which the process is inactive (planned and unplanned delays, defects, etc.)

This is obtained as a result of monitoring the relevant indicators and the results need to be documented in appropriate forms. Documentation is essential for the project and is done in order to simplify the use of the data contained therein and to compare the situation with a future state.

2.1.1 INDICATOR: THE CYCLE TIME OF THE PROCESS

The cycle time respresent the time needed for making one series. There are several ways to determine the cycle time. Determining the cycle time:

i. With detailed recordings in tables
ii. By analyzing the standard times
iii. Tracking only certain series
iv. Pragmatic methods

Affected by: Preparation time, synchronization, maintenance, training of operators.

Affects: Delivery times, flexibility and capacity optimization.

Visualization:

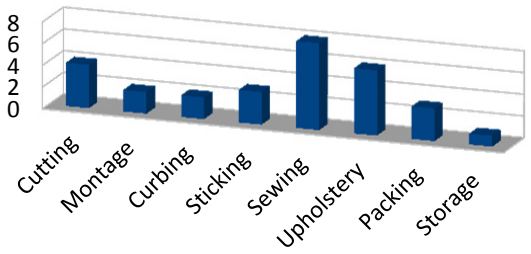

Fig. 1 The cycle time for the production of PURE 300x230

The goal is to take appropriate action, to decrease the values for the cycle time as much as possible and to reduce the variation between the longest and the shortest cycle for the product. One of the possible actions for improving this indicator is precisely the introduction of the KANBAN system.

2.1.2 INDICATOR: PREPARATION TIME

Preparation time represents the time for preparation of one machine for one product.

Source: Preparation time is obtained from the following sources: Working orders and time norms.

Affected by: Working methods and training of operators.

Affects: Production time, delivery time, flexibility, optimization of capacity.

Visualization:

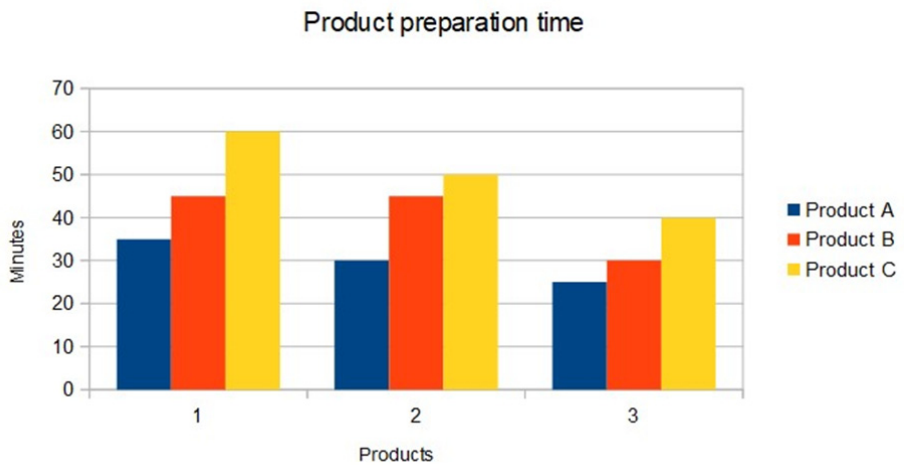

Fig. 2 Visualization for preparatory time for three different products

From the visualization it can be noticed how much preparation time is needed to prepare the series. Therefore, the desire is to make it as shorter as possible by undertaking appropriate actions. The following table shows the form for entering the results of the monitoring of the indicators shown above.

Table 1 Form for entering the results from the monitoring of indicators for PURE 300x230

Serial number	1
ID number of the section	00946
Name of the section	PURE 300x230
Number of species types in the series	22
% of drawback for the process	/
Production time	29 hours
Preparation time	4 hours

2.2 CALCULATION THE NUMBER OF KANBAN

At this phase is determined the number of KANBANs. The formula for estimating the desired number of KANBANs will include different factors. So mainly when determining the

number of KANBAN the information from the first phase is used, which are then translated into formulas which calculate the available active time, the time of planned and unplanned delays, the coefficient of drawback, etc.

2.3 DESIGNING THE KANBAN

Once the number of KANBAN is defined, the next one is the design phase which includes the designing of information holder – KANBAN card. The purpose of this phase is to design KANBAN which can successfully signalize: process, percentage of the blemish):

- When to start producing parts
- When you need to make a change and setup
- When to stop the production

Recommendations that has to be followed at this stage are:

- Signals should be simple and visual
- The signal should prompt an unequivocal reaction
- Unnecessary repetitions of the same signal in multiple places should be avoided.
- Signals should be easy to be managed

2.4 TRAINING OF ALL INVOLVED

In this phase is carried out the training of all involved in the project for introduction of the KANBAN system. It is very important to note that one of the most common mistakes made by people in charge of conducting training is that when they try to make KANBAN experts from the involved persons. On the contrary, during the training the involved should be familiar with the information enough to fit into this whole puzzle.

2.5 LAUNCHING OF THE KANBAN SYSTEM

Once the KANBAN card, system and training is completed, the KANBAN system can be started. Before doing this, it is necessary to make final checks from the aspect of:

- Are all signs throughout the drive set?
- Are the rules of KANBAN placed in a visible place?
- Is visual management established?
- Is training successful? (through trial KANBAN cycle)
- Are all materials and machines ready for startup?

After completing all checks, the system is ready to start. Most commonly problems occurred when starting the KANBAN system are:

- Operators are not sure whether the KANBAN is started
- Operators do not follow signals
- Operators cheat with the signals.

In the first period of introduction the KANBAN system, such errors need to be documented in order to be able to develop an action plan for their overcoming.

2.6 MAINAINING OF THE KANBAN SYSTEM

Once all the problems of the start have been overcome and it can be concluded that the KANBAN system is functioning, the monitoring and auditing of the situation should begin, immediately. When the project team is determining, it should be determined from persons responsible for this function.

This stage is very important to locate errors in the functioning of the KANBAN system and immediately fix them in order to maintain the integrity of it. Otherwise, if it does not work, it can lower the morale of all involved and the system to be doomed to failure.

The results of the maintenance and audit of the system are entering the next phase, improving the system.

2.7 IMPROVEMENT OF THE KANBAN SYSTEM

Improvement occurs as a result of the maintenance and auditing of the KANBAN system. Of course, this includes the suggestions from the operators themselves and others involved. The improvement of the system is most often in the direction of greater reduction of the quantity of materials through the processes, reduction of the time for changes and adjustment, reduction of the time when the machines are inactive due to delays, defects, etc.

In the direction of system improvement, there are several tools and techniques that influence the factors outlined above.

3. CONCLUSION

From the foregoing, it can be concluded that the KANBAN system is one of the tools that can be used to manage the work, on a personal or organizational level.

KANBAN panels show how the work moves from left to right, each column represents the stage of the entire process, or rather the system that is visualized from the board. The team pulls the cards from one column to the other on the right to show progress and coordinate their efforts with others. The KANBAN system can be used in the work of knowledge or in the production process.

How it would be implemented and would function after the introduction into a production enterprise in the Republic of Macedonia is presented with spreadsheets and graphic representations for the company ZINES DOOEL.

REFERENCES

[1] Jolevski, T. (2001). *Management of Industrial systems*, MMA, Bitola.

[2] Minovski, R. (2007). *Designing of information systems.* University of St. Kiril and Metodij, Skopje.

[3] Jovanoski D. (2010) *Production Systems - Structure, Analysis, Design,* UKIM, Skopje.

[4] Jovanoski D. (2013). *Management of technological development*, UKIM, Skopje

[5] Lodding H. (2013). *Handbook of manufacturing control,* Springer-Verlag GmbH

[6] Gross J., McInnis K. (2003) *Kanban Made Simple*, AMACOM

[7] Bangsow S. (2010) Manufacturing Simulation with Plant Sim and SimTalk, Springer – Verlag Berlin Heidelberg,

[8] https://www.plm.automation.siemens.com/en/products/tecnomatix/manufacturing-simulation/material-flow/plant-simulation.shtml

[9] https://www.lean.org/lexicon/toyota-production-system

[10] http://allaboutmetallurgy.com/wp/wp-content/uploads/2017/01/kanban-made-simple.pdf

[11] https://leankit.com/learn/kanban/kanban-board/

[12] https://vietnamwcm.files.wordpress.com/2009/06/halevi-gideon-handbook-of-production-management-methods.pdf

[13] https://www.linkedin.com/pulse/1989-tps-handbook-kanban-system-mark-warren

[14] https://community.plm.automation.siemens.com/t5/Tecnomatix-News/Tecnomatix-Plant-Simulation-software-featured-in-SMART/ba-p/397739

[15] https://www.zines.com.mk/

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OPPORTUNITIES FOR STRAW PELLET PRODUCTION IN PELAGONIA REGION

Oliver Slivoski[1], Nusev Stojance[2], Dragan Temeljkovski[3], Igor Andreevski[4], Vitomir Stojanovski[5]

Abstract: *Alternative resources as feedstock for the pellet production are becoming more prominent. This development results from an untapped potential of agricultural residues as well as a globally increasing use of wood residues in the form of pellets. Nowadays, agricultural residuals as straw, hay and husks are the most popular raw materials for the agro pellets production. Taking into consideration that the straw in Macedonia is baled and used mainly for internal consumption of the agricultural farms as bedding for livestock and in rare cases for feeding animals, this paper analyses the justification one agricultural company to produce pellets from straw that is usually burned on the field.*

Key words: *Straw, Pellets, Production, Market, Investment.*

1. INTRODUCTION

Nowadays, the major raw material for pellet production is wood residues from wood industries (furniture producers, building materials, etc.). At the moment, large quantities of biomass are unused. Following the growing demand of pellets, these raw materials will be considered as potential raw material for wooden and straw pellet production.

In Macedonia, wood residues are used unprocessed, as they leave the industrial operation. These materials are often used in boilers directly by the producing company or by companies near the production site. Nowadays, with the development of wood pellet production, these residues become more important, which means that the economic profit of the company would be higher if residues were sold as raw material for pellet production.

The situation in Macedonia regarding the use of agricultural biomass (straw and other agricultural residues) is still in its initial phase. There are some initiatives for use of these resources, but still most of the quantities are left unused.

Being at the beginning of its development, Macedonian pellet market still features considerable growth potentials. There is no legislative framework for pellet production and consumption in Macedonia.

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The types and regional distribution of the sources of biomass in Macedonia depend on the features of each individual region. Biomass is mostly available is the agricultural and forest regions of the country. Out of the total biomass used for energy purposes, wood and wood coal account for 80%. The Republic of Macedonia also makes use of the grape vine branches, rice shells and fruit tree branches for energy purposes.

2. THE MACEDONIAN ENERGY POLICY

- October 2005: Macedonian Parliament signed the Energy Community Treaty in Athens, bringing together 8 South-Eastern European states (Albania, Bosnia Herzegovina, Bulgaria, Croatia, Romania, Serbia Montenegro and the United Nations Mission in Kosovo, UNMIK) and the European Union for the creation of an integrated energy market. This treaty also reinforced the legal bases for the creation of an independent energy market regulator.
- 2010: Macedonia adopted a Strategy for Energy Development 2030 as a result of country's heavy dependence on imported energy, the bad conditions of the energy production system and the inefficiency of energy production and use. The program goals are to modernize existing infrastructures and build new facilities, using renewable and natural gas and favoring domestic resources for electricity production. It also aims to improve energy efficiency, introduce economic energy prices and integrate the energy sector in the regional and European markets.
- February 2011: Macedonia adopted new Energy Law to transpose EU legislation into national law. The law includes a new model for electricity and gas markets. It aims to introduce new forms of energy trading, promote real competition in the electricity market, and increase transparency. The powers of the ERC have also been reinforced, thereby creating the necessary conditions for the full opening of the electricity and natural gas markets. During the years few amendments on this law have been adopted.

3. AMOUNTS AND USE OF AGRICULTURAL RESIDUES-BIOMASS IN PELAGONIA REGION

As the investment – the facility for production of straw pellets will be located in Pelagonia Region and the production will use biomass that originates from this region, we enclose some data that refers to this region.

- Average number of livestock is 59507 (average 2010-2014) [5]

- The average use of straw for bedding is 1-2 t/head [2]
- The average straw used for bedding (1,5 t/head) is 89260 t
- The average straw production 145202 t (average 2010-2014) [5]
- Surplus of straw is 55942 t
- Equivalent to light oil EL-1 (Makpetrol RM) 18737 t [7]

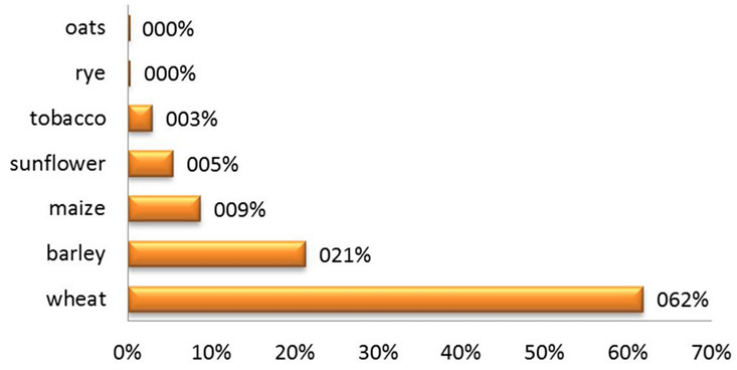

Fig. 1 Straw production in Pelagonia Region (avg. 2010-2014)

Crop residues in Pelagonia region are underutilized. Cereal straw is used as litter and fodder, and corn stubbles are used mainly as fodder. There are certain surpluses of cereal straw that can be used as energy source (55942 t). Grape pruning residues recently are used as mulching material that has highly positive effect on soils and yield. This is new movement and still big portion is underutilized and burned in open fires. Orchards pruning residues are relatively smaller but highly concentrated in several regions, so use as energy source can be of interest. The easiest way of utilization is in heat production (direct combusting). Heath from crop residues can be directly used on the farm for:

- Decreasing cost of energy use in rural household (cooking, heating of the house, hot water production);
- Improvement of agricultural activities (heating of protected areas for vegetable growing, heating of animal farms) that will increase productivity and/or increase value of the products from the farm;
- Development of processing capacities that need heat energy in the process (heat for sterilization, pasteurization, etc.).

The main disadvantage of crop residues is low bulk density and it is very costly to transport them, so they should be used as local energy for local development, especially for producing of briquettes/pellets from crop residues or use of heat energy for processing/industry development (local development).

4. THE INVESTMENT: ESTABLISHMENT OF MODERN STRAW PELLETS PRODUCTION PLANT

4.1 INVESTMENT OBJECTIVE

The strategic objective of the investment is to start a new business, which includes production, promotion and sale of biomass fuels - straw pellets. Therefore, the investor has performed all the necessary analysis and developed a Business Plan covering not only the key factors for the full operation of the business, but the financial aspects of the investment for the first 6 years of operations as well.

4.2 THE INVESTOR

The investor is agricultural company that intends to use the raw material - its own biomass, available from its own agriculture production. The company cultivates 100 ha: 34.46% wheat, 29.90% barley, 25.33% maize and 10.31% sunflower. The production facility will be installed on total surface of 1 ha land, owned by the Investor.

The company can calculate 300t biomass from its own agricultural activities; the remaining needed quantity will be bought from the near agricultural companies in order full operational capacity of the production plant to be achieved.

4.3 PRODUCTION CAPACITY

According to the findings of the conducted analysis on European market of good manufacturing practice (GMP) and producers for projected capacity (150-250kg/h), the Investor decided to invest in a straw pellet production plant with a production capacity of 250kg/h [8].

4.4 FUNDING SOURCES & INVESTMENT PATTERN

The Investor developed a Business Plan for production of straw pellets for the first __ years of business, according to which the total investment equals to 118.809,00 euro. The funding sources are consisted of:

- Bank loan: 70% of the investment

The following terms and conditions of bank loan are preferable:

- Credit line of total amount of 83.167,00 euro.
- Credit interest rate: 7.5% per year.

- Period of credit line use: 72 months.
- Grace period: 12 months.
- Pledge for the loan: real estate, pledge of equipment.

- **Investor's funds: 30% of the investment with a total amount of 35.642,00 euro.**

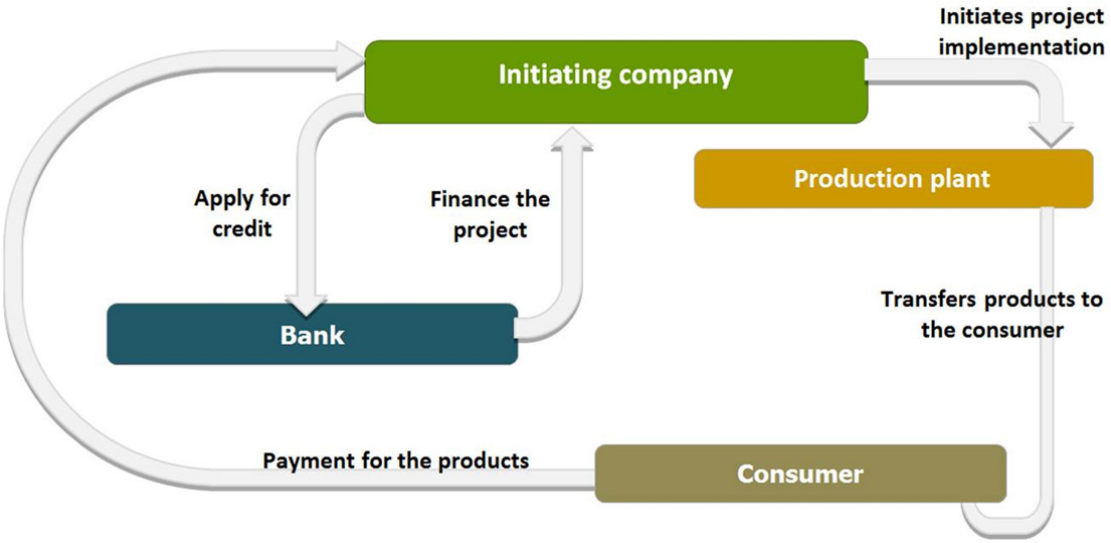

Fig.2 Investment Implementation Scheme [3]

4.5 INVESTMENT STRUCTURE

The main operations that will take place in the first 6 months so the plant get its full operation are:

- Construction of facilities for production of straw pellets;
- Purchase and installation of technological equipment (production line) for straw pellet production;
- Providing (purchase) of raw material for processing;
- Purchase of loading and transport vehicles, packing equipment, office equipment and supplies, other tools and equipment;
- Equipping the necessary personnel for work.

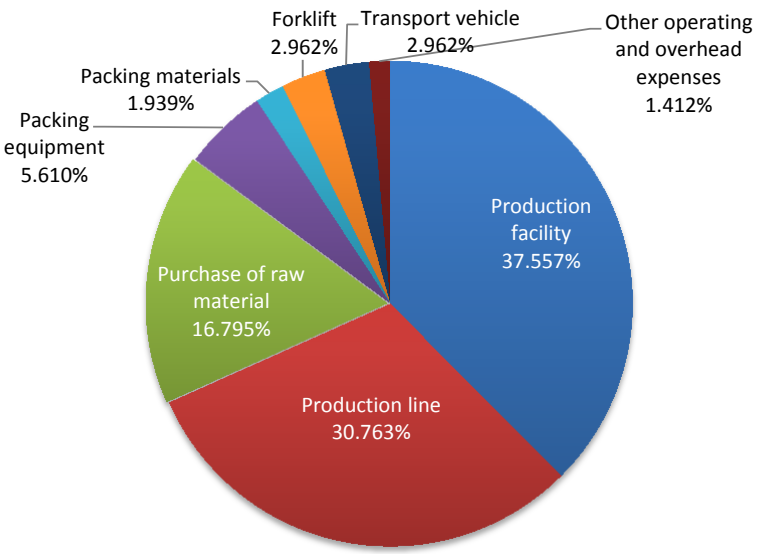

Fig.3 Investment expenditures [3]

4.6 HUMAN RESOURCES

The Company foresees engagement of 5 persons:

- A manager responsible for general management of the enterprise i.e. including management of current production and the financial activities of the enterprise;
- Production personnel consisted of 4 workers (production line operators, load/unload, distribution workers).

4.7 SALES FORECAST

Total sales volume for the operation period of 6 years is forecasted to the level of **978.200,00 euro.**

Table 1 Sales forecast[3]

Project period	1st year	2nd year	3rd year	4th year	5th year	6th year	TOTAL
Straw pellets							
Sale price of straw pellets, EUR/ton	€ 146	€ 146	€ 146	€ 146	€ 146	€ 146	€ 146
Sales volume of straw pellets, tons	700	1.200	1.200	1.200	1.200	1.200	6.700
Revenues from sales, EUR	€ 102.200	€ 175.200	€ 175.200	€ 175.200	€ 175.200	€ 175.200	€ 978.200
TOTAL SALES	**€ 102.200**	**€ 175.200**	**€ 175.200**	**€ 175.200**	**€ 175.200**	**€ 175.200**	**€ 978.200**

4.8 PROFIT GENERATION

Profit generation, reflected within the below chart, has been developed upon forecasted calculations of profit and loss and presents stage-by-stage formation of operating profitability taking into account for different factors:

- Gross profit Margin (%) – reflects operating profitability with account for cost of manufactured products.
- EBITDA Margin (%) – reflects operating profitability with account for all operating expenses before amortization, interest and taxes.
- Ordinary Income Margin (%) – reflects operating profitability with account for operating expenses and amortization before interest and taxes.
- Return on sales (%)–reflects operating profitability with account for all incurred expenses.

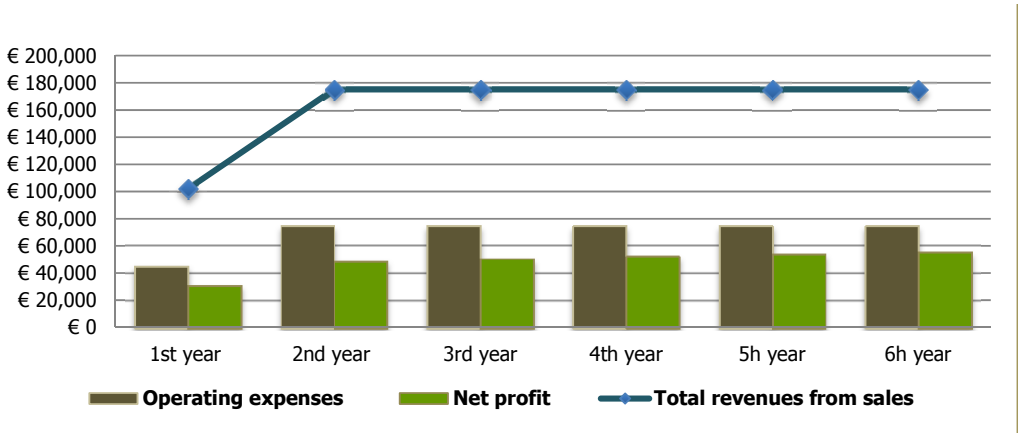

Fig.4 Net profit generation for the 6 years of operation [3]

4.9 THE EFFECTIVENESS OF THE INVESTMENT

Table 2 The effectiveness of the investment[3,9-13]

Investment Concept	PRODUCTION OF STRAW PELLETS FOR CAPACITY OF 250 kg/h	
Location	Macedonia, Pelagonia Region	
Implementation Schedule	Rated period	6 years
	Beginning of sales of straw pellets	The 6th month
Budget	**Investment value**	**€ 118 809**
	Own capital	€ 35 642
	Credit (investment) capital	€ 83 167
	Autonomy rate	30%
Terms and Conditions of Credit Receipt	Credit amount	€ 83 167
	Credit period, years	6 years
	Credit interest rate, % per annum	7.5%
	Interest paid	€ 15 854

	Credit repayment	€ 83 167
Investment Profitability	**Total revenue**	€ 978 200
	Capitalized net profit	€ 305 250
	Aggregate cash flow	€ 301 095
Attractiveness for Investments	Discount rate	5,8%
	Discounted payback period (DPP), years	**1,76**
	Net present project value (NPV)	**€ 216 163**
	Internal rate of return (IRR)	**124,5%**
	Investment profitability index (PI)	2,76

5. CONCLUSION

Taking into account the above mentioned information and parameters it can be concluded that the investment is profitable and efficient to implement, which is confirmed not only by the profitability and margins, but also by investment attractiveness indices.

Namely, the level of net profit for the first 6 years of operation is 305.250,00 euro, the investment shows high investment attractiveness indicators and a reasonable payback period of approximately 21 months.

Cost-effectiveness and investment attractiveness of project can be decreased by reduction of production capacities load, increase of manufactured products cost, and also reduction of prices for manufactured products. At the same time, in accordance with optimistic forecasts, project profitability and investment attractiveness will grow.

Project success criteria certify that project has “margin of safety” that can guarantee timely return on investment even in case of negative deviations of actual data on project implementation from calculated data.

Establishment of such company in Macedonia is very reasonable step and is considered to be extremely timely and cost-effective project. Gross cash flow has positive value within whole project period that reflects balance of profit and loss items of project. Net Present Value of project (NPV) is positive that confirms reasonability of its implementation.

REFERENCES

[1] Armenski, S. (2005). Bioenergy from Agriculture and Livestock. *Renewable Energy Sources in R. of Macedonia – MAGA edition of the renewable energies identification and development in Macedonia*, p.14-33;

[2] Cukaliev, O. (2007). Production of straw and other agricultural residues in Republic of Macedonia and possibilities for use as bio fuel, *Workshop "Cereals straw and agricultural residues for bioenergy in New Member States and Candidate Countries";*

[3] Slivoski, O., (2016).Generic business plan for production of straw pellets **(**strawpower.eu /wp-content/uploads/2016/12/BP_EN_Final_OS.pdf);

[4] Ministry of Economy (www.economy.gov.mk) ;

[5] State Statistical Bureau of Republic of Macedonia (http://www.stat.gov.mk);

[6] Energy Agency of the Republic of Macedonia (www.ea.gov.mk);

[7] Makpetrol AD Skopje (https://www.makpetrol.com.mk/index_en.asp);

[8] ELF Systems s.r.o (http://www.smallpelletmill.com/);

[9] http://www.tradingeconomics.com/macedonia/deposit-interest-rate;

[10] http://www.sparkasse.mk/term-deposits-with-monthly-payment-of-interest.nspx;

[11] https://www.procreditbank.com.mk/compare-savings-options.nspx;

[12] http://eurostandard.mk/index.php?option=com_content&view=article&id=145& Itemid=140&lang=en;

[13] http://halkbank.mk/general-saving.nspx.

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REASONS FOR FAILURE REGARDING START UP ENTITIES

Richard Bednár[1]

Abstract: *A startup is a company working to solve a problem where the solution is not obvious, so it ussualy create a blue ocean. According to the European Association of Business Angels there are launched about 50 million new projects every year (137,000 per day), but 90% of them fail. In the paper we analysed 65 startups, which had a minimum viable product and also some investment, but failed. The main aim of the research was to identify the factors leading to the failure of startups. The result has been to create an overview of the mistakes that young entrepreneurs commit at the early beginning.*

Key words: *startup, investement, team, financing, failure, success*

1. INTRODUCTION

Fast development of technology and so-called Internet fever in the years 1996-2002 brought a large increase in the number of young companies characterized by two basic elements – innovation and discovering new markets. These companies are often labelled as startups (or start-ups).The startup guru Steve Blank defines a startup as "a temporary company form dedicated for repeatable and scalable business model."[1] According to Paul Graham, a startup is "a company established with the aim for fast growth." [2] However the fast growth itself does not define the complexity of a startup. Startups are mostly connected to rapidly growing and technology-oriented companies. They are financed by investors who consider the risk level in relation to the expected economic return. In my opinion, a startup is any new company which already exists in the market and fulfil the following criteria: it creates a blue ocean in a given area, it has high business risk while establishing itself in the market and after a successful exit, its rapid growth is likely.

According to the European Association of Business Angels [3] (EBAN), around 300 million founders currently have 150 million businesses worldwide. There are launched about 50 million new projects every year (137,000 per day). CB Insight's research, which analysed the causes of 101 startup failures, has shown that 9 out of 10 startups fail to 1-3 years, what is a 40% riskier than in standard business models. According to Bloomberg's analysis[4], 8 out of

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10 startups fail over 18 months, mainly due to lack of understanding of customer needs and inadequate revenue generation what also confirms KPMG Startup Survey 2016[5] which define, that only 37% of startups generate revenue (69% up to 50 thousand euros, 23% more than 50 thousand and 8% more than half a million euros) and others do not receive any money yet. Because the primary goal of doing business is to generate finance for covering company costs as well as for shareholders. So every startup should create an ideal revenue model, which describes[6] how a company generates profit and sufficient capital for further investment.

2. AIM OF THE PAPER

The main aim of the research was to identify the factors leading to the failure of startups. The result has been to create an overview of the mistakes that young entrepreneurs commit at the early beginning. We divided the main goal into testing three hypotheses in which we analyzed possible failure indicators:

a) Most startups have an inadequately defined product / problem and its solution.
b) Startups do now know how to correctly estimate customer, target group and market potential in the industry.
c) Startup failure is mostly caused by incorrect setting of the revenue model.

3. METHODOLOGY

In the first phase we compared current knowledge in scientific literature, using resources in the ScienceDirect, Springer and RePEc databases and Google Scholar Search. Subsequently, based on comparisons of literature and scientific research, we created a structured questionnaire that helped us to structure and analyze 51 statements of the startup founders. We received these testimonials from the Autopsy.io database, which was founded by Maryam Mazraei and Matthew Davies in September 2014, and which creates list of blogs, testimonials and analyzes of the startup founders, who evaluate the reasons of their failure. The analyzed startups included: Admazely, Allmyapps, Arkad, Bawte, Bellstrike, BitPass, Blurtt, Bookish, BricaBox, Canvas, CertTime, Critica, College Inside View, Delight, Devver, Digital Royality, Droppie, eCrowds, EventVue, Everpix, EXFM, Flowtab, Flud, FormSpring, Goldee, GOWALLA, Group Spaces, Hello Parking, Intellibank, KOLOS, lookery, Lumos, Melotic, Monitor 110, MyFavorites, MyManual, NewsTilt, NOKTER, On-Q-ity, Ordr.in, Outbox, Plancast, Play Cafe, Pollarize, Proto Exchange, Readmill, RiotVine, Saaspire,

Secret, Shnergle, SMSnoodle, Sonar, Standout Jobs, Stipple, Teamometer, TeeBeeDee, THRIVELY, Tigerbow, Totsy, Travellllll, UDesign, Unisport, Vitoto, Wahooly, Wattage andWesabe.

4. RESULTS

The gender analysis showed that 98% of the founders were men. This is mainly due to the fact that most of the startups are created in the technology sector, which is still the main domain of men. From the place of company establishment point of view, nearly 70% come from the US, most of them from San Francisco, California, which not far known as Silicon Valley. A more accurate overview is provided in Figure 1.

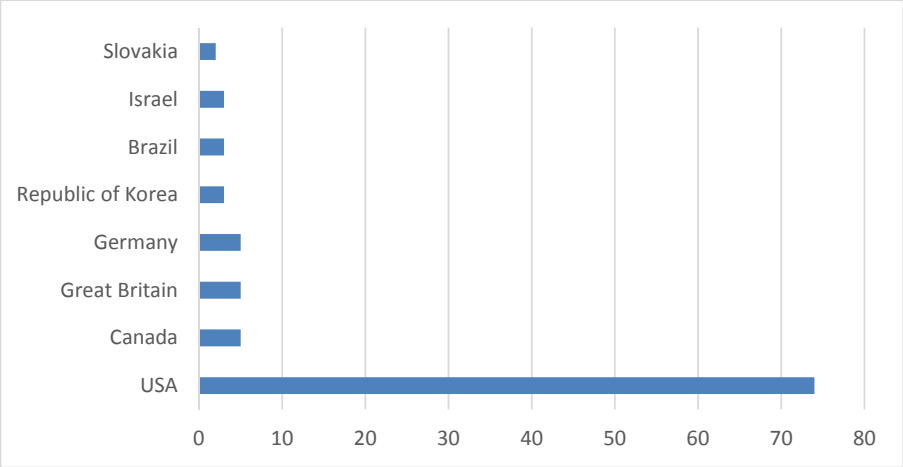

Fig. 1 Location of analysed startups

Analysed startups were established in 2009-2015 (Figure 2 and Figure 3). The average period of startup existence was 27 months. The fastest failure was reached in 2 months and the longest business time was 56 months. Modus, the most common startup existence period, was 12 months and the median was 24 months.

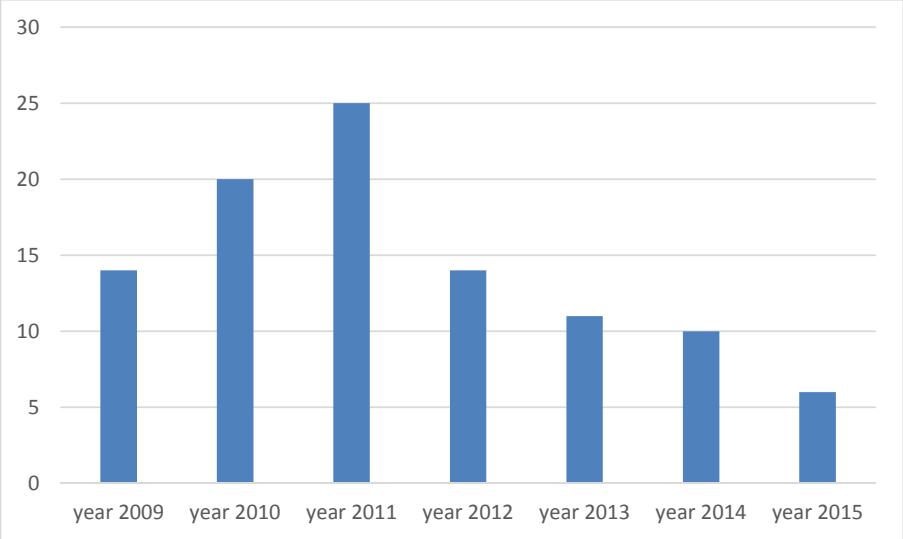

Fig. 2 Year of establishment

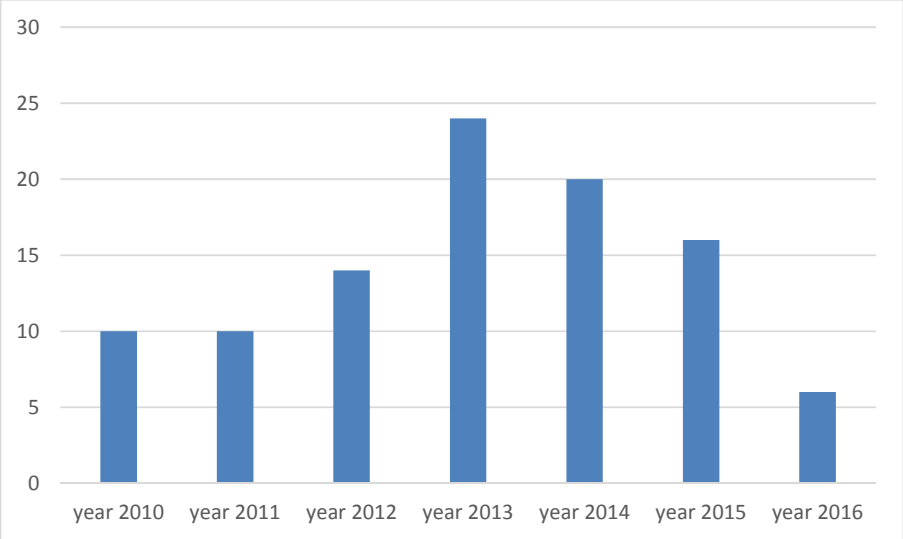

Fig. 3 Year of failure

Startups have created their business models most often in the area of social applications (36%) and in software tools aimed to simplify people's lives (25%). The least represented startup sectors included education, robotics, internet security, financial services or food and beverages (Figure 4)

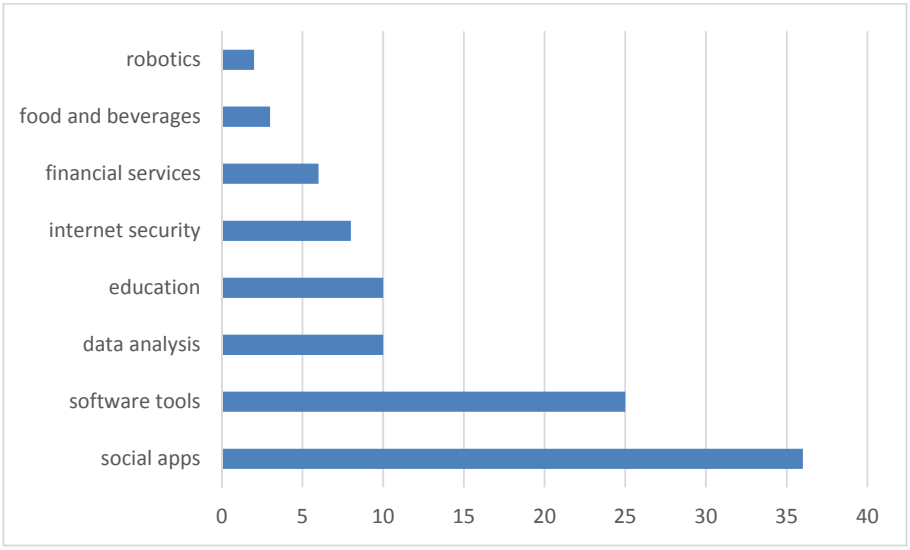

Fig. 4 Industries of analysed startups

An important indicator of a startup business failure was the amount and type of investment (Table 1). The number 92% of the analysedstartups received an investment, mostly in the amount of 10-100 k Euros and 1-10 mil. €. Only 8% of them did not receive any investment. It follows that the specimen was under the control of investors and other third parties and startup had to have some MVP. Revenues and profits of 80% startups were not published, so we did not analyse them further.

Tab. 1 Amount and type of investmens

Investor types	**up to 10k €**	**10 - 100k €**	**100k - 1 mil. €**	**1 - 10 mil. €**	**more than 10 mil. €**	∑
3F (family, fools, friends)	*8%*	*4%*	*4%*	-	-	*16%*
business angels	-	*6%*	*6%*	*8%*	-	*20%*
investors	-	*20%*	-	*18%*	*4%*	*42%*
banks	*2%*	*4%*	-	-	-	*6%*
other	*8%*	-	-	-	-	*8%*
no investment	-	-	-	-	-	*8%*

Startup statistics in the literature show that approximately 90% of startups are convicted to an absolute failure and their further fate is extinction. More about 5% are in a situation when all the activities are not enough to meet the need of the market. In our research, we have analysed startups from around the world. Based on the analysis, we identified 10 different factors, which, according to the founders themselves, caused the failure of their startup. A detailed overview is provided in Chart 5.

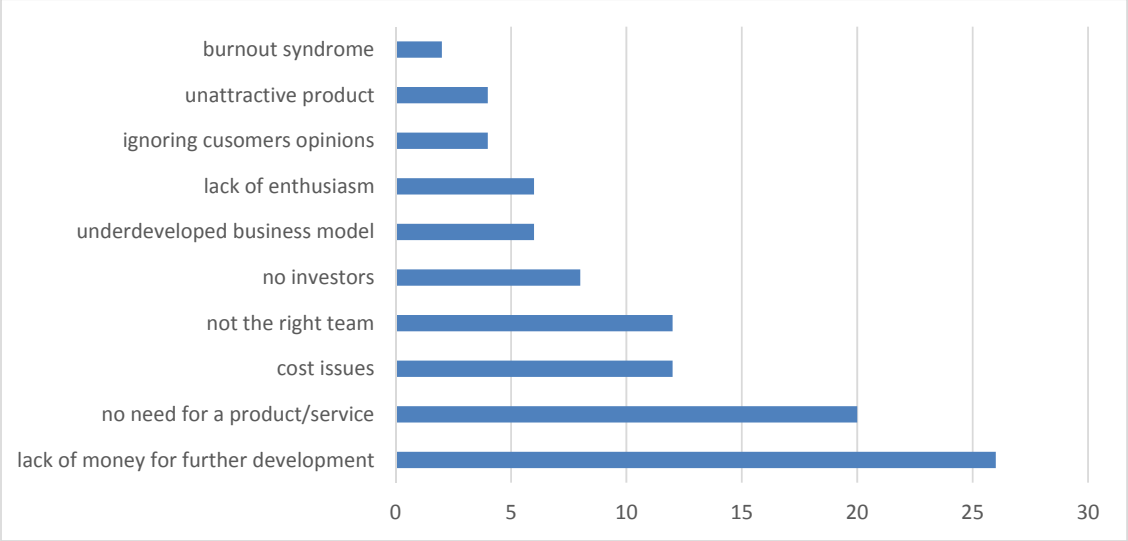

Fig. 5 Reasons of startup failure

The 5 most serious problems include the following:

I. Lack of money for further development (26%)

One of the key factors behind the startup success is finding enough financial resources to develop an idea, especially in phase when the startup does not generate revenue. Because of this reason, startups must look for financial resources from the external environment - family, friends, banks, venture capital, development capital, state support, or crowd funding. Branislav Zagorsek identified also the positive impact of the higher cost strategy on the pay-as-you-go acquisition [7]. In more than 1/3 of analysed startups, it was shown that the companies had not defined sufficiently the amount of funds needed for the launch and for the investment time schedule. At the same time, they were unable to reach the sales stage and thus obtain additional financial resources from customers. The lack of money led to next problem: reimbursement of capital expenditures, financing of expansion, covering operating

costs for staff, offices, infrastructure, etc. and covering other costs.

II. No need for a product / service in the market (20%)

The second biggest problem was the lack of customer interested for the startup solution. The founders defined this problem as a lack of real market testing. Many of them met with customers and asked about their problems, analysed possible solutions. Preliminary analyses seemed promising. However, when they came out with the product on the market they found out that people, despite the fact that they had previously said they were interested, did not really want to buy it. The founders called these product “Vitamins” (it's nice to have t) even though they thought they are going to sell Aspirin (must have it). The founders said that also the timing of product launch was probably not right - either customers or the market was not ready yet, or they came out with the product too late. In both cases, the result was the same.

III. Cost Issues (12%)

One of the main problems was the cost calculations. In these cases, founders did not make accurate finance planning that included both direct and overhead expenses. Incorrectly defined costs have resulted in incorrect price formation and therefore the market price could not cover costs at all. There were more reasons, why founders failed their budgeting:

- acted under the pressure of their investor and defined only preliminary costs,
- did not know which material they will finally use,
- Could not define all cost items (material costs, labour costs, investments to technology, etc.),

IV. Not the right team (12%)

Most investors evaluate a quality of the team, experience, creativity and cooperation as one of the key factors of success. In most cases, startups need to change their business model several times, and it can only be done by a high-quality team. The most common issues that the startup analyses were:

- not the right mix of people: in many cases incompatible people and too strong personalities created many conflicts / wrong people , who appeared at first as professionals and then turned out to be incompetent,
- bad team leadership: incorrect team manager caused a feeling of unfair distribution of work and not fair financial reward / in other cases the founders themselves reflect that they were not able to lead their team.

V. No investors (8%)

It seems, that finance is the biggest problem, because it take first and third place in our results. In this case, it is more about problems with investors. Founders defined the main

issues:

- the startup has hurt its investors several times and failed to fulfil the required goals in the basic series, thereby losing confidence,
- the startup did not produce any evidence to increase its potential to convince the investor of its exponential growth potential (pre-contract with buyers, a large number of applications downloads, sales, success in the crowdfunding campaign, etc.),
- lack of logic of the business model from the investor perspective,
- insufficient investor awareness of all issues,
- time has shown that there is no understanding between the startup team and the investor.

6. CONCLUSION

It is natural for startups that they do not reach sales in the early stages of development, and their economic result is negative. Most founders are primarily focused on analysing the problem with a potential customer and then creating value in the form of a product or service that will help solve the problem's problem. In creating an entrepreneurial model, more attention should be paid to revenue generating options. Income model research should further analyse the effectiveness of product and service monetization. Such research could serve both professionals and entrepreneurs to make better choices about choosing how to create revenue channels and monetize their business idea. „The main goal of founding a startup is to discover new marketplaces and create high added value products.”[8] At the beginning, startups are low-cost projects mostly created by programmers and designers who want to create something unique and earn a lot. However, in more than 90% of cases, they fail. Three of five main problem deal with finance - either incorrect product pricing, poor cost estimates or lack of capital for further development. The second key issue is the lack of market need – result of inadequate product testing on the real market. And also, one of the biggest problems is the poor team that cannot solve the problems and cannot develop the right MVP or business model.

REFERENCES

WWW pages:

[1] Čo je a čonie je startup? Nekonečnýboj o konečnúdefiníciu,from http://blog.helios.eu/sk/2013/04/08/co-je-a-co-nie-je-startup-nekonecny-boj-o-konecnu-definiciu, accessed on 2017-10-11.

[2] Slovníkpojmov, from http://www.ratsk.sk/inovacnepodnikanie/clanok.php?idclanok=3, accessed on 2017-10-11.

[3] Early stage investing explained, from http://www.eban.org/about-angel-investment/early-stage-investing-explained/, accessed on 2017-11-13.

[4] WAGNER, T. W.: Five Reasons 8 Out Of 10 Business Fail, from http://www.forbes.com/sites/ericwagner/2013/09/12/five-reasons-8-out-of-10-businesses-fail/#5e1536415e3c>, accessed on 2017-11-22.

[5] Prieskum Startup Ecosystem Survey 2016, from https://home.kpmg.com/sk/sk/home/insights/2016/06/startup-ecosystem-survey-slovakia-2016.html, accessed on 2018-02-01.

[6] Revenue model, from https://en.wikipedia.org/wiki/Revenue_model, accessed on 2017-10-11.

Chapters in Books:

[7] ZAGORŠEK, B. (2016). Využitiestratégienadosiahnutieväčšiehoúspechu startupov. In Podnikateľskémodely a podnikateľskéstratégie startupov II. Bratislava :Vydavateľstvo EKONÓM, 2016. ISBN 978-80-225-4328-6. p- 162-169.

Proceedings Papers:

[8] PROCHÁZKOVÁ, Katarína. Podnikateľskémodelyvybranýchmedzinárodnečinnýchpodnikov. In Revue mladýchvedcov :zborníkvedeckýchprácdoktorandov a mladýchvedeckýchpracovníkov. - Žilina :Žilinskáuniverzita v Žiline, Fakultariadenia a informatiky, Inštitútmanažmentu, 2014. ISBN 978-80-554-0892-7, s. 70-72. VEGA 1/0363/14.

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EUROPEAN UNION INVESTMENT POLICY FOR BUSINESS ESTABLISHMENT IN LITHUANIA

Teodoras Tamošiūnas[1], Lijana Rupšienė[2]

Abstract: *The article deals with EU investment policy for business establishment in Lithuania. It analyses the basis for establishing business according to EU investment policies, examines general business environment and conditions for business in Lithuania and singles out factors determining the implementation of EU investment policy. The means of EU investment policy implementation and their importance for establishing business in Lithuania were examined and the evaluation of EU investment policy in terms of establishing business for years 2014 – 2020 were provided. It was demonstrate that EU investment policy is not oriented towards direct financing of business establishment. It has only an indirect impact on the improvement of business conditions and attractiveness while establishing new companies. Financial means (credits), guarantees and partial compensation of interest payments, consultancy and information services, implemented infrastructure and energy projects, provided for businessmen improve conditions for business establishment.*

Key words:*EU investment policy, business environment, business establishment.*

1. INTRODUCTION

The importance of the research. Small and medium-sized enterprises make the basis of economy of most European countries, Lithuania included. Sustainable development of regions, aimed by EU member countries, depends on the opportunities of small and medium-sized businesses to be established and developed in a concrete region. That is why EU investments are meant to strengthen the economy of its weaker regions. Lithuania, having joined the EU in 2004, also got the right to such investments.

Businessmen in order to use EU structural funds for their investments, not only have to comply with certain requirements, but have to be exceptional in their branch. Here confrontation among state institutions, administering structural funds, setting priorities and making decisions regarding financing, and business representatives, who expect to get

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financing, starts. State institutions seek efficient usage of EU structural funds and achievement of strategic investment policy aims, while business representatives claim that in Lithuania conditions for creating and developing business are adverse, EU financing programmes do not stimulate appearance of the new companies and the increase of the level of entrepreneurship.

Most information about the implementation of EU investment policy can be found by analysing reports on using these funds, which involve a broad assessment of all supported areas and projects; however, a systemic attitude towards the assessment of EU investment policy in terms of establishing small and medium-sized business is lacking. Research literature most often analyses the impact of EU structural funds on the economy of the country, but little attention is paid to the impact on the business itself. Business establishment criterion is important in assessing the importance of EU investment policy on the changes of the level of entrepreneurship in the country; that is why it is important to analyse EU investment policy in a narrower context, i.e. in terms of establishing small and medium-sized businesses.

Research problem. The paper aims at defining EU investment policy implementation conditions for business in Lithuania. Another aspect of the problem is how EU investment policy contributes to the improvement of conditions stimulating business establishment in Lithuania. The main question is: what are the opportunities for the proper use of EU investment policy implementation measures for business establishment in Lithuania?

The aim of the article is to analyse EU investment policy for business establishment in Lithuania. The following objectives were set to reach the aim: 1) to examine the basics of EU investment policy for business establishment, 2) to analyse general business environment and conditions in Lithuania in the context of the EU.

Research methods: analysis and systematisation of research literature, laws and by-laws, strategic and program documents, generalisation, statistic data analysis and comparison, empiric research methods – document analysis and analysis of information received by a qualitative semi-structured expert interview method.

2. INVESTMENT POLICY ASSESSMENT

EU investment policy is one of the directions of public policy, which is formulate and implemented together by EU and its member countries with regard to the strategic EU sustainable development provisions. Public policy is often viewed as singling out and solving

problems arising in society by including them in political agenda (Parsons, 2001). The review of the definitions found in research sources allows defining public policy as a process of solution of problems arising in society from the moment of their identification, establishing priorities and highlighting alternatives to their solution and assessment of the achieved results. The implementation of public policy affects certain groups of interest, e.g., business establishing policy, oriented towards the improvement of business conditions, development of business environment and its adjustment for the establishment of new companies.

Dunn (2006) suggests certain criteria, which can be used for assessing investment policy: 1) efficiency, when the value of the outcomes is assessed, 2) productivity, when the volume of the outcomes is assessed, 3) adequacy, when the sufficiency of the outcomes for the solution of the problem is assessed, 4) fairness, when fair distribution of the input among the interested groups is assessed, 5) ability to react, when opportunities of the outcomes to meet the needs of certain groups are assessed, 6) feasibility, when the suitability of the outcomes for the environments assessed.

Dvorak (2011) suggests assessing the impact of EU investments from four aspects: 1) an impact on the sphere of activities, 2) an impact on the economy, 3) an impact on state finances, 4) an impact on social environment.

While analysing the impact of EU investment policy on the establishment of business in Lithuania, it is necessary to examine the importance of EU investments on the improvement of business conditions and stimulation of entrepreneurship. To assess EU investment policy, decisions, made with regard to the interested parties, mostly the needs of business subjects, are analysed.

In assessing business conditions, foreign practices are taken into consideration, when one of the aspects of assessing business conditions is macroeconomic business conditions, i.e., when assessing business conditions, attention is paid to macroeconomic situation in the country or in a concrete branch of economy (Titarenko, 2007). Macroeconomic situation is the first indicator, which can show what business prospects are in the country.

3. BUSINESS ESTABLISHMENT POLICY IN EU AND IN LITHUANIA

Small businesses are the main condition of economic development in most European countries, Lithuania included. Small and medium-sized enterprises account for about 99% of all EU companies, they employ 67% of the private sector working force. That is why it is small business and its development that is emphasised in EU strategy “Europe 2020”. EU

investment policy comprises general business support policy; however, means that are applied can be exceptionally directed at business establishment. One of trends of the strategic EU investment policy is increasing entrepreneurship, the results of which directly depend on the increase of the number of the newly established companies.

In 2014, in order to improve the state of small and medium-sized businesses in EU member countries, the European Commission passed The Small Business Act for Europe, the main idea of which is to develop small and medium-sized business policy in EU, while at the national level a comprehensive implementation of the principles and means of this act should be ensured. With this act, the Commission obligates member countries to use the offered financial means in a comprehensive way, to decrease administrative burden on business, to shorten the time for establishing new businesses and to decrease its costs.

One of the key documents defining concrete actions in implementing EU investment policy is Republic of Lithuania Partnership Agreement, approved by the EU Commission on 20th June 2014. It makes the basis for EU structural funds investment strategy in Lithuania for years 2014 – 2020. The Partnership Agreement itself embraces a very wide spectrum of problems to be solved and means of solution, linked with the concept of sustainable development. In this context, the stimulation of business establishment and development is one of the elements, related to the implementation of sustainable development strategy. The key aim of EU investment strategy is to ensure a rapid long-term economic growth, to decrease the level of lagging of a country behind the European average, to implement on-going structural reforms and to ensure appropriate financing for the means stimulating economic growth. One of the means to reach this aim is to encourage the establishment of small and medium-sized businesses and their development, to increase their competitiveness and internationality.

According to the Partnership Agreement (2014), Lithuania occupies the 17th place in relation to the business environment among 189 countries of the world and the 6th place among the EU member states. However, state regulation in Lithuania is still too heavy. That is why in order to improve business environment in Lithuania, greatest attention is paid to the development of state regulation and decrease of administrative burden to small and medium-sized businesses, thus hoping to increase the attractiveness of business to the people and to encourage their entrepreneurship. The level of entrepreneurship in Lithuania is low. It is impeded not only by limited financial accessibility to establish new businesses or to develop the existing ones, but also by insufficient presentation of information, the lack of education of the population on the issues of entrepreneurship. The level of entrepreneurship is especially low among the rural population. In terms of integration in European markets, Lithuania also

lags behind the EU average. Although a certain growth of export has been felt recently, it was determined not by the goods produced in Lithuania but by re-exportation, which does little for the economic development of the state and the wellbeing of its citizens. The Partnership Agreement (2014) states that it is necessary to stimulate the level of business productivity, which is influenced by cheap and easily available work force, which does not stimulate the use of progressive means increasing business productivity.

EU investment policy for small businesses is revealed in Operational Programme for the European Union Funds' Investments in 2014-2020, approved by the decree of the Government of Lithuania in 2014. By stimulating small businesses, the Government wants to increase the competitiveness of the country, to recreate the pre-crisis wellbeing of the country by implementing novelties, by supporting creation of the new technologically progressive products. Stimulation of small businesses is aimed at increasing the level of entrepreneurship in Lithuania, which is much lower than European average. EU investment policy is geared towards the development of the system of support and innovations for small businesses, stimulation of collaboration, and improvement of financing and dissemination of information. While emphasising the importance of small and medium-sized businesses for increasing coherence, the stimulation of its competitiveness is raised from the eleventh to the third priority, surpassed only by investment into research and IT development. The initiatives of implementation emphasise the importance of a better business environment. The document states that for Lithuania it is of utmost importance to improve the conditions of starting business, to decrease administrative burden for business, to ensure the accessibility of financial sources, to provide fair conditions for competition by removing obstacles for the young businesses to enter the market, and to stimulate productive investments. Another sphere which is considered a priority in terms of EU investment is creation and implementation of business models for small and medium-sized businesses. Internationally operating companies, able to work under global conditions, are especially encouraged. Foreign investments are stimulated in the sphere of tourism and export. Creation of products and services requiring knowledge and high technologies is also promoted. The importance of sparing use of resources is revealed by encouraging small and medium-sized businesses to participate in the processes of economic growth and innovations. The appearance of various clusters is supported as well as clean technologies, future energy, creative and cultural industries, the spheres of wellbeing and health.

In general it can be stated that the main priorities for small and medium-sized businesses in EU investment policy for years 2014-2020 for Lithuania are promoting entrepreneurship,

increasing competitiveness and encouraging internationalisation and innovations.

Having defined the priorities of EU investment policy in business, Lithuanian Government has admitted the importance of small and medium-sized businesses for the economy of the country and singled out the main problems connected with it. One of the main tasks of economic policy of Lithuania is the development of small and medium-sized businesses and creation of new jobs. To implement this task, it is important to improve legal and economic business environment, to make some structural institutional changes – to found and support institutions helping entrepreneurs in terms of information, financial and technical support.

4. CONDITIONS FOR STARTING BUSINESS IN LITHUANIA

In assessing business conditions, foreign practices are taken into consideration, when one of the aspects of assessing business conditions is macroeconomic business conditions in the country or in a concrete branch of economy (Titarenko, 2007). Macroeconomic situation is the first indicator, showing the prospects of business in that country and the probability to earn a profit from the activities of the company. Macroeconomic indicators are analysed by both public administration experts and business representatives while assessing business development opportunities (Worthington, Britton, 2009).

The level of the development of the country is indicated by GDP per capita and its changes in the long-term perspective (Čiegis, 2012). According to Eurostat data, between 2010 and 2015, GDP per capita in Lithuania was increasing by 3-4%, which is above EU average.

High unemployment figures can show economic recession and difficult state of business in the country. However, high unemployment figures can also indicate large numbers of people available on the labour market and an opportunity to develop business by using unemployed people and cheap human resources. During 2010 – 2014, the unemployment level in Lithuania decreased from 17.8 to 10.8%. During the same period the level of unemployment in EU increased from 9.6 to 10.2%. In 2015, the unemployment level in Lithuania corresponded to the EU average.

However, EU investment policy is not directly oriented to the financing of business establishment. It has only an indirect impact on the establishment of business, improvement of conditions and its attractiveness: businessmen receive partial compensation on interest payments, they are provided consultancy and information services, roads, energy and other infrastructure projects are financed, which increases attractiveness for business establishment.

Before founding a company, a businessman has to analyse and compare different forms of company establishing in order to choose the most appropriate for the foreseen activities. The most important criteria in choosing business organisation form are the number of business organisation participants, the size of minimal capital, liability, and managerial specialties. One form of business will be acceptable for a beginner, another – for the businessman who wants to establish a family business, still another – for an experienced group of investors. Most often small companies are established. A comparison of these companies according to the main criteria is presented in Table 1.

Table 1: A Comparison of Legal Forms Most Often Established by Private Legal Entities

Criterion	*Private company*	*Sole proprietorship*	*Small partnership*	*Agricultural company*
Minimal number of participants	*1 shareholder*	*1 owner*	*1 member*	*2 members*
Maximal number of participants	*249 shareholders*	*unlimited*	*10 members*	*unlimited*
Minimal size of the capital	*Authorised share capital not less than 3000 €*	*none*	*none (the size of contributions is set by the members)*	*none*
Liability (of the shareholder, owner or member)	*Limited liability – shareholders are not personally liable for the debts of the company*	*Unlimited liability – the owner(s) is personally liable for the debts of the company*	*Limited liability – members are not personally liable for the debts of the company*	*Limited liability – members are not personally liable for the debts of the company*
Management	*CEO; a collegial organ of*	*The owner of the company is at the same time the head*	*A General Meeting (which appoints a*	*Chairman of the Board or Head of Administration, if*

	management can be made - a Board.	*of the company, although the owner can appoint another person.*	*representative of SP) or the head of the company*	*the General Meeting decides not to have a Board.*

Source: composed by authors, on the basis of Legal forms of companies, 2017.

The most important external business stimulation factor in Lithuania is EU investment policy. EU investment statistics in Lithuania shows that 7, 423, 436, 547 € were allocated for increasing business productivity and improving business environment between 2007 and 2013, out if which even 6, 775, 492, 823€ were allocated by EU, which accounts for 91.27% of the total state funds allocated for business stimulation. On the data of the Ministry of Finance, during the period between 2007 and 2013, 8,341 projects were financed in Lithuania, with the total value of 9,274, 681,676 €.

The standard of living, inflation, the average wages, state debt, direct foreign investments, legal and administrative investment environment, export and import rates have a considerable impact on business establishment. The analysis of macroeconomic indicators performed by the authors of the paper shows that in Lithuania macroeconomic business environment is not exceptional in the context of the EU. Tendencies prevailing in all East and Central European countries are also noticeable – greater that average EU rates of growth of GDP and unemployment rates corresponding to the EU average. It can be concluded that at present the macroeconomic situation in Lithuania is favourable enough for the establishment and development of business.

Social environment is an important factor for the establishment of business. The decreasing numbers of population, its ageing, high rates of emigration make a substantial negative impact on all business spheres. With young qualified specialists emigrating to foreign markets, the opportunities for establishing and developing business in Lithuania are decreasing.

Technologic environment is favourable for establishing business in Lithuania. Although the country occupies the 23rd place among EU countries according to the total innovations index, in 2011-2015 Lithuania made a lot of progress and moved from the group of weak innovators to the category of average. During the last few years, quite a few foreign companies founded their service centres in Lithuania, including a lot of IT companies. These companies created a rapidly growing demand for IT specialists and created the majority of new jobs for them. During three years, only Barclay's technologies centre employed more than 1,000 of new

staff. Global IT services companies, such as CSC, IBM Lietuva, Western Union, Call Credit together also employed over 1,000 IT specialists.Possible business organisation forms in Lithuania in essence do not differ much from the types of companies in other EU countries. Practically almost in all EU countries one can find equivalents to joint stock companies, limited partnerships, and sole proprietorships.

EU countries have over 25 kinds of direct and indirect taxation. However, the greatest tax burden for businesses is generated by three main taxes: value-added tax (VAT), social security tax and company profit tax. Table 2 presents the rates of these taxes in Lithuania and a few other EU states.

Table 2: A Comparison of the Main Tax Rates in EU Countries in Percentage in 2015

State	*VAT*	*VAT exemption*	*Employer's compulsory social security*	*Company profit tax*
EU (28) average	*21.7*		*23.78*	*22.9*
Lithuania	*21*	*5*	*30.98*	*15*
Latvia	*21*	*12*	*23.59*	*15*
Estonia	*20*	*9*	*33.8*	*21*
Poland	*23*	*5*	*20.74*	*19*

Source: composed by authors, on the basis of Taxation trends in the European Union, 2015.

One of the most efficient taxes is value-added tax (VAT), because it has low tariffs, marginal suppression of activities and brings a lot of income to the state budget. VAT is easy to collect because it is included in the price of every product and doesn't require a special calculation. The tax is paid by the final consumer by acquiring goods or services.

The system of taxation in Lithuania is essentially favourable for business. The standard VAT tariff is slightly below the EU average (Table 2). The highest VAT rates are in Hungary (27%), the lowest are in Malta (18%). In the countries nearest to Lithuania, VAT rates are almost the same. Some kinds of goods may have reduced rates of VAT. The greater the number of such goods, the more favourable environment for business establishment. In Lithuania, reduced rate of VAT is applied to media products, passenger transportation, heating energy and medical equipment.

A major influence for business environment in the country and development of its attractiveness is made by its taxation system. A huge tax burden impedes the appearance of the new business subjects and increases the share of black or shadow economy. Taxation

system is one of the elements of political environment, having a direct impact on the appearance of new companies.

Probably the heaviest burden for business is employer's compulsory social security tax. In the global practice, the tax is shared by the employer and the employee in various proportions. Among EU countries, Lithuania is one of those with the highest compulsory social security tax rates paid by the employer, which is 30.98% of the total calculated wage. Greater rates are only in Belgium, Czech Republic, Estonia, and Sweden. In Slovak Republic, the employer has to pay even 35.2%. However, EU (28) average is only 23.78%. The lowest rate is in Malta and Bulgaria (10%), but in these countries a greater part of social security has to be paid by the employee or by voluntary insurance.

Company profit tax in Lithuania is low (15%). Besides, there are quite a few conditions allowing reducing the taxed share of the profit. Very small companies, having fewer than 10 employees and generating less than 300, 000 EUR turnovers per year, are eligible to pay a reduced profit tax (5%). In other EU countries this rate is much higher (in Germany, Italy and Portugal it is more than 30%, in Malta it is even 35%). That is why it can be stated that in Lithuania profit tax rates are favourable enough for the establishment and development of business. Besides, there exists a flexible system of tax reductions for beginning businessmen.

Besides the analysed taxes, businesses have to pay a lot of other taxes, such as real estate tax, taxes on land, various excise taxes, pollution taxes, etc.

5. CONCLUSION

The implementation of EU investment policy in Lithuania is carried out in a few ways: by direct support for companies via financial means and information/consultancy provision and by creating a favourable environment for business, i.e. taxation system, infrastructure, areas equipped for business (business incubators, industrial parks, industrial zones, etc.).

However, EU investment policy is not oriented towards direct financing of business establishment. EU investment policy has only an indirect influence on business establishment: conditions for business are improved and attractiveness for establishment of new businesses is increased.

Summing up the research on the environment for business establishment in Lithuania it can be stated that the legal framework for business establishment in Lithuania is strong enough. The regulatory framework of company establishment and development is influenced by the processes of integration into EU; that is why it corresponds to the requirements set by the EU.

In Lithuania, as well as in other EU countries, the choice of legal forms of business establishment is wide enough; it is determined by the chosen sphere of activities, management structure, the size of business, competences and experiences in the respective branch of business. Taxation system is essentially favourable for business establishment, but few concessions are applied for the newly established businesses in Lithuania. The heaviest burden for business is VAT, profit tax and compulsory social security taxes. Spheres where VAT reductions are applied are scarce. More exemptions are applied in the sphere of profit tax; however, they are also not oriented towards stimulation of establishment of new businesses and supporting them. In comparison with other EU countries, Lithuanian taxation system is inflexible, and the rates are high enough. Although profit tax rates are one of the lowest among the EU countries, social security and VAT rates are one of the highest. Such taxation policy impedes the development of business and does not stimulate the creation of the new subjects of economy. That is why other means stimulating business establishment are necessary – support for businesses from EU and national funds. Support is especially important for small businesses, which have difficulties in establishing and developing independently.

REFERENCES

Books:

[1] Čiegis, R. (2012). *Macroeconomics*. (In Lithuanian). Vilnius University, Vilnius.

[2] Dunn, W. N. (2006). *Viešosios politikos analizė. Įvadas (The Analysis of Public Policy. An Introduction)*(In Lithuanian). Homo Liber, Vilnius.

[3] Dvorak, J. (2011). *Viešosios politikos vertinimas Lietuvoje: diegimas, mastas ir reikšmingumas. Daktaro disertacija (Assessment of Public Policy in Lithuania: Implementation, Extent and Importance. A doctoral dissertation).*(In Lithuanian). Vytautas Magnus University, Kaunas.

[4] Parsons, W. (2001). *Viešoji politika: politikos analizės teorijos ir praktikos įvadas (Public Policy: an Introduction to Political Analysis Theory and Practice)*.(In Lithuanian). Eugrimas, Vilnius.

[5] Worthington, I., Britton, CH. (2006). *The Business Environment*. Fifth Edition. Pearson Education, Harlow, England.

WWW pages:

[6] European Commission. Republic of Lithuania. Partnership Agreement. (June 20, 2014, Amendment No. C(2017)211 of 23 January 2017), from http://www.esinvesticijos.lt/en/documents-2014, accessed on 2017-12-12.

[7] European Commission. The Small Business Act for Europe. (2014). Brussels, from https://ec.europa.eu/growth/smes/business-friendly-environment/small-business-act_lt, accessed on 2017-12-14.

[8] Eurostat Statistical books. Taxation trends in the European Union. Data for the EU Member States, Iceland and Norway.(2015), from https://ec.europa.eu/taxation_customs/sites/taxation/files/eco_analysis_report_2015.pdf, accessed on 2017-12-11.

[9] Įmonių teisinės formos (Legal forms of the Companies). (In Lithuanian), from http://www.vakarai.lt/article.php?id=31, accessed on 2017-12-17.

[10] The Government of the Republic of Lithuania. Operational Program for the European Union Funds' Investments in 2014-2020. Republic of Lithuania. (2014). Vilnius, from http://www.esinvesticijos.lt/en/documents-2014, accessed on 2017-12-13.

[11] Titarenko, V. (2007).*Verslo sąlygos ir jų gerinimas Lietuvoje. Taikomasis mokslinis tyrimas (Business Conditions in Lithuania and their Improvement. Applied research).*Europos technologinių platformų ir pramoninių klasterių nacionalinis biuras(National Bureau of European Technology Platforms and Industrial Clusters), Vilnius. (In Lithuanian), from *https://ukmin.lrv.lt/uploads/ukmin/documents/files/imported/lt/strategija/doc08/VS_Idalis.pdf,* accessed on 2017-12-16.

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HOW TO MEASURE THE LOAD ON FOLLOWING SHAFT OF GEARBOX REDUCER

Elizabeta Hristovska, Ivo Kuzmanov, Roberto Pasic, Vangelica Jovanovska

Abstract: *This paper presents the methodology, the measurement equipment and the original approach in the application of the strain gage method (tens metric method) for measuring the loads of unreachable following shafts on gearbox reducers operating in difficult working conditions and exposed to dynamic and often stochastic loads. The measured values obtained in this way are reliable data for the deformations and therefore indirectly for the load and the stresses of the shaft and can be faithfully used in the further analysis of the shaft and the gearbox in general with all its constituent elements.*

Key words: *gearbox reducer, following shaft, load, experimental measuring, methodology*

1. INTRODUCTION

In order to accurately define the load regime for a machine part (mechanism or machine), it is necessary to conduct experimental researches of stress-deformed shape of the part in all characteristic working regimes in its exploitation life. The essential mechanical quantities required for this purpose are usually obtained by electric way with various types of electrical instruments and installations.

The accepted method for this purpose in the paper is the strain gage method, which is characterized by high precision in the transformation of the measurement mechanical quantities into an electrical signal, which takes place in the measuring gages-sensors used for this purpose. The measuring gage directly or indirectly detects the dilatations on the measurement point and transforms it into an electrical signal that is carried out to the measuring equipment.

On the choice of measurement equipment and the methodology of the research influence have: the expected values and character of the measurement quantities, the location on which the measuring gages should be placed, the possibilities for reachable of the gearbox shaft, the working conditions and the external influences.

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2. DESCRIBING THE CHARACTERISTICS OF THE MEASUREMENT METHOD

Defining the load regime of the gearbox in principle is carried out by determining the load on its following shaft (output shaft), which means measuring the value of the torque moment in all possible gearbox working regimes. Measurement of the torque moment of the shaft by the strain gage method is carried out indirectly, i.e. the dilatations of the outer surface of the shaft are measured at the measuring points, that is, in the measuring points where the measuring gages are placed. Then, based on the measured dilatations in the measuring points, the torque moment is calculated on the basis of the corresponding basics defined in the strength of the materials science.

The dilatations of the measuring points are the consequence of the stresses acting on the measuring points, which are the result of the workload of the gearbox, that is, of his following shaft.

The dilatation, i.e. the relative elongation of the measuring point, can be represented by the relative change in the resistance in the measuring gage glued to that measuring point, that is:

$$\varepsilon = \frac{1}{k}\frac{\Delta R}{R} \qquad [1]$$

where k is the proportionality factor characteristic of the corresponding type of measuring gage.

The tangential stress at the measuring point is determined by the following equation:

$$\tau_{xy} = \frac{E \cdot \varepsilon}{1+\upsilon} \qquad [2]$$

where: E - modulus of elasticity and Wo - Poisson coefficient, referring to the material from which the shaft is made.

The relation between the torque moment and the tangential stress, i.e. the torque moment and dilatation is:

$$T = \tau_{xy} W_o = \frac{E}{1+\upsilon} W_o \varepsilon \qquad [3]$$

where: Wo - polar resistant moment on the shaft, which for a shaft with a circular cross-section is $W_o = 0.2d^3$, where d is the diameter of the shaft at the intersection where the measuring gages are places.

Replacing Wo and ε in equation [3] follows:

$$T = \frac{E}{1+\upsilon} 0.2d^3 \frac{\Delta R}{R}\frac{1}{k} = C\Delta R \qquad [4]$$

where:

$$C = \frac{E}{1+\upsilon} 0.2d^3 \frac{1}{kR}$$ is a constant value

To make self-compensation of the flexion stress impact, 4 measuring gages are generally used in a single intersection of the shaft, which is advantageous for connecting the measuring gages in the Whitestone's bridge. The position of the measuring gages is determined by the direction of the maximum tangential stresses, which occupy the angle of 45 ° with the direction of the long axis of the shaft.

3. CONCEPT OF THE LOAD MEASUREMENT SOLUTION

The object of research for the stated intention in this paper is the gearbox whose scheme is shown in Figure 1, in which measuring point is marked with M, that is, the intersection where the measuring gages are placed.

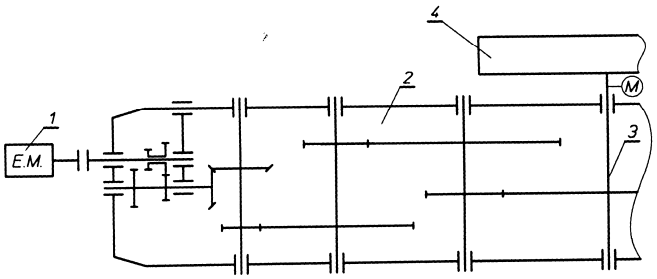


Figure 1 -Gearbox with the indicated measuring point

The measurement installation, which is the concept of the solution set out in this paper, is shown in Figure 2. As can be seen from the scheme, the measurement installation is a set of several components related to each other according to the set measuring target and the needs of the strain gage method, which have the following meaning:

The marks: 1,2,3,4 - measuring gages placed at an angle of 45 °, that is, two measuring gages-rosettes intended for torsional deformations; 5- sliding rings; 6- sliding brushes; 7- measuring bridge with amplifier; 8- magnetic recorder; 9- printer with exiting paper.

During the measurement, two measuring gages were used, from the type XY 216/350, the product of the company Hettinger Baldwin Messtechnik (HBM) Germany.

Sliding rings (Figure 3-a) are one-piece, made of brass and are set on a collar of insulating material (plastic), marked with 1 in the figure. The brass rings (marked with 2) are centered with distant rings between them (marked with 3), which are made of the same material as the

collar. Through the collar in the longitudinally direction is carved canal where the copper wires pass through and which go one to every ring where they are soldered.

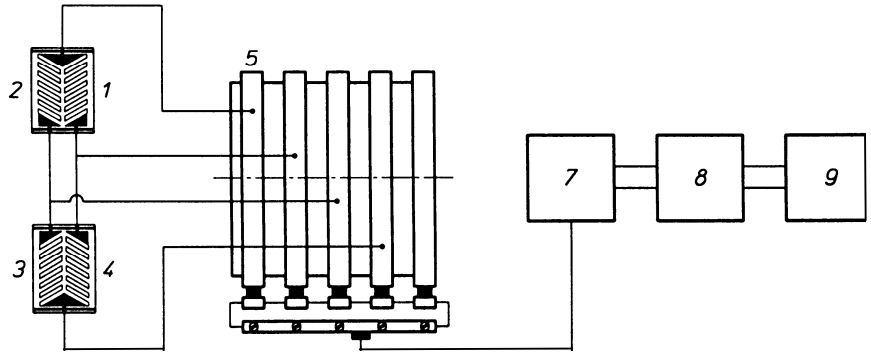
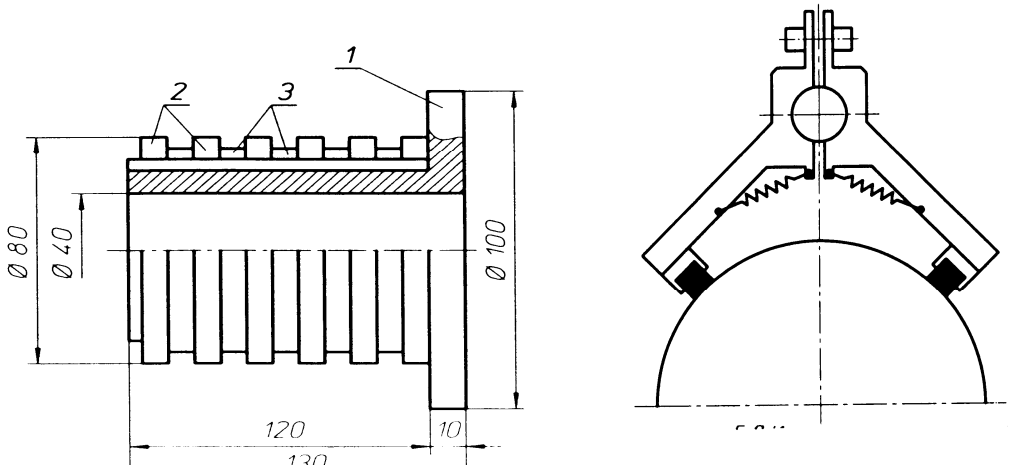


Figure 2 -Scheme for measuring installation

Sliding brushes (Figure 3-b) are made of copper and graphite alloy, and their holder from brass. For a better contact between the brushes and the rings, two brushes are used on one ring. The brushes are placed on separate pieces, and the pieces are joined by springs to achieve constant pressure between the brushes and the rings.



a.) b.)

Figure 3 - Design of sliding rings and brushes

The transfer of electricity to and from the measuring gages is carried out through the sliding rings and the brushes. In order to obtain the desired measurement quantities, according to the used measuring gages and the principles of measurement with the strain gage method, the method of connecting the measuring gages with the rings using the wires is shown in Figure 4.

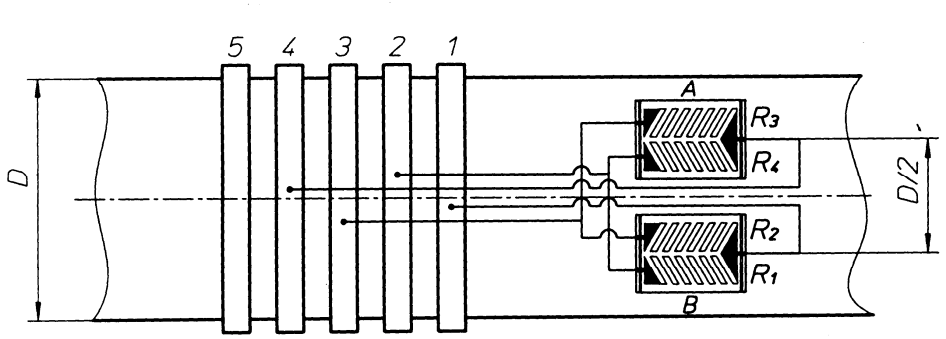


Figure 4 - Connecting the measuring gages with the sliding rings

Due to the impossibility of placing the sliding rings on the output shaft of the reducer (no physical approach is possible for constructive reasons), a new way of setting is proposed, presented below.

The measuring gages are glued to the gearbox shaft at the point of its tilt, when the gearbox is withdrawn with its output shaft from the shaft to which the torque moment is hand over. When they are got on, there is no damage to the measuring gages because they are placed at the spot of the air gap between the shafts. The wires coming from the measuring gages passing through one of the vent for the axle-pin, which transmits the torque moment from one to the other shaft (no axle-pin is placed in this vent) and also passing through the vent for this purpose screwed onto the gearbox cover, exit the gearbox housing. Here, the wires are connected to the sliding rings.

The collar of the insulating material with the rings is compacked on a pin with a flange, made for this purpose,which fastens through the vents of the flange with screws to the cover of the gearbox and the face of the gearbox following shaft. With this constructive solution, the pin with the rings rotates together with the following shaft. This constructive solution on the output of the gearbox cover is shown in Figure 5.

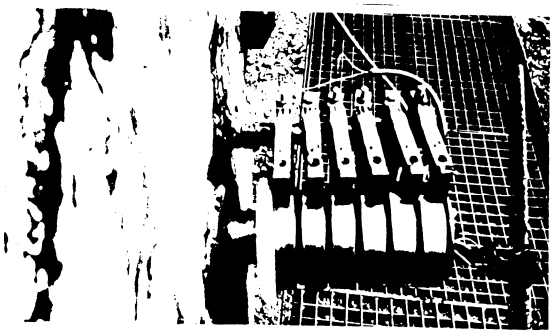


Figure 5 - Contact of the sliding rings and the brushes mounted on the cover of the gearbox

4. CONCLUSION

With the conceptual methodology in this paper and the use of the presented measuring equipment, reliable load data of the gearbox following shaft are obtained.

If the measurements are carried out in all its working regimes, data are obtained which can define the load regime of the shaft according to an appropriate methodology for that purpose, which can be further used for the analysis of the shaft and the gearbox as a whole.

The applied measurement methodology gives objective indicators and the mistakes of the obtained results with respect to the realistic expectations are less than 1%, which characterizes the methodology as reliable for the use of other gearboxes in need of measuring their load.

Particular influence on the accuracy of the obtained measurement results has the quality of contact between:

- shaft and measuring gages;
- wires and measuring gages;
- brushes and rings;
- brushes and measuring instruments.

The advantage of the strain gage method when is used for this purpose as in the paper is perceived in a simple mathematical calculation, and the disadvantage is in the long and complex measurement preparation.

REFERENCES

[1] Technical measurements and controls of gearbox reducers in REK Bitola, carried out by the author

[2] Catalogue from the German company HBM

[3] Technical documentation for the gearbox

[4] Advices from experts in charge of the exploitation and maintenance of the gearbox

[5] Advices from experts in charge of working with measuring equipment

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EXPLORING THE IMPACT OF INNOVATIVE DEVELOPMENT ON THE COMPETITIVENESS OF SMES IN BULGARIA

Siyka Demirova[1], Sibel Ahmedova[2]

Abstract: *The purpose of this report is to examine and analyze the peculiarities of innovation development of small and medium-sized enterprises (SMEs) in Bulgaria. Special attention is given to the formation of corporate policy based on an innovative basis. The labor productivity, innovation activity of enterprises, the necessary investments and other indicators, related to the innovation development of SMEs have been studied via some analytical methods. On this basis, proposals have been made to improve the competitiveness of the innovation base in SMEs in Bulgaria.*

Key words: *Innovation, innovation development, competitiveness, innovation activity*

1. INTRODUCTION

Specificities of innovative development and on this basis of SME corporate policy

SMEs occupy a crucial role in the globalisation of the world economy. In developed industrialised countries, in their interaction with large companies, millions of SMEs form a special mechanism for market self-regulation, with the entrepreneurial landscape being determined entirely by them. As the global economic system cannot exist without the large-scale enterprises, so is the economy incapacitated without SMEs. As a basis for economic development, it is precisely the small and medium-sized entrepreneurship that determine the level of creative achievements, entrepreneurial initiative, the degree of readiness to provide services and the ability to adapt dynamically to the new business environment.

Modern SMEs are highly specialised. This specialisation is flexible and dynamic and responds quickly to market changes. A key feature of small enterprises is their high degree of flexibility and their enormous potential. They respond quickly to the ever-changing market requirements, refocusing their production on goods and services in popular demand,

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satisfying differentiated individual and fast-changing needs. Small enterprises improve the existing nomenclature of materials, details, assemblies and linkages, products and commodities, achieve significant market breakthroughs.

The small -scale entrepreneurship as an important structural element of the economy is the first to embrace scientific discoveries and employ advanced technological resources. It is a phenomenon with a variety of features and perspectives, and is distinguished by the following characteristics: the type of economic activity, yielding profit in a particular sector of the economy, and forming a process of creating something new and different.

SMEs are a principal source of economic power, and their development and existence should accordingly be held in considerable respect. They have a special place in the modern industrial structure of development and will continue to strengthen their wider significance in economic life. SMEs should gradually assume the function of satisfying certain societal needs. This particular role will be determined by the place they occupy in the industrial structure and by the problems they solve at this stage of development, such as:

- What part of the publicly demanded need they supply in their service of large-scale industry?
- What is the number of persons employed in them, i.e. what social function they perform in terms of employment and how they partially compensate for the loss of labour?
- What traditional activities do they maintain and, on this basis, determine the national priorities in this direction of industrial development?
- Can they be the focal point of rapid and effective experimentation of innovative technical solutions (structures, technologies, inventions, etc.)?

Addressing these issues is inevitably connected with closer investigation, further clarification and proper articulation of their significance as small economic units in the scale of the new requirements imposed by the market economy and widespread globalisation. In addition, it is essential to note that their research and development capabilities are determined by their specific development potential and suitability [2].

2. INNOVATION-BASED COMPETITIVENESS AS AN ELEMENT FOR FOSTERING CORPORATE GROWTH TITLE

The objective of SME innovation policy is to ensure a competitive advantage and corporate growth on the basis of their increased innovation capacity. Innovative development,

furthermore, can also be seen as a continuous process of improving productivity and creating new products while conquering new market niches.

Each innovation process begins with defining and identifying the problem or formulating the enterprise innovation policy in the field of product improvement. If the problem is precisely and clearly defined, the solution can then be easily formulated and presented, i.e. the enterprise has an effective product policy (*fig.1*). This, undoubtedly, implies that innovation development also forms the enterprise's policy as part of its corporate policy and is an integral part of its overall technical and economic development.

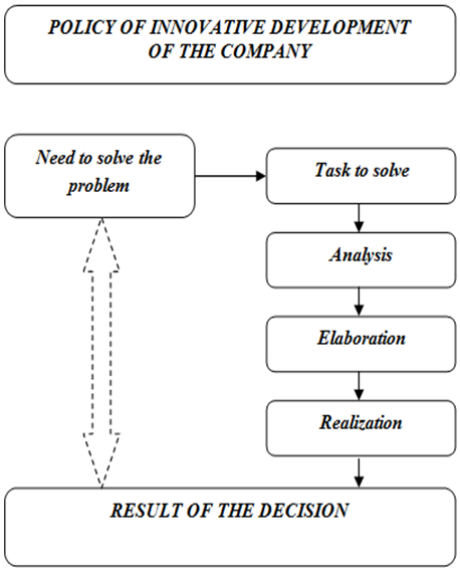

Fig.1. Innovation development as a process for problem solving

The strategic corporate policy of every industrial enterprise is inconceivable without a well-established, carefully considered and well-planned framework for innovation policy which is to shape the concept of the economic indicators of the enterprise performance and is, therefore, considered a key factor for its prosperity.

3. THE EFFECT OF INNOVATION ON SMEs COMPETITIVENESS IN BULGARIA

The current stage of business life cycle development is also characterised by globalisation of the requirements for both product quality and the need for sustainable growth, as well as for

the pursuit of highly effective implementation of innovation achievements, particularly the most advanced cutting-edge information and industry-related technologies.

Sustainability trends in the globalization of economy support the accelerated introduction of innovative solutions, as manifested in new technologies and automation of manufacturing processes. Moreover, in doing so, accomplished is a wide range of tasks related to increase in productivity, the quality of production, the sustainability and flexibility of the production process, decrease in the cycle from the inception of a given idea to its completion, i.e. to bringing the product to the market [1,3,9,10,11].

Research into the impact of innovative development on the SME competitiveness in Bulgaria is based on the following indicators:***investments in new technologies involving SME technical equipment in line with local and European standards; internationalisation; innovation activities in SMEs; training of labour resources; process management systems; level of best practices application; level of labour productivity:***

- ***SME investment in new technologies*** - the technological development of SMEs is lagging behind the global trends [7,8]. Of the surveyed enterprises, 43% have invested the absorbed funds in new technologies, while 57% of them remain without such technologies (*fig.2)*.The main reason that could be pointed out is the fact that the latter enterprises do not have sufficient financial resources for new technologies.

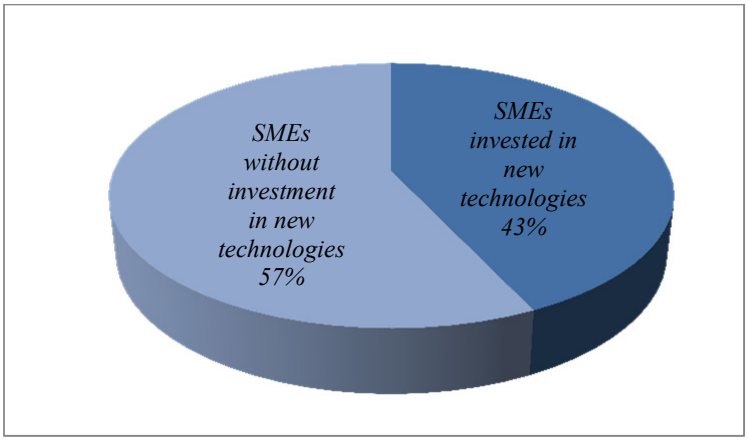

Fig.2.Investments in new technologies

State of the technical equipment in SMEs with regard to local and European standards (%)

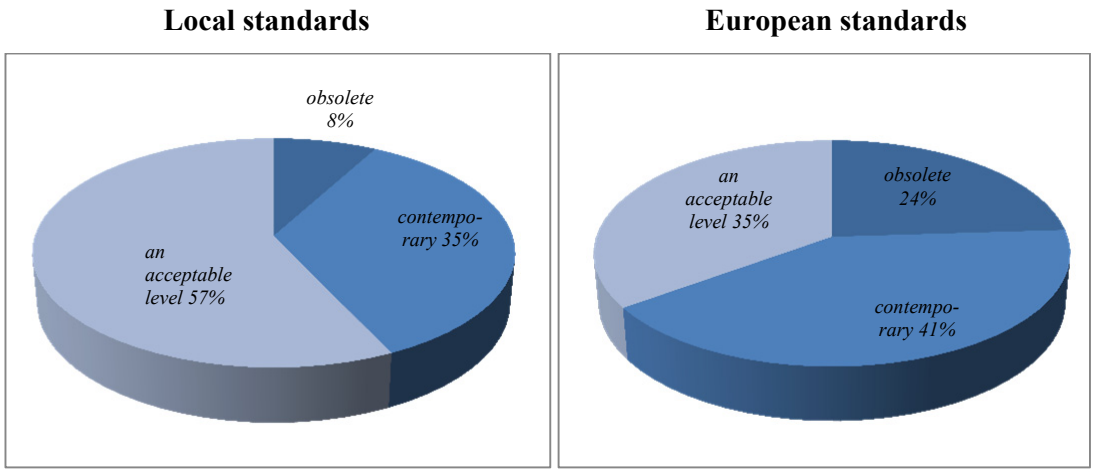

Fig. 3. State of the technical equipment in SMEs with regard to local and European standards (%)

According to purely local standards, managers in the surveyed enterprises believe that 8% of the available technology is obsolete and 35% - up-to-the-minute. 57% of the companies surveyed indicated that the equipment is at an acceptable level for the country (*fig.3)*.

With regard to EU standards, only 41% of enterprises maintain that their equipment is up-to-date and 35% — at an acceptable level. Nevertheless, only 24% of the respondents state that they have made some recent investments to upgrade their technologies with the largest share of 44%being taken by the medium-sized enterprises, followed by the small enterprises -36% (*fig.3)*.

- Internationalisation of SMEs (%) – over the period 2013-2017the share of the exports of the surveyed SMEs to EU countries decreased to 3.9% compared to the previous years when exports reached up to 12% of the produced output. Unlike European countries, there has been an increase in the trade with the so-called third (world) or developing countries. Bulgaria's main trading partners outside the EU are Turkey, the Russian Federation, China, Serbia, Macedonia and Egypt, which account for 51,6% of exports to third countries [3,4,5].

Among the companies surveyed, 57% of them have introduced an international standard, and 43% of SMEs do not have any. The low volume of exports predetermines its insignificant contribution to the formation of SME turnover and respective productivity. 65% of the companies surveyed indicated that exports did not make a significant contribution to the company's turnover and productivity.

As a result, it can be said that SMEs rely mainly on domestic consumption. 75% of enterprises indicate, of enterprises indicate that they do not participate in exhibitions and fairs despite the fact that they can receive funding for the successful performance of the country on international markets. On the other hand, 50% of SMEs indicate that they import raw materials due to shortages or scarcity (*fig.4)*.

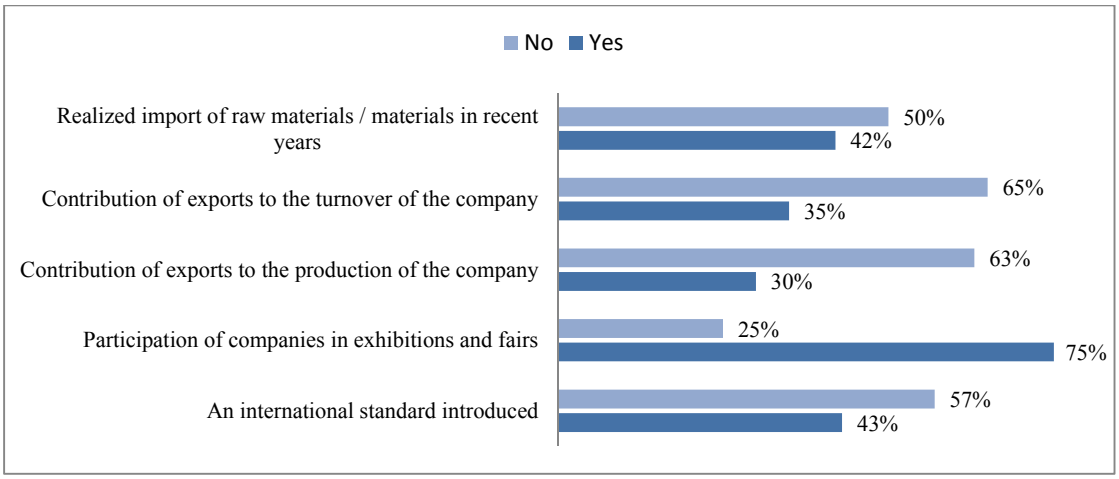

Fig.4. Internationalization of SMEs (%)

- Innovation activities in SMEs – as regards SME innovation activity 73% of the enterprises surveyed state that they do not have sufficient financial resources for funding and only 23% have some. Joint initiatives with educational institutions are conducted by 33% of the companies surveyed with the share of the staff who have undergone specialised training in the sphere of current innovative practices in the sector being 26% (*fig.5*).

No more than 5% of the surveyed enterprises have benefited from the possibility of using or translating the results of the scientific workers and institutions of research to create new or improve the existing products, services and process. 65% an improved or modified version of an existing product and 35% of the enterprises under study intend to develop a new product/introduce innovation in their manufacturing processes by the next year.

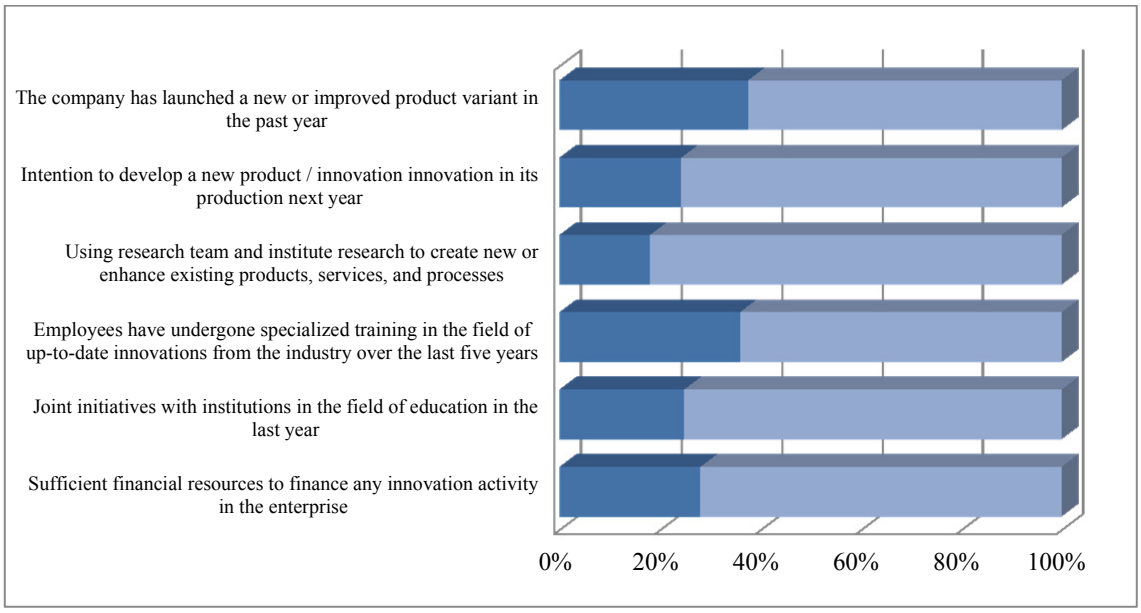

Fig.5. Innovative activity of SMEs

- ***Staff training in SMEs*** -the existence of a human resources strategy is of paramount importance for thes ustainable development of the enterprises both in the short and long terms. The requirements of the modern global market create the need for new skills and competences that are gradually stepping into domestic markets as well. These new skills and knowledge can be acquired and developed only through a targeted policy towards improving staff qualifications (*fig.6)*

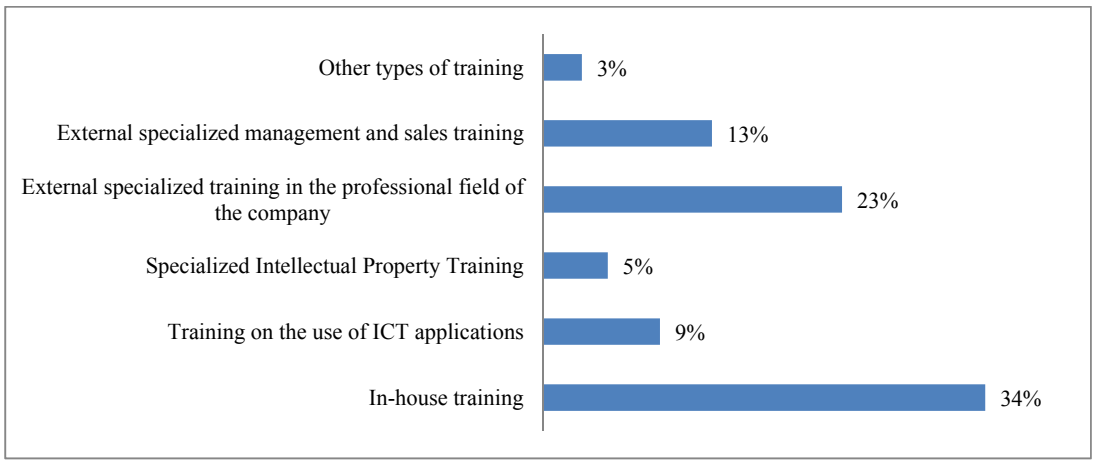

Fig.6. Training of staff in SMEs

Staff training is not yet a well-established practice in most SMEs but is relatively a more widely observed pattern. 34% of enterprises organize in-house training, and 18% — offer

their staff external specialized training in the field of the business and sales development activities of the enterprise.

- ***Process management systems***

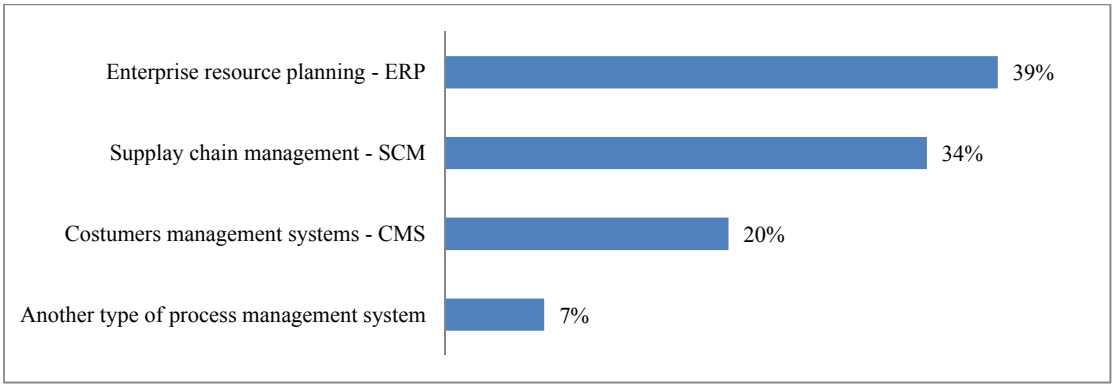

Fig.7.Process management systems

20% of the surveyed SMEs have applied a customer relationship management system. The share of those who have implemented a supplier management system is 34% with the integrated management system becoming an integral part of 39% of the SMEs under study. 7% of the entrepreneurs in the rest of the surveyed SMEs make use of different types of the available management information systems (*fig.7)*.

- ***The level of best practices application***- the development and implementation of market strategies in the context of strong competition both in the European and global markets is crucial for the success of the enterprises. In view of the easy access to information in recent years and in response to market pressures, activities such as planning, marketing research, expansion ofinternal and external markets, which otherwise appear to be more specific of large-scale companies, are increasingly being integrated into SMEs operation as well.

Currently, with the instant access to information technologies and well-developed marketing strategy for these particular goods and the global downturn in their prices, SMEs have an excellent opportunity to take advantage of and maximize their potential to apply the best practices and knowledge related to the specific industry sector [3,6]. Internet usage facilitates businesses' access to information, improves the communication with their business partners and it also allows for sales to be made at low transaction costs. All in all, the use of management information systems is likely to improve the organisational processes

significantly, to reduce the intra-company transaction costs, to provide accurate and timely information for business decision-making processes, etc.

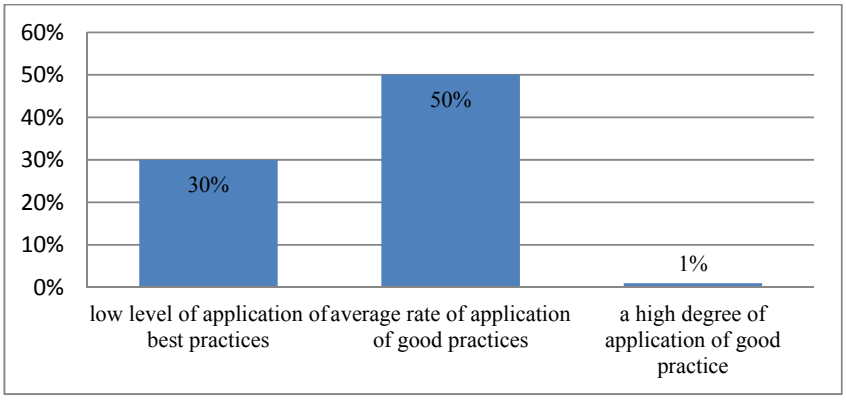

Fig.8.Degree of application of good practices

30% of the companies surveyed, across different spheres, indicate that they have a low application level of the best practices. 50% of the SMEs surveyed have displayed an average rate of application of the industry-related best practices. In general, internet technologies are most widely adopted (*fig.8*). 67% of the enterprises under study have built a company website, while 27%–electronic signature management. Nevertheless, the share of SMEs using information management systems is still very low - less than 6%.

Therefore, the best practices in the use of modern technologies, human resource development strategies and marketing strategies have proven to be the key factors for increasing the competitiveness of SMEs, while the transfer of best practices and their successful implementation contributes significantly to their stable development.

- ***level of labor productivity***- over the last few years, SMEs have reported tendentious increase in relation to this indicator. For the period 2013- 2017 labor productivity in SMEs grew by 2,80% (fig.9.)

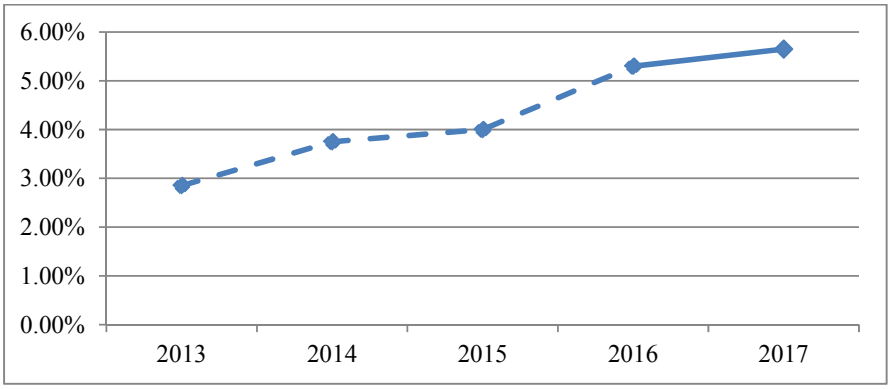

Fig.9. Level of labor productivity in SMEs

The achieved level of labor productivity is due to the gradual introduction of investments in cutting-edge technologies and proper standards; overall improvement in the degree of internationalisation and innovation activities in SMEs. There is also a growing trend in employee training and development, in the introduction of process management systems and the application of best practices.

4. PROPOSALS FOR IMPROVED INNOVATION ACTIVITY IN SMALL AND MEDIUM-SIZED INDUSTRIAL ENTERPRISES

To improve innovation and competitiveness in small and medium-sized industrial enterprises, the following suggestions should be considered:

- strengthening R & D funding.
- supporting SME research and testing of new business models through EU operational programmes.
- complete support for export-oriented industrial SMEs and intensification of knowledge and services.
- provision of assistance in institutionalization of the hidden forms of science-to-business interaction, which is related to the entrepreneurial activity of the respective scientists and researchers.
- promoting the new role of universities, stimulating university-industry collaboration and linking research and business.

This, however, is also associated with the issue of the availability of adequate policy instruments, and in particular the role of universities in stimulating more innovative start-up companies, thus linking public sector research and business practices. A detailed review of the incentive methods should be further carried out, including:

- the introduction of intellectual property rules;
- giving a sharper focus on entrepreneurship higher education;
- improving the access of the entrepreneurial students to finance;
- provision of business incubation support oriented towards the results of technology transfer centers.

The review under consideration should also address the most efficient ways to stimulate the creation and development of high-tech and knowledge-intensive SMEs. It is obvious that universities play a crucial role in such a process and their new role in stimulating

entrepreneurship and linking research to the actual needs of the business sector should come to the front.

REFERENCES

[1] Bamberge I., Developing competitive advantage in small and medium-size firms, 2016, pp. 133 - 155

[2] Demirova S., Innovation development and innovation policy of small and medium-sized industrial enterprises, ed. Color Print, Varna, 2013

[3] Executive Agency for Promotion of Small and Medium-Sized Enterprises, (2016). A study into the entrepreneurship and prospects for innovation development in SMEs (2012-2013)

[4] European Commission, Periodic Report on the Social and Economic Situation of Regions in the EU, 2014

[5] National statistical institute. 2014-2016-Innovation activity of the enterprises during the period, 2017

[6] National statistical institute. Statistical reference book, 2017

[7] OECD, Enhancing the Competitiveness of SMEs through Innovation, 2017

[8] OECD (2011), OECD Science, Technology and Industry Scoreboard 2011, OECD Publishing.doi: 10.1787/sti_scoreboard-2011-en

[9] Petkova – Georgieva S., Reasons Analysis for Increasing of Outsourcing Manufactures Activity Effectiveness, Izvestia, Journal of the union of scientists - Varna 2/2017, pp. 122-129

[10] Viinika E., Innovation expertise for boosting international growth of Finnish SMEs, 2016

[11] Wynarczyk P., Open innovation in SMEs: A dynamic approach to modern entrepreneurship in the twenty-first century