

PROJECT

Modern Textile Industry as Attractive Career Path for Young Generations and Contributor for Economic Development and Social Prosperity of Cross Border Region

REPORT

Program for Modernization of Textile Industry in Cross-Border Region

2020



TEXTILE AND CLOTHES BRANCH ORGANIZATION

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ABBREVIATIONS

ALS	Accomplishment of the labor standards
BGN	Bulgarian New Lev
BNS	Bulgarian National Standarts
BOTO	Branch Organization for Textiles and Clothing
CMT	Cut-Make-Trim
CS	Client sample
ERP system	Enterprise resource planning system
EU	European Union
GDP	Gross Domestic Product
HRM	Human Resources Management
MIS	Management information systems
NSI	National Statistical Institute
PPS	Pre-production sample/samples
QC	Quality control
SAM	Standart allowed minute
SMD	Sewing Machine Devices
SMEs	Small and medium enterprises
SP	Sewing products
STD	Special technical devices
T&C	Textile and clothing industry
TSP	Technological sequence for the production
TTZ-TK	Textile Trade Association- Textile Cluster-Republic of North Macedonia
Non-Vat time	Non Added Value time



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I. INTRODUCTION AND METHODOLOGY

Within the project "Modern textile industry as attractive career path for young generations and contributor for economic development and social prosperity of cross border region", activity 5 "Program for modernization of textile industry in cross-border region" by the Association of Textile Companies and Clothing "Branch Organization for Textiles and Clothing" (BOTO) - Bulgaria has developed and conducted a study of textile and clothing companies in the cross-border region. The study is a stage aimed at identifying technological and organizational gaps in the research and development industry activity of companies in the region, as well as the establishment of good practices. The evaluation was performed on both sides of the border by the project partner countries.

Based on the reported results in the study, the Joint Program for modernization of textile industry in cross-border region of the Republic of Bulgaria-Republic of North Macedonia was developed and proposed.

The enterprises covered in this study are precisely in this region, where the clothing sector is structurally crucial and key to the development of the local economy.

The analysis covers the main trends in the development of the sector and in the development of company strategies for renewal and modernization based on national and regional statistics and the opinions of enterprises in the sector, collected through a survey.

Within the survey for 20 questionnaires collected by local garment companies from the countries in the cross-border region (10 for each country), containing information about the profile of the sector in the region, the state of technical and information resources in the sector, measures taken by companies to improve their condition at regional level.

At the same time, a survey was conducted among companies on the production organization in enterprises and the management of quality and work processes in order to assess the measures for efficiency and convenience of work in enterprises. The collected data are processed, summarized and synthesized for the purposes of the study and represent a starting point for formulating the main recommendations for the development of modernization and implementation of innovations in the sector.

II. PURPOSE OF THE PROGRAM

The aim is to define the need for modernization as the best precondition for maintaining the competitive position of the textile industry in the cross-border region.

The successful identification of the problems in this area, in combination with the borrowing of the established good practices, will ensure the development of a purposeful program for dealing with the problem areas. This will contribute both to the adaptation of the company's policies for modernization of production to the changing economic conditions and will favor the creation of a broad approach to restructuring the sector in the region, including good partnership, inter-company contacts and strengthening measures to increase activities modernization of the enterprises, which will improve the work in the companies and will help to increase their competitiveness.



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III. RESEARCH, ANALYSIS AND ASSESSMENT OF THE MAIN TECHNOLOGICAL AND ORGANIZATIONAL GAPS IN INDUSTRY ABOUT REGIONAL TEXTILE AND CLOTHING COMPANIES' SCIENTIFIC AND RESEARCH ACTIVITIES

The textile and clothing (T&C) industry has a wide range of activities including the processing of natural fibers (cotton, wool, silk, linen, hemp and jute), natural polymers (viscose, acetate, modal), synthetic fibers (polyester, nylon / polyamide, acrylic, polypropylene) and fibers of inorganic materials (eg glass, metal, carbon or ceramics) in yarns and fabrics, as well as the production of a wide variety of products: clothing and accessories (knitted or woven), carpets and other textile floor coverings, home textiles such as bed linen, tablecloths and curtains, technical or industrial textiles. To these main activities are added many auxiliary and finishing products such as bleaching, printing, dyeing, impregnation, coating and plasticization.

III.1. Summary of key data for the sector at European and regional level

According to data from recent years, there are about 185,000 companies in the T&C industry that work with 1.7 million people and generate a turnover of 166 billion euros. The sector represents 3% of value added and 6% of employment in total production in Europe (European Commission, 2016). A significant proportion of textiles and clothing consumed in the EU (mostly with lower added value) are produced in remote areas of the world, often in Asia, due to very low labor costs. The disadvantages of this model are: long-distance deliveries, poor working and operating conditions, environmental damage. Modernization of textile and garment production within the EU is expected to offer opportunities to address these issues. New production technologies lead to the development of more advanced production systems - clean, less labor-intensive and resource-demanding, where the system of production and consumption is designed to circulate resources, reduce waste and dependence on raw materials. EU-based production would also offset the risks and costs associated with long-distance supply chains. This allows for shorter delivery times, more ordering options, specialized, even customized production with high added value; to strengthen consumer participation, joint design, production and supply of products. The Textile and Clothing (T&C) sector in the EU is based on small business. Companies with less than 50 employees represent more than 90% of the workforce and produce almost 60% of value added (European Commission, 2017).

The European Commission has launched several initiatives within COSME and Horizon 2020 to support innovation and growth of small and medium enterprises (SMEs) through clusters - groups of specialized companies and other related entities that cooperate in a given territory (European Commission, 2017).

III.1.1. Size and importance of the "Textiles, Clothing and Leather" sectors at national and local level- Republic of Bulgaria

The textile and clothing industries are in the group of the industries most affected by the economic changes in the country. Despite the difficulties facing them, most of the Bulgarian textile and sewing companies managed to survive and adapt to the new external environment. However, the dynamic processes of the environment pose new problems for the company management in these sectors. That is why it is important to analyze the



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development of the Bulgarian textile and garment industry in recent years to reveal its place and role in the national economy, and then to outline the observed trends at the local level, collected as a result of the study.

The Clothing and Textiles sector is essential for the Bulgarian economy and occupies an important place in the economic life of the country, has various links with a number of industrial sectors and has a significant impact on their development.

This was particularly clear and stated in the current situation of the World Pandemic by Covid 19.

It is the textile and clothing industry that has been called upon and put in a position to deal with the need to provide protective masks and protective clothing to medics and the general public in order for economic life to function and for the health and lives of the population to be preserved. A task that companies and the industry have coped with perfectly and proved their key role in the economies of the countries in the region. A fact repeatedly stated by the government when announcing the timely measures taken to deal with the crisis - Covid 19.

In this regard, it can be noted that the planning and implementation of innovations in the sector "T&C" is a topic that excites to a large extent the modern Bulgarian and economic and managerial science and practice.

Therefore, solving the problems of the sector largely reflects on the development of a number of other interconnected industries, as well as on the development of industry as a whole.

In the conditions of gradual increase of the deficit of the classical raw materials, globalization (connected with modernization of the economy, intensified urbanization, revolution in information and communication technologies) of the business, appropriate strategic decisions in this direction, combined with corresponding investment activities are needed.

From the point of view of the present research the issue of the technical and technological provision of the enterprises in Bulgaria is actual, which determines the positions on the local, regional and global market. The moral and physical obsolescence of equipment in industrial enterprises is often the main reason for the low efficiency and low competitiveness of clothing enterprises.

Insufficient investment activity of Bulgarian enterprises in the sector is the reason for the reduction of their ability to continuously modernize and be competitive on the world market.

➤ **Production volume - Republic of Bulgaria**

The industry can be considered one of the main ones for the manufacturing sector, although there is a lack of accurate public data on its contribution to Gross Domestic Product -GDP.

Over 95% of the manufactured products are exported, mainly to the EU. In the last 10 years, the sector has formed between 18 and 21% of the country's foreign exchange earnings. The industry is the second largest employer in Bulgaria.

For the period 2016-2018 the production of economic activity "Manufacture of textiles and clothing, leather processing, manufacture of footwear and other leather goods without fur", according to National Statistical Institute (NSI) data, increased from BGN 3892453 thousand to BGN 4272784 thousand (Table 1). BGN, ie with 9.8%. Although in the



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relative shares of the total production of the country there is a decrease by 0.5% (from 6% to 5.5%).

Table 1. Economic activity "Manufacture of textiles and clothing, leather processing, manufacture of footwear and other leather goods without fur", period 2016-2018

Economical indicators by activities	2016 (thousand BGN)	2017 (thousand BGN)	2018 (thousand BGN)
Manufacture of textiles and clothing, leather processing, manufacture of footwear and other leather goods without fur	3892453	3986612	4272784
Share in the total national product	6.0%	5.5%	5.5%

Source: Bulgarian NSI, Statistical Reference Book, 2019

The index of production of industrial production decreased for the period 2016-2018 by 1.6%, as for activity "Manufacture of textiles and clothing, leather processing, manufacture of footwear and other leather products without fur" registered a decrease of only 0.4% .

In March 2020, the index of industrial production registered a decline of 6.9% compared to the corresponding month of 2019 according to the NSI.

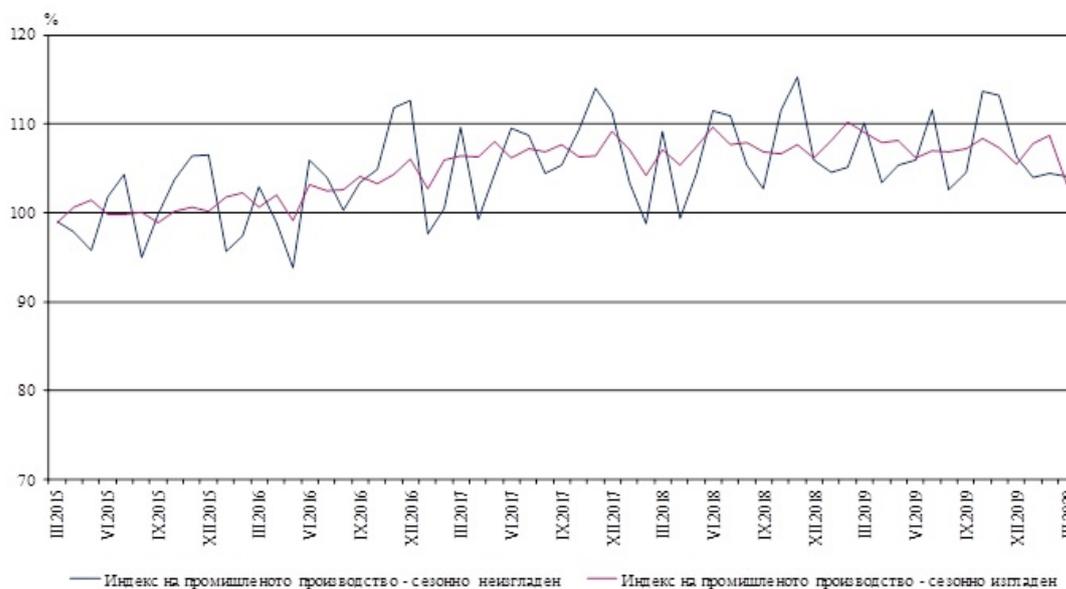


Figure 1. Indices of industrial production, Bulgaria, (June 2014 - June 2019), 2015 = 100, National Statistical Institute (NSI), Bulgaria

According to preliminary data, in March 2020 the seasonally adjusted index of industrial production decreased by 5.1% compared to February 2020.

In March 2020 a decrease of 6.9% compared to the previous month was registered in the manufacturing industry. A more significant decline in the manufacturing industry is



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observed in some industries, including leather processing; manufacture of footwear and other leather products - by 18.5%.

On an annual basis, a decline in industrial production, calculated from the calendar adjusted data, was reported in manufacturing - by 9.8%. A more significant decrease in the manufacturing compared to the respective month of the previous year was observed in the manufacture of footwear and other articles of leather - by 31.0% and in the manufacture of wearing apparel - by 26.0%.

It can be said that in practice these are the first serious economic data that already reflect the consequences of the spread of Covid 19, as in February 2020 industrial production in Bulgaria recorded a slight increase of 0.1% compared to the same month of last year.

In the production of products monitored by the NSI, dynamics was registered, shown in the table 2.

Table 2. Dynamics In the production of products, period 2015-2018

Industrial products	2015	2016	2017	2018
Cotton yarns - thousand tons	4.1	3.4	3.2	2.3
Wool yarns - thousand tons	3.1	2.7	2.3	2.3
Cotton fabrics - million m ²	8.5	9.7	7.5	7.4
Woolen fabrics - million m ²	1.9	1.6	1.2	1.0
Silk fabrics - million m ²	1.2	1.7	1.9	1.0
Tights - million pieces	5.8	5.2	6.4	6.2
Socks - a million pairs	44.2	49.4	52.4	49.7
Bed linen, woven, cotton - tons	1098	1105	1289	1111
Footwear (including boots) with uppers of leather, with outer soles of rubber, plastics or leather (excluding sports shoes) and excluding those with a protective metal toecap - thousand pairs	3881	3878	3821	3530

Source: Bulgarian NSI, Statistical Reference Book, 2019

If compare it with the years ago (eg with 2010) it can be seen an even more significant decrease in production. For example, the produced cotton yarns were 6.4 thousand tons, wool yarns - 4.1 thousand tons, cotton fabrics - 14.2 million m², wool fabrics - 3.4 million m².

The NSI reports a decline in exports of certain products from the Textiles and Clothing sector, such as (Table 3):

Table 3. Exports of products from the Textiles and Clothing sector, period 2015-2018

	2015	2016	2017	2018
Men's suits, jackets, trousers and others for men or boys, (million BGN)	539.5	592.4	519.0	441.1
Men's shirts, (million BGN)	84.1	88.9	72.5	71.7
Leather shoes, (thousand pairs)	6115.5	5286.6	4808.5	3944.0

Source: Bulgarian NSI, Statistical Reference Book, 2019



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The same is the trend in the structure of production at the local level, in the region of Blagoevgrad-Kyustendil.

The companies producing men and women's outerwear predominate, as well as companies specializing in the production of sports and casual clothing (Fig. 2). There are few manufacturers of children's clothing.

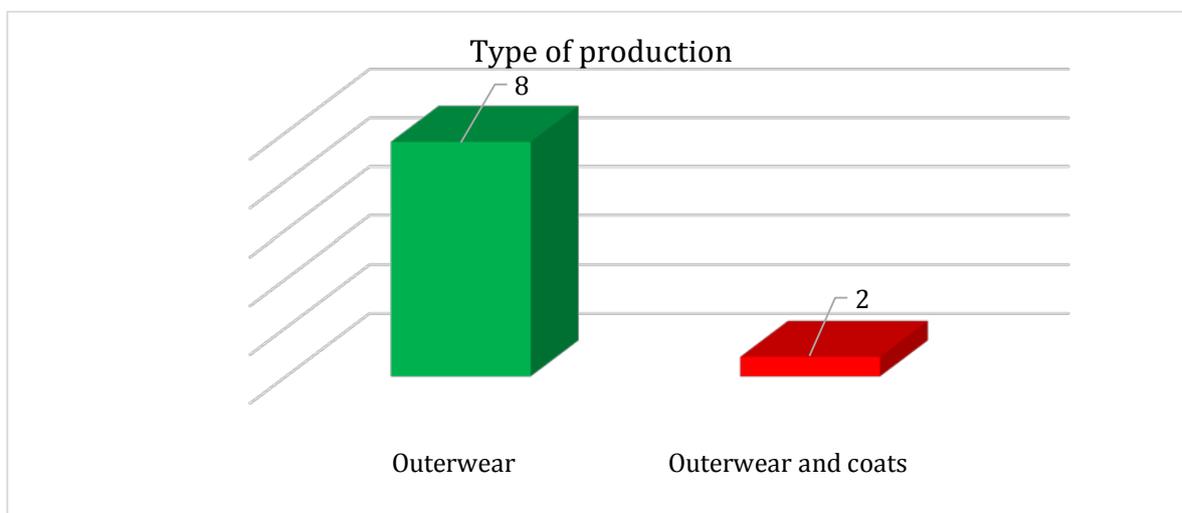


Figure 2. Type of manufactured products, number of surveyed enterprises

A large percentage (about 97%) of the production is cut-make-trim or "CMT".

In the last 7 years there has been a successful development and sale of own products by companies in the sector. The need for production of own sewing products, with a registered trademark, becomes one of the priority directions for the Bulgarian industry. Although still small, almost all companies have their own product, Figure 3.

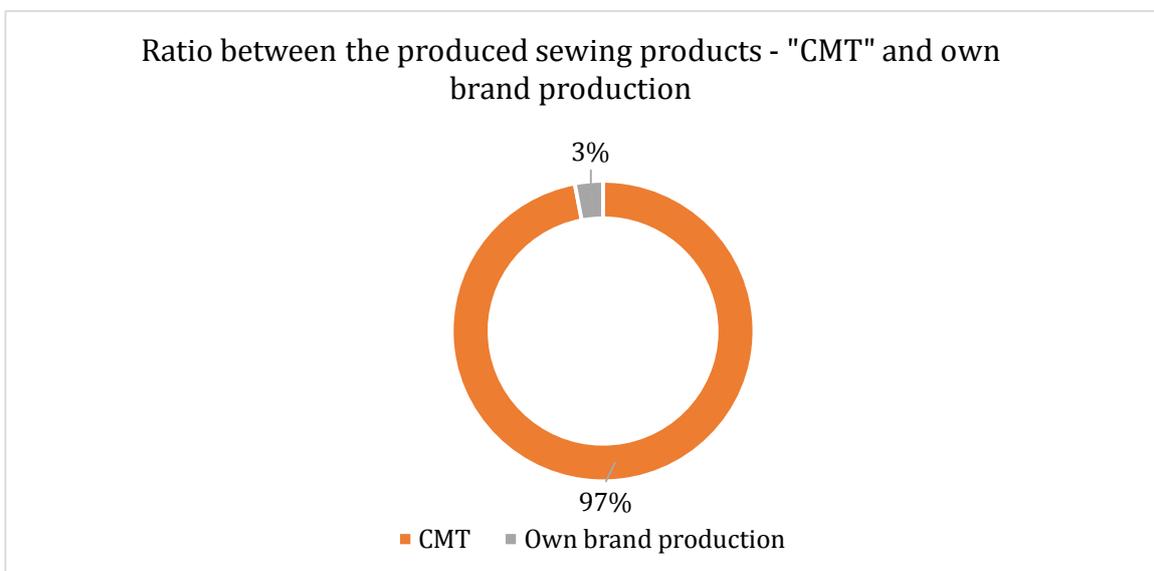


Figure 3. Ratio between the produced garments "CMT" and own brand production, summarized for the surveyed enterprises, in %



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According to industry experts and manufacturers working with multiple local contractors, small and medium-sized enterprises working as subcontractors or subcontractors on separate orders, with a volatile number of employees and strong fluctuations in cash flows, are vulnerable to market changes.

The geographical position of the country, the partially modernized companies, the technological possibilities plus the flexibility of the sewing enterprises make Bulgaria a preferred partner for fashion companies from Italy, France, Germany and others. The country maintains its competitiveness thanks to the established image of good quality and, unfortunately, due to the still low wages. Although for the time being, CMT production is a successful development strategy for most enterprises, this structure of the Bulgarian garment sector is a problem whose solution is important for the strategic development of the industry. While, on the one hand, cooperation with foreign clients is the reason for significant modernization and re-equipment of the sector, on the other hand, the dependence of enterprises on one client (or a small number) determines the short life of these companies.

The task facing clothing manufacturers in Bulgaria is to enter an even higher market segment and achieve greater added value, as well as strengthening the influence and increasing the share of Bulgarian companies in the overall system of European suppliers of fashion sewing products.

Many sewing manufacturers experience other difficulties in their activities. This fact is a result of the short series and the variety of models produced and at the same time the insufficient exchange of information concerning the factors of planning, management and control, the processes in the sewing production and the unsatisfactory available research work in real working conditions.

➤ Structure of the Textile and Clothing sector

The predominant part of the clothing companies in the country are small and medium enterprises with no more than 250 employees. According to the NSI, about 90% of companies in the sector are SMEs. Most of the companies are sole traders and limited liability companies, which have emerged in the last 20 years and have gained experience between 15 and 20 years. There are also a number of joint stock companies, most of which are the successors of the former large state-owned and already privatized enterprises. In practice, ownership in the sector is entirely private.

According to the latest data from Euratex (2020), the number of small and medium-sized enterprises has decreased in the last 12 years, and the data are presented in the table 4 and figure 4. This is due to both market fluctuations and the ever-increasing demands on the producers themselves. Imports from Asian markets, where value added on labor and materials is much lower, are the other main threat to Bulgarian producers. The demographic crisis is also a significant factor that directly affects companies - lack of employees.



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Table 4. Visualization of the difference in the number of enterprises reported in 2008 and 2020

Country: Bulgaria														
Unit: Number														
														
division NACE Rev. 2	size class	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
C13: Manufacture of textiles	0 - 9	453	503	457	451	448	452	443	453	502	516	538	505	504
	10 - 49	138	127	105	101	93	95	103	101	100	102	105	96	94
	50 - 249	44	32	32	31	35	34	35	42	46	46	47	43	41
	250 +	14	11	10	8	7	8	8	6	5	5	5	4	4
	Total	649	673	604	591	583	589	589	602	653	666	695	648	645
	All SMEs	635	662	594	583	576	581	581	596	648	664	690	644	639
C14: Manufacture of wearing apparel	0 - 9	2 808	3 128	2 889	2 759	2 791	2 881	2 906	2 921	3 027	2 995	3 241	3 039	3 038
	10 - 49	1 345	1 210	1 108	1 120	1 047	1 053	1 016	1 015	985	968	1 033	949	929
	50 - 249	564	484	424	433	423	409	400	387	368	356	373	340	329
	250 +	74	66	59	67	63	62	59	50	48	44	46	40	38
	Total	4 791	4 888	4 480	4 379	4 324	4 405	4 381	4 373	4 428	4 417	4 693	4 368	4 334
	All SMEs	4 717	4 822	4 421	4 312	4 261	4 343	4 322	4 323	4 380	4 319	4 647	4 328	4 296
C15: Manufacture of leather and related products	0 - 9	243	274	246	235	237	250	258	269	286	277	306	287	287
	10 - 49	183	168	159	163	162	149	146	159	161	155	169	155	152
	50 - 249	92	85	86	86	75	79	74	66	62	59	63	57	56
	250 +	9	7	9	10	9	7	7	7	6	5	6	5	5
	Total	527	534	500	494	483	485	485	501	515	513	544	505	499
	All SMEs	518	527	491	484	474	478	478	494	509	491	538	499	495

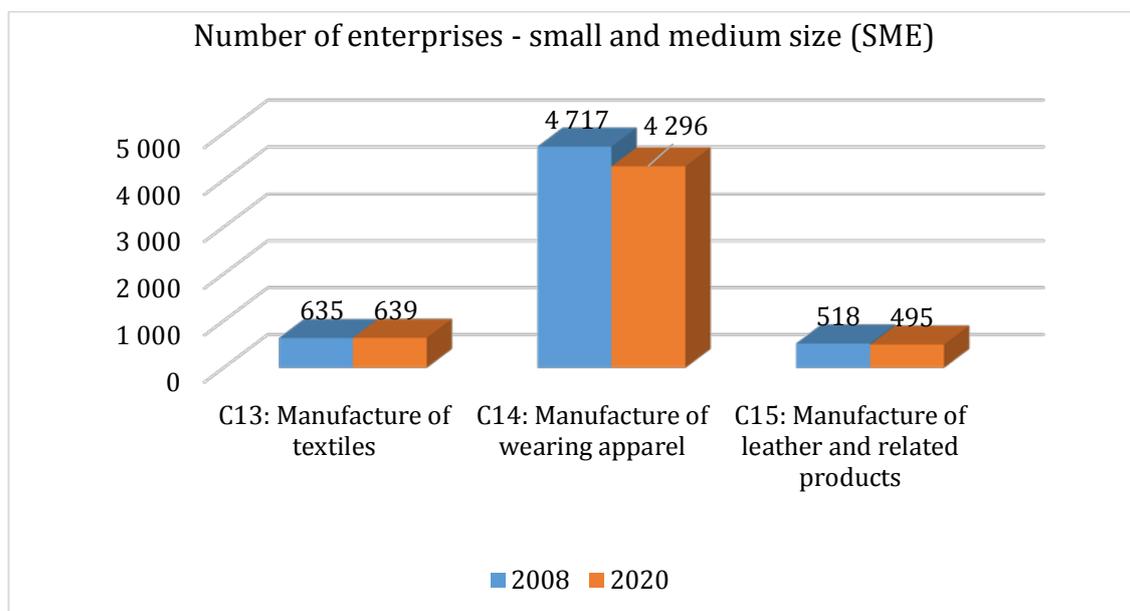


Figure 4. Comparison between number of SME enterprises in Bulgaria, reported in 2008 and 2020



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➤ **Human resources**

According to the latest data, the total number of employees in the sector is significant - 123,604 people, which once again confirms the T&C sector as a structural and key to the development of the regional economy. Table 5 presents the number of employees in small and medium-sized enterprises (SMEs).

Table 5. Number of employees in small and medium-sized enterprises reported in 2008 and 2020

Number of persons employed		Eurostat SBS database Data from national statistical office												
Country: Bulgaria														
division NACE Rev. 2	size class	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
13: Manufacture of textiles	0 - 9	1 366	1 328	1 278	1 226	1 217	1 177	1 150	1 146	1 298	1 326	1 390	1 430	1 470
	10 - 49	3 076	2 750	2 240	2 129	1 921	2 165	2 205	2 177	2 227	2 252	2 336	2 353	2 369
	50 - 249	4 736	3 119	3 108	3 288	3 535	3 399	3 367	4 186	4 555	4 529	4 616	4 605	4 591
	250 +	8 167	6 078	5 823	5 188	4 895	5 268	5 415	4 956	5 085	4 918	4 898	4 741	4 588
	Total	17 345	13 275	12 449	11 831	11 568	12 009	12 137	12 465	13 165	13 025	13 240	13 129	13 018
	All SMEs	9 178	7 197	6 626	6 643	6 673	6 741	6 722	7 509	8 080	8 107	8 342	8 388	8 430
C14: Manufacture of wearing apparel	0 - 9	9 984	9 785	8 677	8 526	8 569	8 544	8 850	8 849	9 164	9 019	9 812	10 091	10 374
	10 - 49	30 130	27 019	25 325	25 386	24 481	24 208	23 802	23 647	23 372	22 772	24 514	24 692	24 862
	50 - 249	58 759	48 859	43 357	42 614	41 987	41 167	40 521	40 218	37 675	36 104	38 178	38 084	37 974
	250 +	37 131	31 521	28 671	32 182	31 064	30 887	30 273	27 822	25 638	23 896	24 697	23 908	23 134
	Total	136 004	117 184	106 030	108 708	106 101	104 806	103 446	100 536	95 849	91 791	97 202	96 775	96 344
	All SMEs	98 873	85 663	77 359	76 526	75 037	73 919	73 173	72 714	70 211	67 895	72 504	72 867	73 210
C15: Manufacture of leather and related products	0 - 9	756	906	790	732	730	800	908	862	869	837	930	956	983
	10 - 49	4 138	3 943	3 756	3 864	3 919	3 489	3 562	3 849	3 855	3 674	4 043	4 072	4 100
	50 - 249	9 655	8 607	8 500	8 942	7 898	8 546	8 031	7 004	6 787	6 362	6 878	6 861	6 841
	250 +	4 125	3 276	4 186	4 615	4 256	3 110	3 624	3 315	2 568	2 342	2 474	2 395	2 317
	Total	18 674	16 732	17 232	18 153	16 803	15 945	16 125	15 030	14 079	13 215	14 325	14 285	14 242
	All SMEs	14 549	13 456	13 046	13 538	12 547	12 835	12 501	11 715	11 511	10 873	11 851	11 889	11 924

Source: Euratex, 2020



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Figure 5. Number of employees in small and medium enterprises (SMEs) in Bulgaria

Despite the large number of employees, employers determine the need for recruitment, as well as raising the qualification of the available as essential, as different types of policies are present in many of the companies - Figure 6.

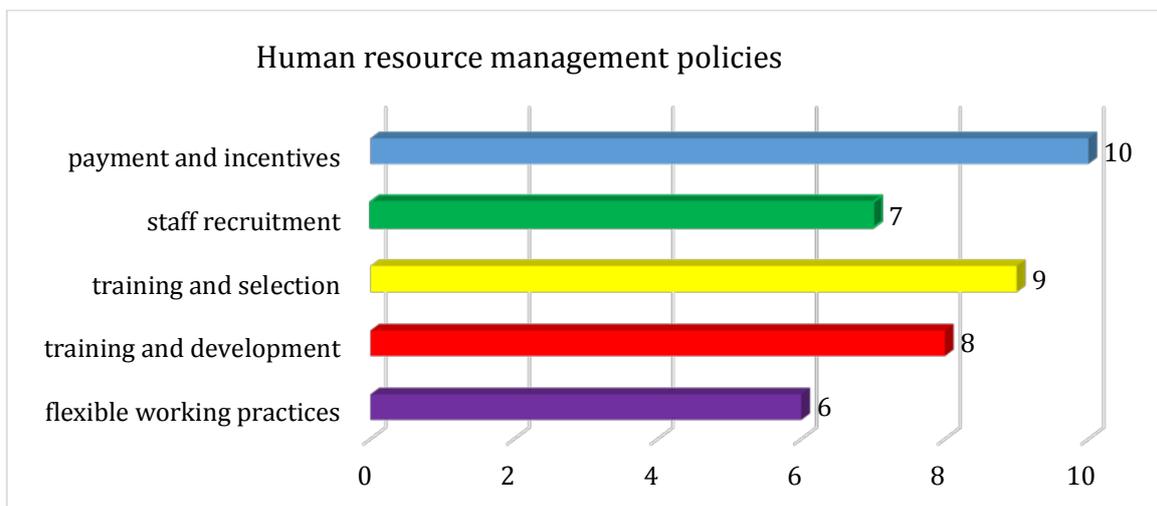


Figure 6. Policies regarding human resource management, by number of surveyed companies

The role of educational institutions is of great importance in the analysis of the state of human resources in the industry, the measures for maintaining and improving their qualification, as well as the policies towards them.

According to the Ministry of Education of Bulgaria, the number of vocational schools is relatively large (84 secondary vocational schools and 8 higher education institutions) and offers great training opportunities in all professions related to the textile and clothing industry.

Some of the described trends at the national level are manifested in the characteristics of the sewing industry in the Blagoevgrad-Kyustendil region.



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The latest NSI data show that the processes of change in the structure of the Bulgarian manufacturing industry continued in 2018. Some "traditional" for the Bulgarian industry economic activities such as the production of textiles, clothing and leather products continue to lose positions in the number of employees at the expense of economic activities traditionally perceived as having higher added value, Figure 7.

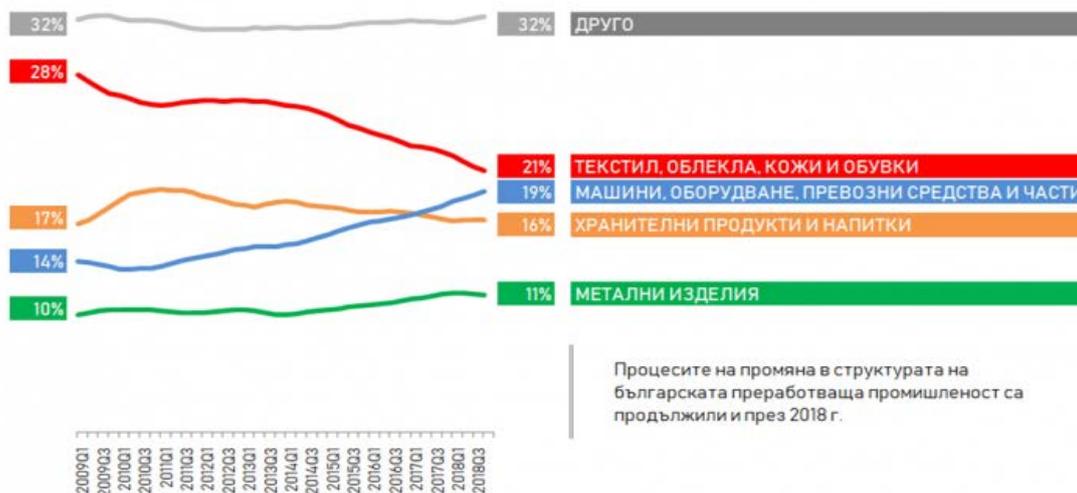


Figure 7. Processes of change in the structure of the Bulgarian processing industry

Lack of employees remain a serious problem for Bulgarian industrial enterprises, reaching a new record of 37% in March 2019, according to preliminary NSI data. However, with the slowdown of the Bulgarian and European economies, it can be seen that the focus of enterprises is gradually shifting to other problems. For the first time since the beginning of 2015, more companies expect their staff to decrease, and the problem is not only the lack of executive staff, but also an increase in the demand for qualified personnel in the economy.

From the distribution of productions in the country presented in Figure 8, the great importance of the textile and clothing industry for the region covering Blagoevgrad-Kyustendil is clearly visible. The main sector of industrial production is C14. Clothing, followed by C15. Leather and shoes, C13. Textiles are less developed, but also available in the region.

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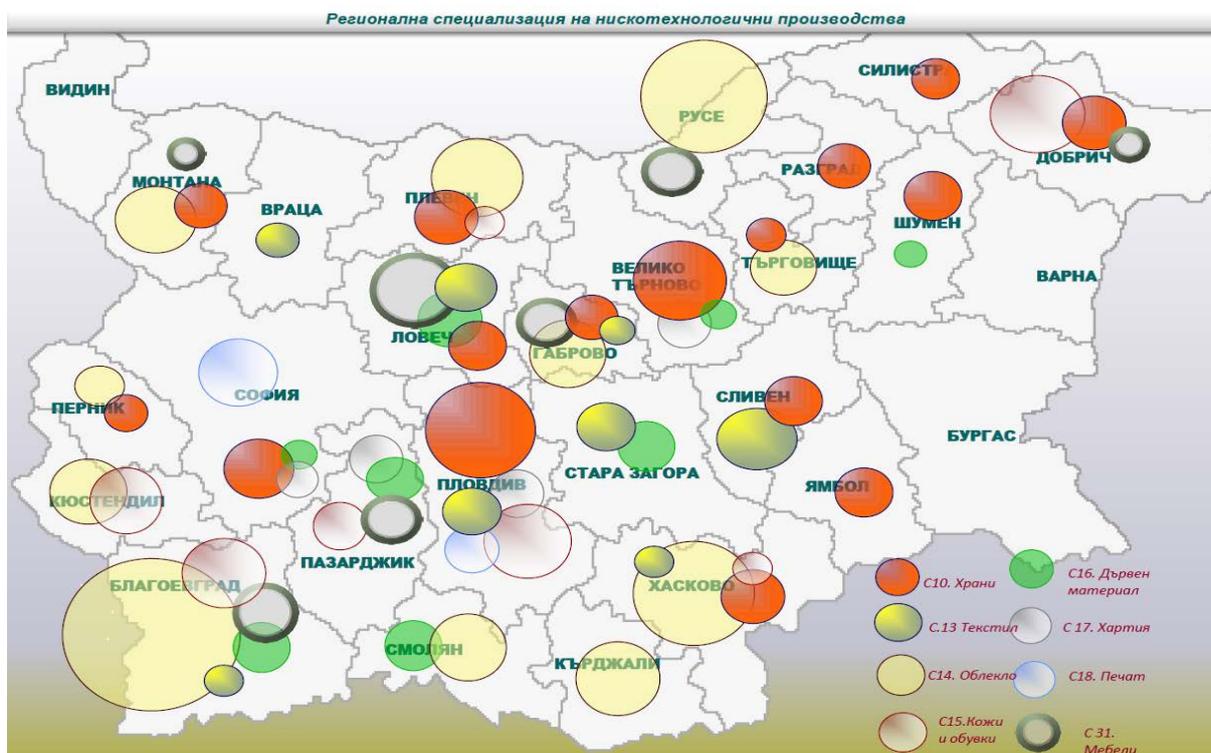


Figure 8. Distribution of the productions, by regions in Bulgaria

III.1.2. Analysis and assessment of the current state of the companies in terms of technical state and capacity

A study, analysis and assessment of the current state and main problems in terms of technical state and capacity of the company’s policy in the sewing industry was made. The enterprises covered in this study fall mainly in the cross-border South-West region, where the sewing sector is structural and key to the development of the local economy.

The analysis presents the main trends in the development of the sector and in the development of company strategies for modernization and introduction of effective production models in sewing production based on national and regional statistics and the opinions of enterprises in the sector, collected through a survey. There are collected 10 surveys from local sewing companies, containing information about the profile of the sector in the region, the state of human resources in the sector, measures for training and qualification of workers and established contacts and partnerships for this purpose at the regional level.

The survey includes questions for current state of the companies in terms of technical state and capacity, which fully affect the production organization in enterprises and quality management and work processes in order to introduce effective production models, evaluation of measures for efficiency and convenience of work in enterprises.

The questions are:

1. Type of manufactured products - characteristics of the company
2. Frequency of order submission
3. Manner of communication with external contracting authorities:
 - a) Electronic production planning and management system;



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- b) E-mail;
- c) Telephone;
- d) Other platforms.

Who is responsible for the correspondence?

Regarding the organization of labor, processes, resources:

4. *Degree of modernization of the work process - Are you aware of the benefits of introducing MIS?*

- a) Yes;
- b) No.

Opportunities of the company to introduce innovations to increase the efficiency of production management

5. *Methods for quality control and management - Do you plan to introduce an electronic system in your company (if it is not introduced) and why?*

- a) *will have a positive effect on relations with contracting authorities;*
- b) *improve the planning and management of production processes;*
- c) *no, I do not have the financial and resource capacity;*
- d) *I do not plan.*

6. *Developed and implemented innovations, improvements and innovations in order to increase production efficiency?*

The formulation of the questions is in accordance with the peculiarities of the production and the level (education and qualification) of the respondents. The survey was developed for completion by specialists - engineers, technologists and managers of sewing companies. The study focuses mainly on the possibilities for optimizing the information flow, modernization of the work environment, the workplace, work processes and management.

A second questionnaire was developed to diagnose the current state / problems, needs / of the company policy of the Bulgarian and Macedonian garment industry in the field of labor development (presented in this report) in terms of qualifications and opportunities to optimize the organization of production.

III.2. Summary data from the conducted survey - Republic of Bulgaria

All respondents answered and received feedback from them, as the answers to some of the questions in the survey exceed the total number (of 10), as the respondents gave more than one answer. The survey was conducted in the field, at personal meetings and general events of the companies.

III.2.1. Type of manufactured products - characteristics of the company

The main production of the surveyed companies is women's, men's and a small number of companies - children's outerwear. The products are made mainly from woven and knitted textile materials.



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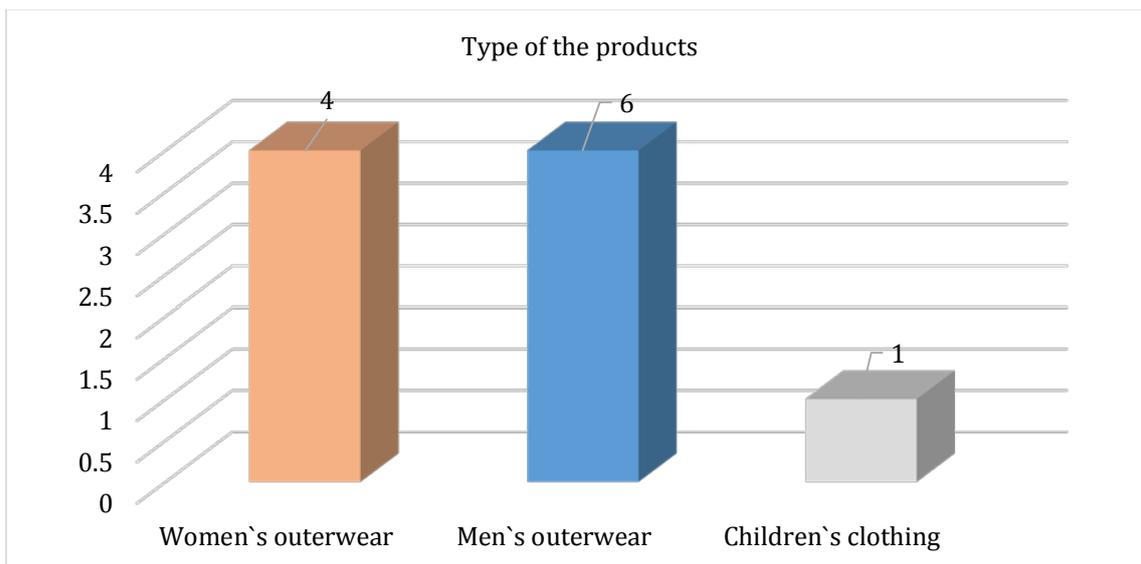


Figure 9. Type of manufactured products, surveyed enterprises

III.2.2. Frequency of order submission

As the companies work with regular customers, they have a rhythmic submission of orders (Figure 10). Planned technologies by models are developed for at least 3 months in advance, in order to ensure production in case of need for rapid readjustment and introduction of a new model. Annual planning is done for own production. An important fact is that all respondents have their own products with a registered trademark, which makes them recognizable and sought after on the Bulgarian market.

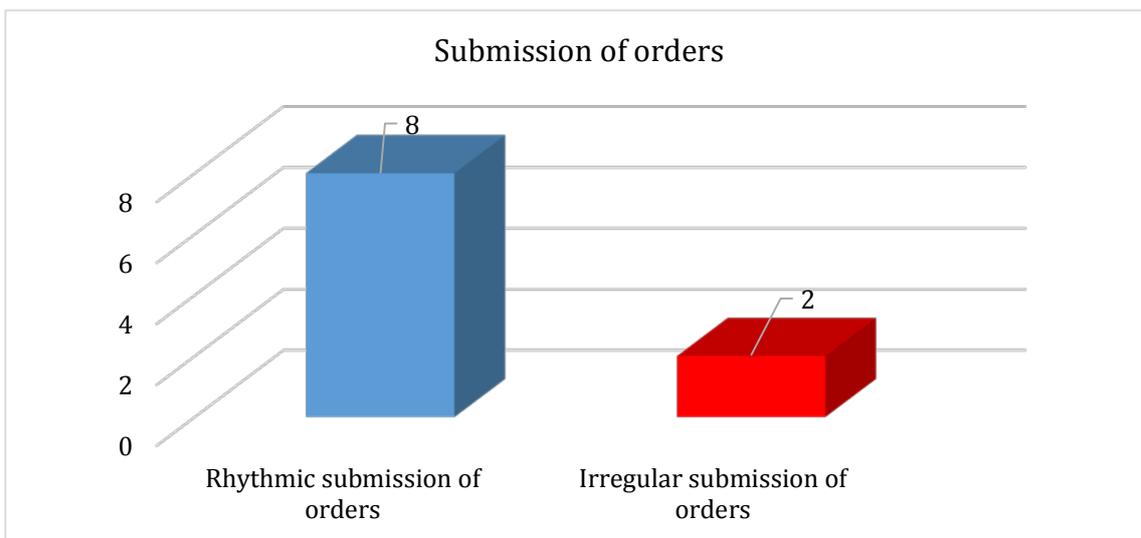


Figure 10. Frequency of order submission

III.2.3. Manner of communication with clients / assignors

About the way of communication with customers / clients, the most common answer is via e-mail and telephone. Other communication channels and platforms are also used -



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Viber, Messenger and others, but in a small percentage. A significant share of the respondents state that they have own systems for direct communication - developed and put into operation their own electronic systems for organization and management of production, Figure 11. The search for ways to systematize data and archiving has led to the implementation of their own solutions. The methods of information provision include stored and classified data for processes, operations, models, logistics, etc., as their reproduction, reliability and application have not been verified for other SP productions, except for own use.

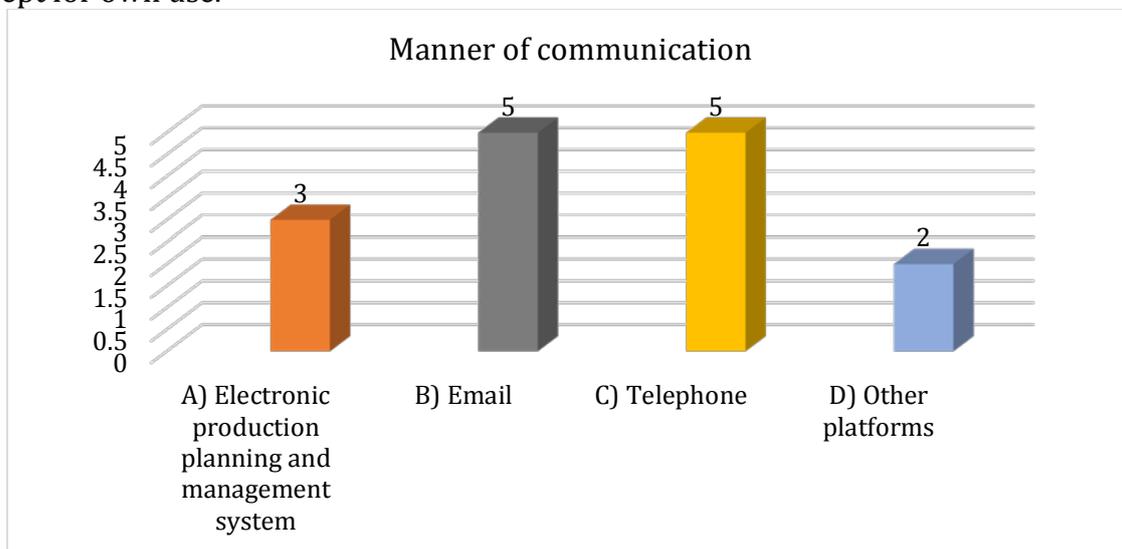


Figure 11. Manner of communication with clients / assignors

III.2.4. Distribution of managers by customers or orders

Strictly defined rules for communication with customers have been introduced. The distribution of responsible people by customers or orders allows for tracking and accurate execution of orders. Each responsible person is obliged to draw up the necessary documents for the customer, order, logistics, transfer of data on the production between the units of the company and the contracting authorities. This avoids the loss or duplication of information, Figure 12.

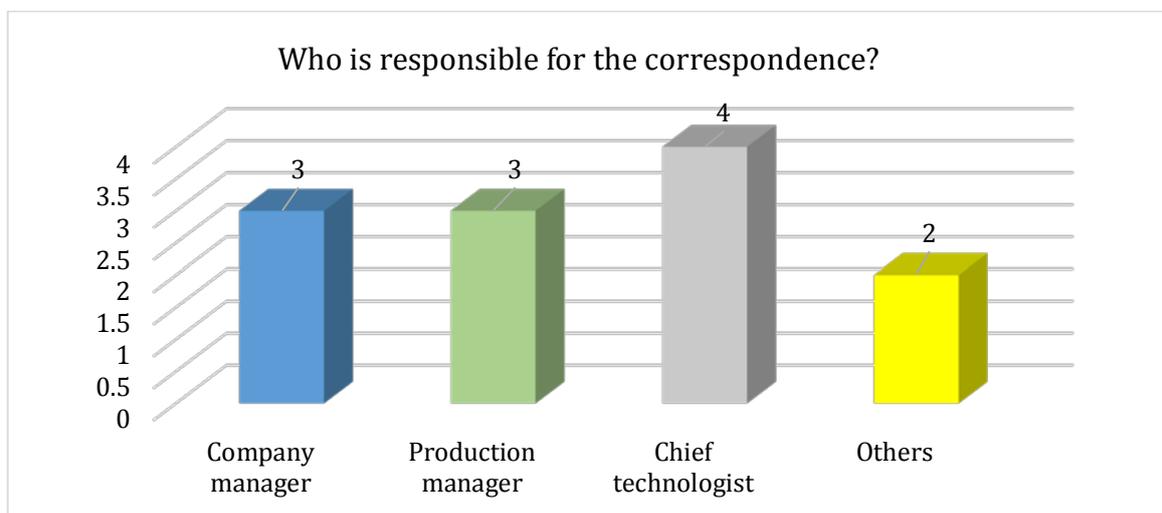


Figure 12. Distribution of managers by clients or orders, number of surveyed companies



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III.2.5. Awareness of the benefits of implementing management information systems (MIS)

Respondents are interested in the implementation of modern production management information systems, ERP system or other electronic applications, integrated computer products. Here the awareness regarding the issue stands out, but also the need for additional information (Figure 13). Companies offering such systems are not inclined to provide complete information. According to data from software developers, according to a study, the finished products do not contain closely specialized information and functions for the sewing company. In general, they are designed for general management and need to be supplemented with data to the specific SP production.

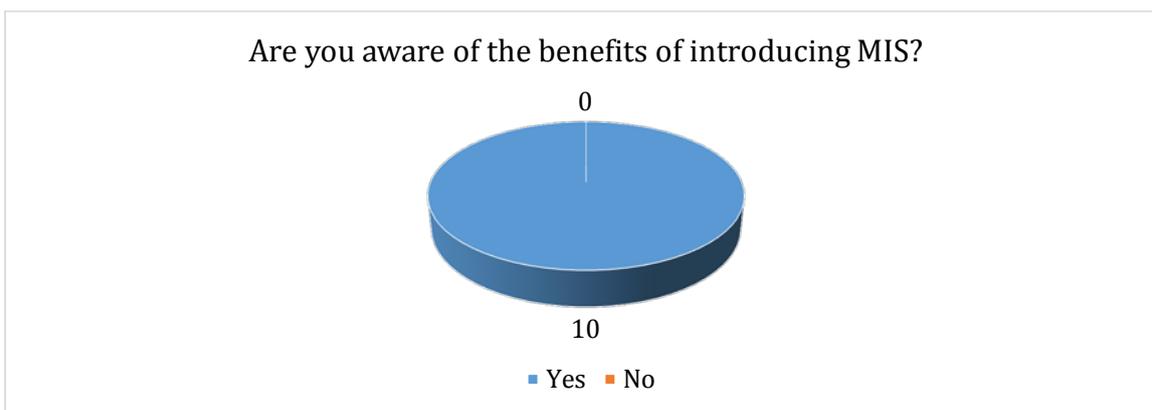


Figure 13. Awareness of the benefits of the introduction of MIS, number of surveyed companies

III.2.6. Planning the introduction of an electronic production management system

Companies are aware of the benefits of introducing MIS. The understanding of the advantages of such systems is clearly differentiated, but for a large part of the respondents their high cost and lack of human resources for maintenance are other significant obstacles to the implementation of the software, Figure 14.

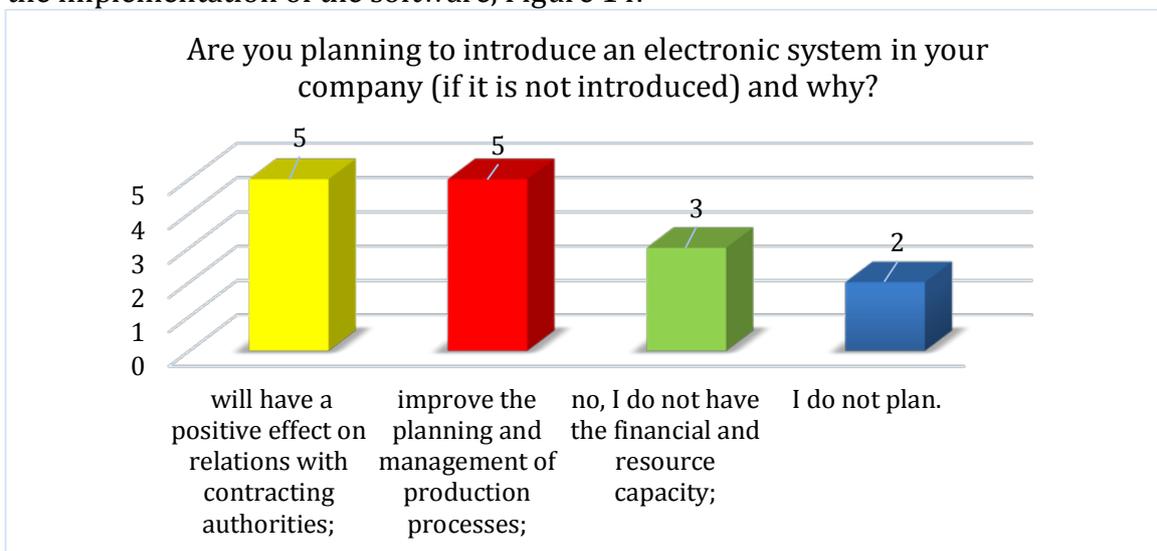


Figure 14. Planning the introduction of an electronic production management system



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III.2.7. Developed and implemented innovations and improvements in order to increase production efficiency

The availability of appropriate technical equipment and supporting for the productivity and quality of manufactured products, as well as for the competitiveness of the company and its prospects to maintain and develop the market. This fact is taken into account by the manufacturers of textile and sewing products and leads to the desire and search for ways to update or improve the equipment.

The direction is both to purchase new, modern high-performance equipment and to improvements and innovative solutions in order to use the existing one. In this way, with relatively small amount of money, on its own and in a short time, the facilities for performing specific activities or automation of some of them are processed and put into operation. To the question of developing and implementing innovations and improvements, all respondents gave positive answers. The need to update the equipment, improve working conditions and take into account the specifics of the activities are the basis for the implementation of innovations, Figure 15.

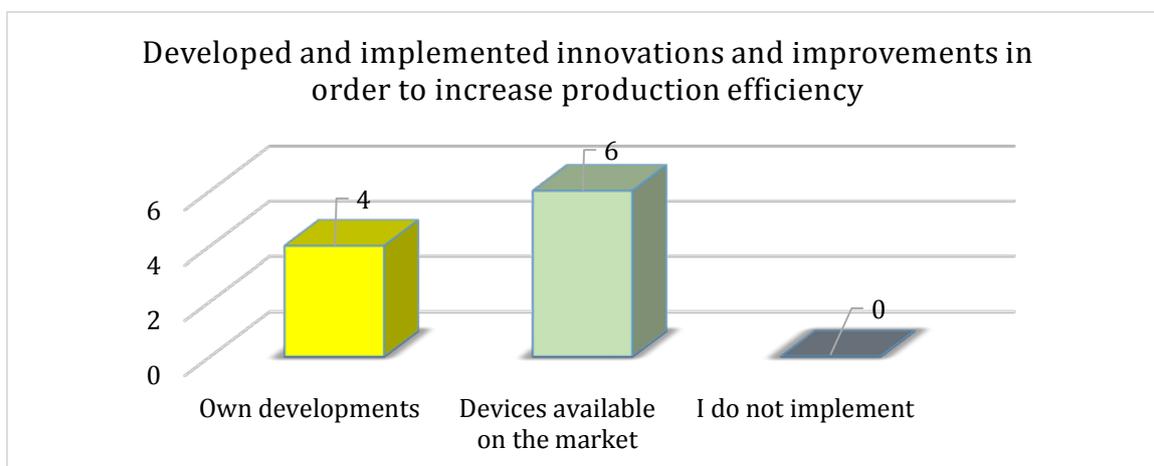


Figure 15. Development and introduction of innovations and improvements, surveyed companies

The improvements are aimed at all activities in the company - from the control of the materials entering the production, to the control of the finished product at the exit.

III.3. Main conclusions and evaluation of the results of the survey in the cross-border region

III.3.1. Main conclusions and evaluation of the results of the survey - Republic of Bulgaria

• Manner of communication with clients / assignors

The most commonly used e-mail and telephone connection. The e-mail connection as correspondence is defined as the most secure connection, ensuring the preservation of information and its repeated use. But this type of communication is slow in time and requires additional time to receive, refine, check, send and more. Developed and



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implemented own systems for direct communication are also used. Their advantage is that the interested party can receive in real time all the necessary data from the manufacturer. The risk of using this type of communication is loss or misuse of company information. The access of external clients and users is restricted, which in turn can lead to insufficient or lack of necessary data for clients.

• Distribution of managers by customers or orders

The distribution allows for an individual approach and precision in the acceptance, processing and tracking of orders assigned by each customer. The individuality of the order is ensured so as to prevent the dissipation of information between departments, managers and others. The formation of the necessary documents for each client - order, logistics, data transfer for the production between the units of the company and the contracting authorities is led by one person who monitors and submits the information in a timely manner. This avoids the loss or duplication of information, but is a time-consuming activity.

• Awareness of the benefits of implementing MIS

There is great interest and awareness regarding the implementation of modern information systems for production management, ERP system or other electronic applications and integrated computer products. The ready-made software offered on the market does not contain closely specialized information and ready-made functions for the sewing company. Ready-made software offered on the market are designed for general management and sometimes need to be supplemented with data specific to the specific production of garments or restructuring of the enterprise in order to adapt to the system. This activity is extremely labor-intensive, time-consuming and requires human resources, with specialization in technology and excellent knowledge of the organizational and production needs of the company.

• Planning the introduction of an electronic production management system

For the companies-manufacturers of sewing products, the benefits of introducing MIS are known in a sufficiently broad aspect. The understanding of the advantages of such systems is clearly differentiated, but for a large part of the respondents their high cost and lack of human resources are significant obstacles to the use of ready-made software.

• Development and introduction of innovations and improvements

The need to update the equipment, improve working conditions and take into account the specifics of the activities are the basis for the implementation of innovations. The correct selection of existing labor saving Sewing Machine Devices (SMD) is one of the ways to increase the efficiency of production. The need to solve technological and production problems at the time of manufacturing the garments has led to the implementation of their own solutions, developed by the technicians and technologists of the companies. Most of the improvements have been made after consultations and joint work with consultants - specialists in industrial engineering.



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III.4. Size and importance of the "Textiles, Clothing and Leather" sectors at national and local level- Republic of North Macedonia

The textile and clothing industry provide a significant number of jobs in the Republic of Northern Macedonia. In 2018, there were 28,232 garment workers (clothing production) and 7,519 textile workers (textile production). The production is mainly based on the CMT principle (CMT - Cut Make Trim) and 92%, and only 8% of companies have a finished product.

The dominant employees in the textile industry are people with lower levels of education, this contributes to solving some of the social problems as well as the problems of poverty. Also this industry mainly employs women labor.

Not only in terms of the number of employees but also in terms of the high share in the exports of the Macedonian economy has one of the leading places. This industry realizes foreign exchange inflow which is of serious importance for the country. The foreign exchange inflow from the export of textiles and clothing is in the amount of 450 million Euros in 2018, thus this industry is the fourth in a row after the export and follows the export of various chemical products, electrical and mechanical devices, equipment and parts.

The group of clothing producers consists of over 900 registered companies. Textile Trade Association- Textile Cluster-Republic of North Macedonia (TTZ-TK's) research has shown that about 500 companies are actually active.

Number of companies in the clothing production industry are presented in table 6.

Table 6. Number of companies in the clothing production industry

Sector	2012	2013	2014	2015	2016	2017
B13 Textile production	203	192	200	193	195	201
B13.1 Preparation and spinning of textile fibers	9	6	5	6	8	6
B13.10 Preparation and spinning of textile fibers	9	6	5	6	8	6
B13.2 Textile weaving	9	9	11	8	11	9
B13.20 Textile weaving	9	9	11	8	11	9
B13.3 Textile finishing	52	46	46	52	46	47
B13.30 Finishing of textiles	52	46	46	52	46	47
B13.9 Manufacture of other textiles	133	131	138	127	130	139
B13.91 Manufacture of knitted and crocheted fabrics	3	2	2	2	2	4
B13.92 Manufacture of finished textile articles, except apparel	73	74	75	76	75	78
B13.93 Manufacture of carpets and rugs (floor coverings)	5	5	4	2	1	:
B13.94 Manufacture of ropes, ropes, braids and nets	5	5	6	5	5	4
B13.95 Manufacture of nonwovens and nonwovens, except clothing	4	3	2	1	2	:
B13.96 Manufacture of other technical and industrial textiles	2	1	1	1	3	:
B13.99 Manufacture of other textiles, not elsewhere specified or included	41	41	48	40	42	47

Source: State Statistical Office of the Republic of North Macedonia (MAKSTAT database), accessed on 27-04-2020

According to the number of employees, most of the companies have 10-49 employees. The role of small and micro companies is irreplaceable in every economy, so in our country they are also vital. Therefore, if a strategic approach is not taken for these small companies to support them, they could hardly follow the technical and technological development in the industry, and thus play the role they have in the economy of our country.



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Of these companies, the most dominant (500) are small companies that employ between 10 and 49 employees, followed by medium-sized companies with 50 to 249 employees, table 7.

Table 7. Number of companies in the clothing production industry, per size

Number of employees	Number of companies	%
>250	24	4,70%
50 – 249	170	33,50%
10 - 49	253	49,90%
0 - 9	60	11,80%
Total	507	100,00%

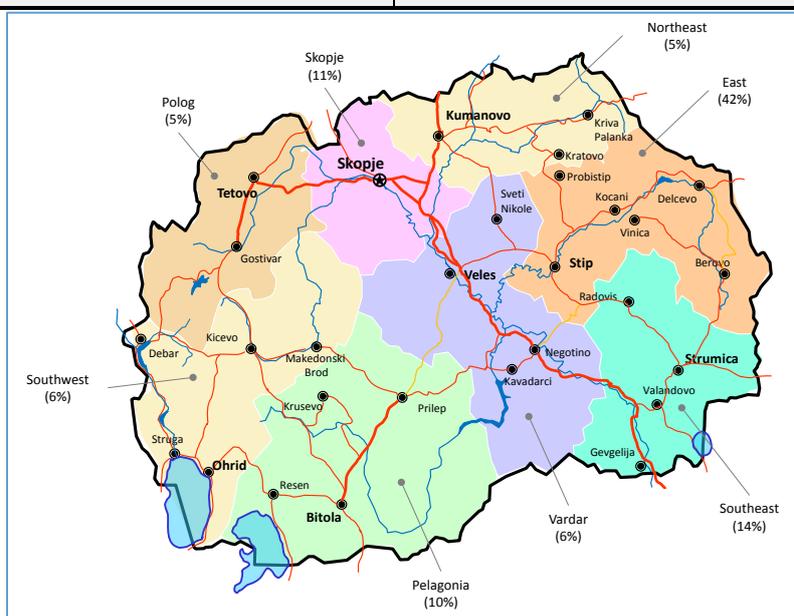
Source: Own investigation (TTZ-TK)

Over 40% of the industry is located in the eastern statistical region. The center of the textile and clothing industry is the city of Stip (over 70

companies), Kocani (more than 50 companies) and Delchevo (over 30 companies), and the development of cities depends exclusively on the condition of these two industries, table 8.

Table 8. Number of companies in eastern statistical region

City	Region	Number of companies	%	City	Region	Number of companies	%
Stip	East	77	15%	Radovich	Southeast	13	3%
Skopje	Skopje	56	11%	Veles	Vardar	9	2%
Kochani	East	53	10%	Kavadarci	Vardar	9	2%
Delchevo	East	31	6%	Struga	Southwest	9	2%
Prilep	Pelagonija	25	5%	Valandovo	Southeast	9	2%
Strumica	Southeast	22	4%	Probitip	East	8	2%
Vinica	East	22	4%	Sveti Nikole	Vardar	7	1%
Gevgelija	Southeast	21	4%	Negotino	Vardar	7	1%
Bitola	Pelagonija	18	4%	Makedonska Kamenica	East	7	1%
Ohrid	Southwest	17	3%	Berovo	East	6	1%
Tetovo	Polog	15	3%	Kratovo	Northeast	6	1%
Kumanovo	Northeast	15	3%	Zrnovci	East	5	1%



Source: Own investigation (TTZ-TK)



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The total annual exports of textiles, clothing, footwear, leather and other leather goods, on average over the past five years, totals over 580 million Euros, table 9.

Table 9. Total annual exports of textiles, clothing, footwear, leather and other leather goods, period 2015-2019

Group	Description	2015	2016	2017	2018	2019
62	Clothing and apparel, except knitted or crocheted products	380.356	365.488	365.176	353.623	337.526
61	Clothing and accessories for clothing, knitted or crocheted	96.669	94.178	94.844	95.470	92.300
63	Other ready-made textile products, sets, worn-out clothes and worn-out textile products, towels	23.131	21.926	23.787	25.675	28.100
64	Footwear, household and similar products, parts of those products	57.926	51.366	57.479	49.009	38.683
52	Cotton	13.209	14.301	11.279	10.944	12.938
56	Cotton wool, felt and non-woven materials, special yarns, twine, ropes, orthoses and, cables and products for them	4.954	6.284	3.780	4.610	6.275
54	Artificial or synthetic filaments; strips and similar artificial or synthetic textile materials	4.025	4.048	4.203	4.396	4.854
55	Artificial or synthetic fibers, cut	5.336	4.324	9.002	12.109	4.370
41	Raw coarse and fine-grained leather with or without hair (except fur) and tanned leather	5.041	4.679	6.307	5.284	3.913
60	Knitted or crocheted materials	4.423	6.020	5.291	4.849	3.854
58	Special fabrics; tufted fabrics; lace; tapestries; embroidery	1.183	1.959	2.730	3.187	3.475
42	Leather products, saddlery and crayfish products, travel items, handbags and similar containers, animal intestinal products	1.889	1.355	2.186	1.903	2.195
51	Wool, fine or coarse animal fiber, yarn and horse fiber	3.160	3.462	2.167	2.523	1.001
43	Natural and artificial fur, fur products,	2.655	2.218	2.913	3.871	871
59	Textile fabrics, coated, coated or laminated; textile products suitable for technical purposes	540	431	513	710	694
57	Carpets and other floor coverings	771	1.139	367	234	251
53	Other plant textile fibers; paper yarn and paper yarn fabrics	66	16	20	26	35
50	Silk	75	106	74	17	20

Source: State Statistical Office (MAKSTAT database)

III.4.1. Summary data from the conducted survey in the cross-border region - Republic of North Macedonia

An identical survey was conducted in the cross-border region of the Republic of North Macedonia. The survey aims to collect and systematize information on the need for modernization, mechanization and introduction of innovative technologies in garment companies.

The answers to some of the questions in the survey exceed the total number of respondents, as they gave more than one answer.

III.4.1.1 Type of manufactured products - characteristics of the company

The main production of the surveyed companies is men's, women's and work outerwear (the last- produced by a small number of companies). Sewing products (SP) are made of both woven textile materials and knitted textile materials.



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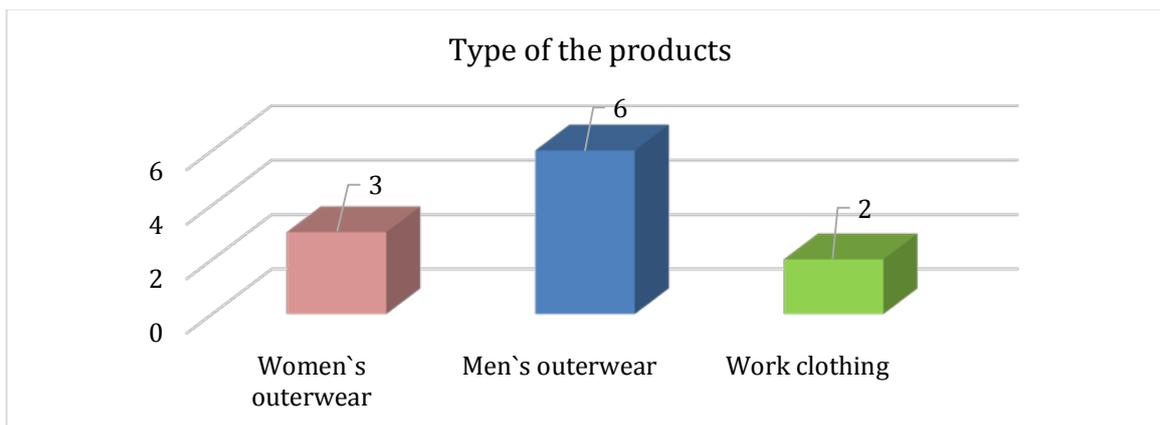


Figure 16. Type of manufactured products, number of surveyed enterprises

Regarding the size of the surveyed companies in the cross-border area, most of them are in the category of "small and medium", which have an average number of employees less than 250 people, and one of them can be classified as "large enterprise", with 250 people average number of employees, figure 17.

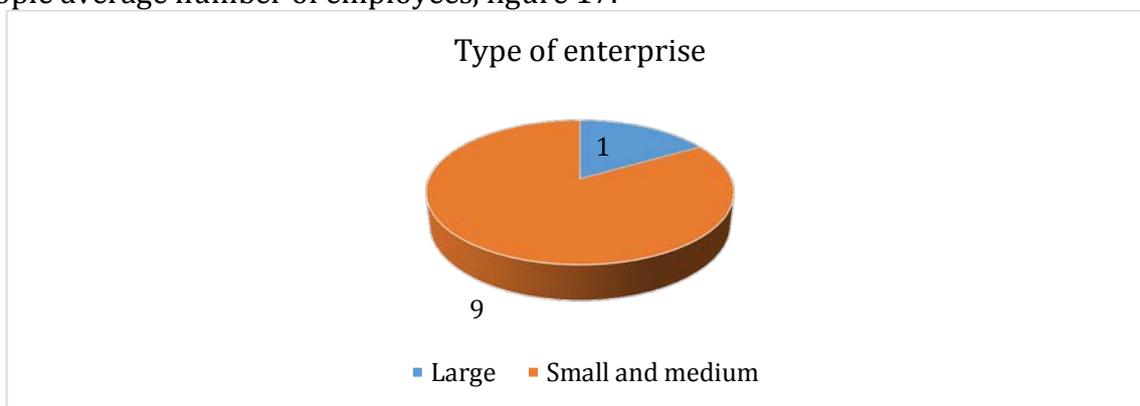


Figure 17. Type of enterprise, by number of respondents

III.4.1.2. Frequency of order submission

Most of the companies work with regular customers and have a rhythmic submission of orders (Figure 18). It is possible to develop the planned technologies by models for at least 3-4 months in advance, in order to ensure production in case of need for rapid readjustment and introduction of a new model.

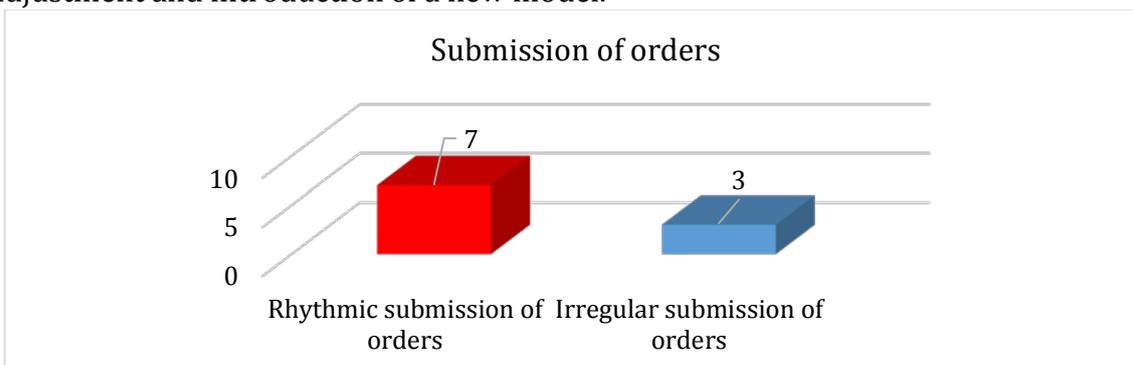


Figure 18. Frequency of submission of orders by customers, number of respondents



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III.4.1.3. Manner of communication with clients / assignors

To this question - way of communication with clients / assignors, the most common answer is via e-mail and telephone. Respondents did not state that they have other direct communication systems available. This is another important factor influencing the efficiency of communication, systematization of data for production and in general for the organization of production (Figure 19).

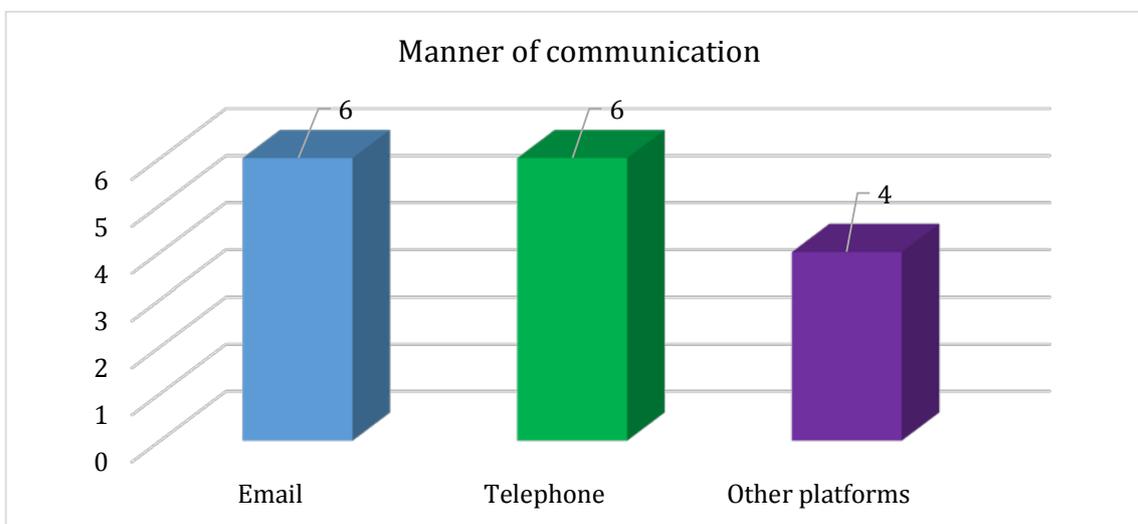


Figure 19. Manner of communication with clients, number of respondents

III.4.1.4. Distribution of managers by customers or orders

There are rules for communication with customers. Customer managers are provided, but the information on the activities is also consulted with a technologist and a company manager. The distribution by customers or orders allows for tracking and accurate execution of orders, Figure 20.

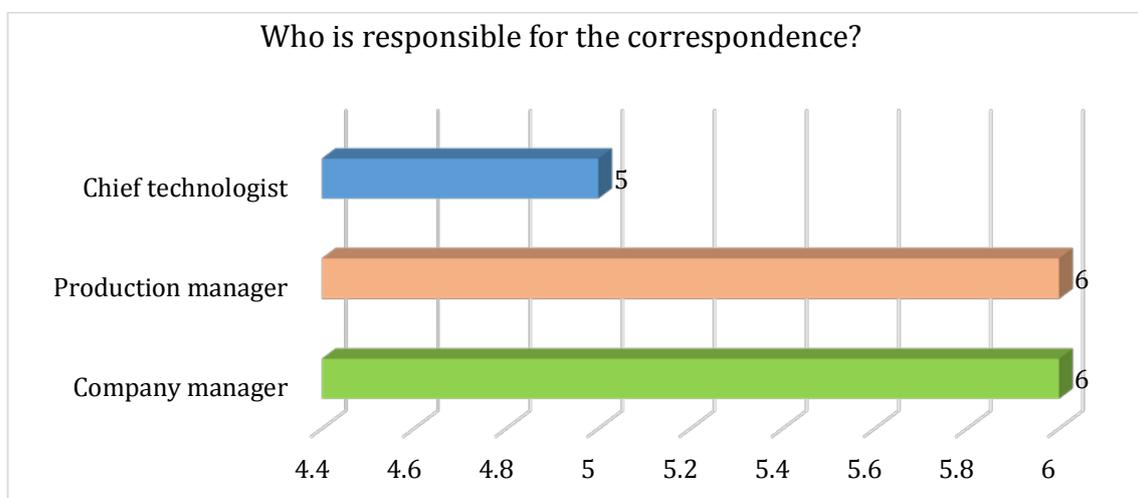


Figure 20. Distribution of responsible persons by clients or orders



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III.4.1.5. Awareness of the benefits of implementing MIS

Respondents are interested in the implementation of modern production management information systems, ERP system or other electronic applications, integrated computer products. Here the awareness regarding the issue stands out, but also the need for additional information (fig. 21). Lack of finances and the irregular presence of human resources are the main obstacles to the implementation of such systems.

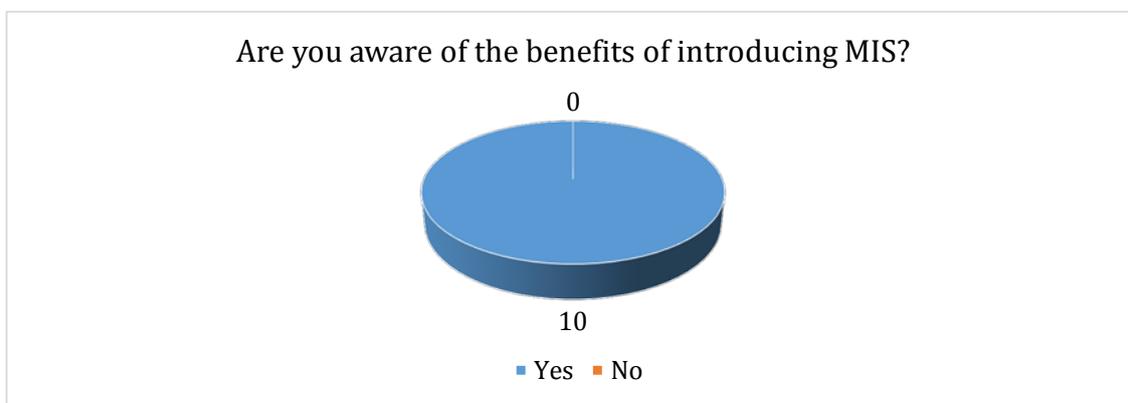


Figure 21. Awareness of the benefits of the introduction of MIS, number of surveyed companies

For medium and large companies, the availability of appropriate technical equipment and its condition is important. The competencies of the personnel for handling the available and implemented innovations are essential for the efficiency of the production and the quality of the produced SP. This determines the competitiveness of the company and its prospects to maintain and develop the market.

The direction is to purchase new, modern high-performance equipment, with opportunities to improve working conditions by taking into account the specifics of the activities. To the question of developing and implementing innovations and improvements, all respondents gave positive answers. But there is still a need to update equipment, planning and management systems and others. In terms of database maintenance, companies have developed ways of providing information, which include stored and classified information about processes, operations, models, logistics, etc., as reproducibility, reliability and its application is for their own use.

III.4.1.6. Planning the introduction of an electronic production management system

Companies are aware of the benefits of introducing MIS. The benefits of using ERP systems are clearly acknowledged, the advantages of operation and communication in such systems are known, but for the respondents their high cost and lack of human resources are significant obstacles to the introduction of special software, figure 22.

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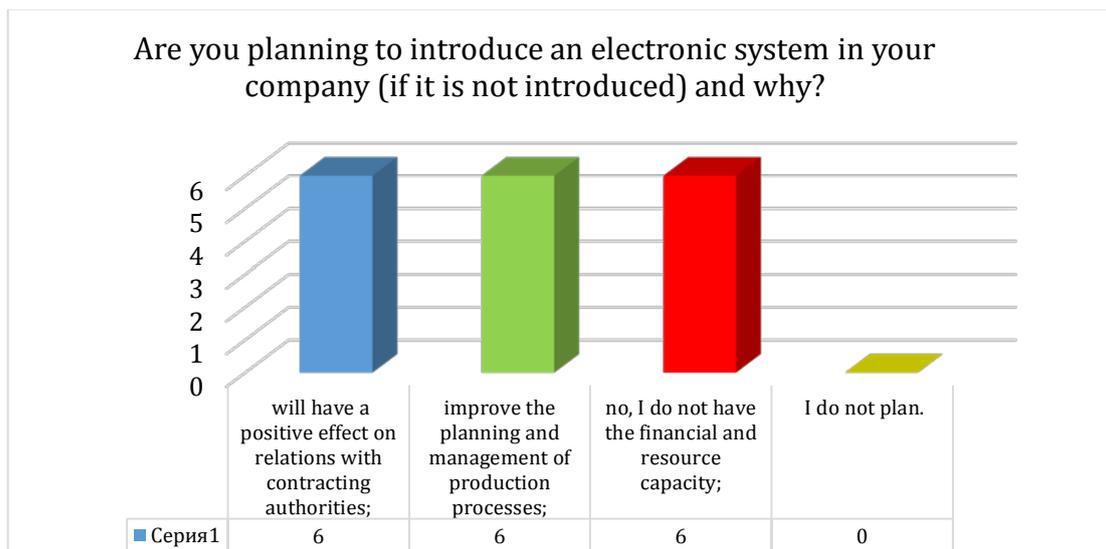


Figure 22. Planning the introduction of an electronic production management system

III.4.1.7. Developed and implemented innovations and improvements in order to increase production efficiency

All respondents stated that they use special technical devices available on the market, as well as that they have developed a small number of their own.

A clear position has been expressed regarding the introduction of energy efficiency measures in a large percentage (90%) of companies. This requires significant financial resources, which companies do not have. For the implementation of energy efficiency measures, external full or partial financing under operational programs is appropriate.

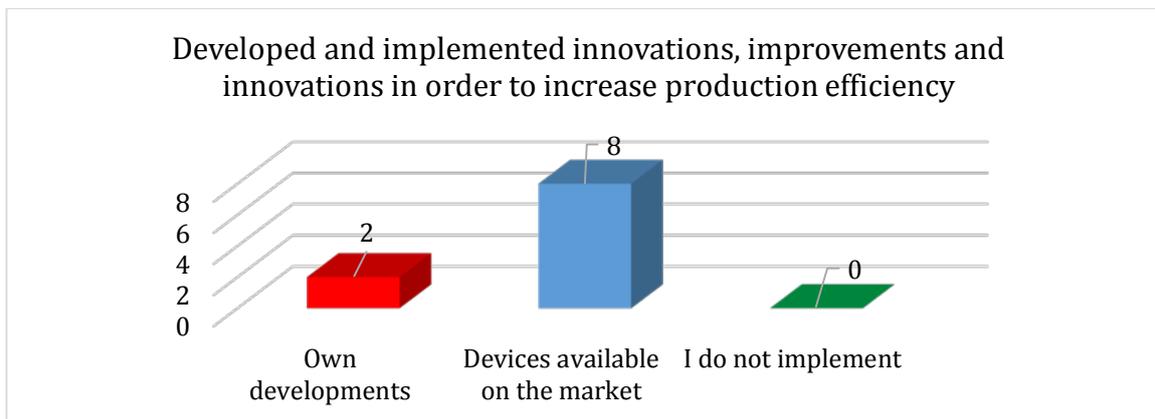


Figure 23. Development and introduction of innovations and improvements, surveyed companies

The same is true for the renewal and modernization of resources - the introduction of automated sewing machines in order to facilitate and reduce human labor and at the same time increase production efficiency.

Gaps in the continuity of work due to frequent and long absences due to illness have been reported. A problem also reported in the companies in Bulgaria. A solution to the



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problem of absentees is training and retraining of workers, which is easier and more effective if workers are trained in automated equipment.

On the issue of compliance with labor discipline- accurate working of the set hours during working hours, companies do not report deviations.

III.5. Analysis of the conclusions

The analysis conducted in the framework of the present study shows some important trends and facts that are valid for the whole sector:

- The relatively high share of work in the various forms of CMT and with a design determined by the customer, reduces the added value formed in the sector and exposes manufacturers to competition exclusively in terms of price. This creates great risks for the stable development of the industry and makes it dependent mainly on the relatively low cost of labor at the moment;
- The main problems of the companies are in the field of insufficiently efficient use of resources, insufficient human resources, which complicates the production, the qualification of the personnel from each level - executive, middle and senior management; the organization of production and communication with the partners in the supply chain;
- Local modern technological solutions for production planning and management are introduced, but the implementation of ERP systems for access and communication in real time is not started due to insufficient financial and human resources;
- Increasing productivity is an essential part of the strategy for future development of companies - awareness of problems related to human resources, organization of production, technologies used and available machinery;

Based on the above, the main objectives that can be set for adapting the T&C sector to changing conditions are the following:

1. Implementation of modern technological solutions in the CMT or ready-made production (if there is), providing flexibility in the planning of the production process and the actual production, which are in accordance with the specific needs of the production;
2. Use of modern methods to increase the efficiency of production in all units, including monitoring and quality control at each stage of production;
3. Creation of company policies for personnel management according to the specifics of the production process and the professional qualities of the employees:
 - qualification: the training of the workers in the sewing enterprises should be subordinated to the formation of skills for faster adjustment to the new models, handling and reading of technical devices, innovations and documentation, as well as work with modern technological means for achieving labor flexibility. ;
 - labor discipline: observance of working hours, technological requirements, ethics and culture at the workplace;
 - stimulation: adequate pay, objective assessment of the work done and achieved quality of work; when acquiring skills for various production activities; to participate in improving the production process.

III.6. Introduced good practices in local sewing companies-Republic of Bulgaria

Two companies were selected, representatives of Kyustendil district and Blagoevgrad district. The garments are of high quality, of different types. This makes it possible to cover a wide range of technological factors, processes and methods of work.



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III.6.1. Study for implementation of a system for production planning and control in a sewing company - Kyustendil, Kyustendil district

An elite sewing company located in Kyustendil, which produces products from woven textiles, women's and men's garment products (trousers and skirts), has developed and implemented its own software for production planning and control. For data registering it is possible to use modern technical devices - computers and multimedia devices / tablets.. They are connected to a single database designed in the form of documents for exchange and storage of information.

The system is designed and implemented by a specialists, working in the company and consultants. Good knowledge of each aspect of production activities and a prerequisite for creating a properly functioning management strategy.

For the starting point of introduction of modern technologies, the company has chosen the warehouse for acceptance and qualification of the incoming materials. The information about the delivered materials for each order is systematized through specially developed documents. They are marked and arranged, and their order is in accordance with the models planned in the production program. This data is specified for the "Cutting" section, in the computer network environment, and its available through a link between the documents.

For planning and control of production lines, the company uses developed special software. Through a created library with data for each technological operation and each workplace, managers and/or technologists create the planned technological sequences for the production of products. At any time, a new, non-existent technological operation in the database can be added and saved for future use.

The data for execution of the standart allowed minute (SAM), by operators and by sections, enters the system by reporting the achieved results by workplaces. For this purpose, technical devices also can be used - tablets, with integrated software and connection to the computer and Internet network. This information can be processed periodically, on a two-hour schedule, and when using tablets - in real time and allows to monitor the workload of operators, production processes. Using this kind of integrated system is suitable for timely and rapid response by managers in various problematic situations. Visualization of the results of the daily schedule can be done using a screen or monitor. The collected information, summarized and analyzed by means of specially developed graphs (processed documents from Microsoft Excel) for real-time data presentation, provides minute-by-minute visual control and awareness of the activities performed in the section. Due to time-consuming implementation, this system is tested and is still in progress.

The company has designed and launched the introduction of LEAN manufacturing tools. A detailed analysis of the existing condition was made, taking into account the technology used, the available equipment, human resources, the possibilities for integrating auxiliary equipment according to the parameters of the floor plan. The study aims to take into account all the possibilities of the current situation and on this basis to design the introduction of LEAN methods.

The information gathered is provided to consultants for innovation proposals. Reaching a final solution and implementing the appropriate innovations is carried out



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jointly with the company's specialists - technologists, managers, and after approval by management.

The organization of the production has been refined and various types and functions of improvements have been implemented.

Transport in production is essential. Depending on the type of sewing products produced, transport trucks (bundle trucks) with bundles are used in the production, which are sequentially numbered, and the color marking of the numbers allows for visual control. To some extent, these bundle trucks can be equipped with different racks, depending on the type of product manufactured.



Figure 24. Methods for visual control

Regarding the transport in the company, the following solutions are implemented:

- for receiving and moving the materials - basic and auxiliary, trolleys have been implemented, which are labor save and at the same time have parameters suitable for transport and storage of the materials on them. (fig. 25).

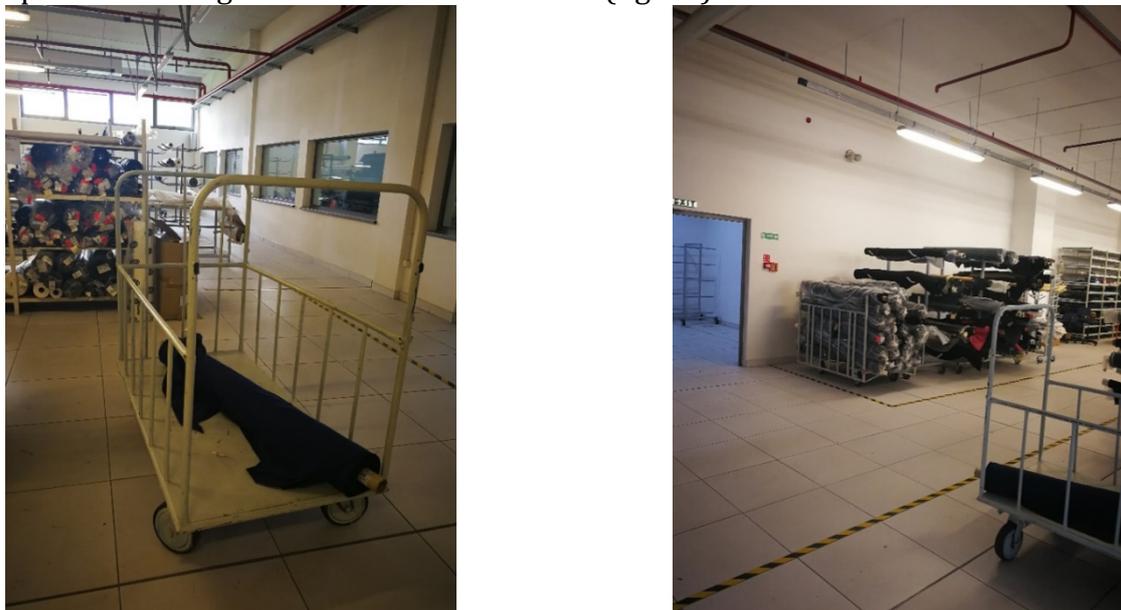


Figure 25. Special trolley for transport of incoming materials

For precise arrangement and distribution of the cut details, transport trolleys/shelves are used with the possibility of placing additional boards, boxes and others. This

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ensures the flow continuity in pre-production activities, minimizing the risk of error in the order and type of parts- figures 26 and 27.



Figure 26. Transport trolleys/shelves for cutted details



Figure 27. Complete small details

In the production of trousers, bundle trucks with clips for the pieces are most often used (production on a waterfall principle), and after the closing of the side seam - a movable hanging system for transport in the production. Figures 28 and 29 show the solutions put into operation.



Figure 28. Bundle trucks with clips for the pieces



Figure. 29 Movable hanging system

All transport equipment are specified by activities, technological units and ensuring a smooth transition between workplaces and premises.



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The principles of workplace organization are:

- The materials, aids and control area should be located so that they fall within the normal work area and are in front of the worker;
- There are parts transporting additional shelves. The direction of transmission must be determined in such a way that the worker does not have to lift the materials or change their direction (figure 30).
 - Tools and materials should be arranged in such a way that the worker can use them in accordance with the optimal sequence of body movements. If possible, the details for the next work process should be located close to where the finished parts from the previous one are left (figure 31).



Figure 30. Transporting shelves



Figure 31. Arranged tools and materials



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The requirements for the adopting of specific technological operations, as well as the need to solve specific tasks, has led to decisions to integrate methods of work and modern equipment in the workplace.

Regarding the organization of line loading plan-technological equipment in the workplace, additional improvements have been designed and implemented.

Step in the introduction of modern technologies in the company are the optimally designed workplaces (eg by increasing or decreasing the worktops, additional worktops, additional devices, etc.), arranged in terms of usability for more purposes to provide a high variety of models in production- figures 32 and 33.



Figure 32. Labor saving additional shelves



Figure 33. Optimally designed workplaces



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- The lighting should be appropriate - in terms of direction and intensity;
- The height of the work table and the chair should be such that both elbows are above the table and the worker feels comfortable - sitting or standing;
- The chairs should be adjusted individually for each worker so that he can sit in the correct position;
- The colors inside the workroom should calm the workers and reduce their fatigue;
- The temperature and humidity must be within appropriate limits.

The effective methods introduced are shown in the following figures 34, 35, 36, 37, 38 and 39.



Figure 34. Optimal solution for workplace-ironing



Figure 35. Optimal solution for workplace-sewing



Figure 36. Optimal solution for workplace-belt assembling



Figure 37. Optimal solution for workplace-special operations



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Figure 38. Optimal solution for workplace-button sewing

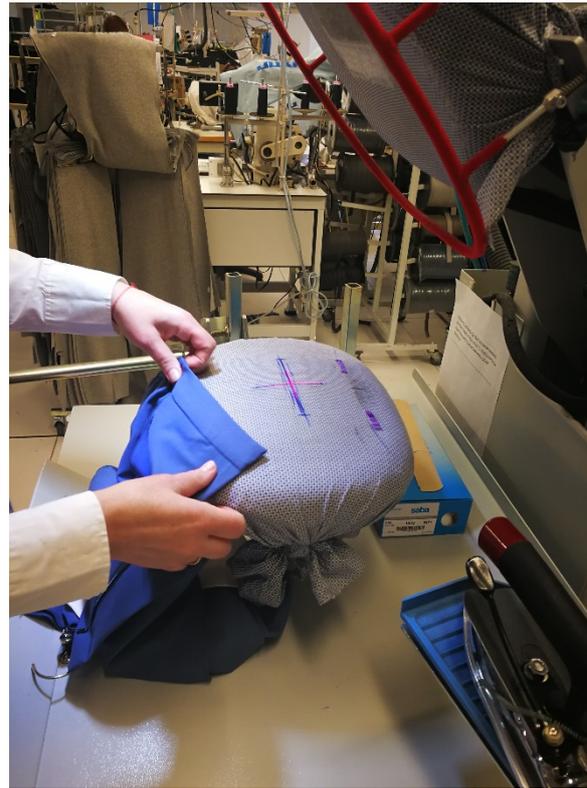


Figure 39. Optimal solution for workplace-bucks for pressing and ironing

III.6.2. Modern methods and solutions to increase the efficiency of production - sewing company, Sandanski, Blagoevgrad district

Sewing company, which produces high-quality sewing products from fabrics and knitted textiles, located in the town of Sandanski, has also developed software for production planning and control. This software helps technologists and managers to monitor the production process in real time and to make timely and accurate corrective decisions if necessary.

Another step in the introduction of modern technologies in the company is the development of own solutions to increase production efficiency. Together, technicians and technologists have designed and created a table for reviewing and measuring input materials. The facility is made of materials offered and available on the market. Despite the offered ready-made similar equipment, from the answers of technicians and technologists it is clear that the own development is significantly cheaper and adapted to the specifics of the materials with which the company works. The inspection and reporting of defects in the obtained textile materials in the pre-production stage is essential. This is a critical point in any production. By marking the defective sections, the involuntary cutting of defective parts is prevented, figure 40.



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Figure 40. Table for reviewing and measuring input materials

Another modern innovation of the company are a tables for review and complete of cut details, figure 41.



Figure 41. Tables for review and complete of cut details

On these tables the division of details into bundles (batches) is made and at the same time the low-quality details are removed. This avoids placing defective parts in the production line, which significantly reduces the risk of low-quality sewing products. This increases production efficiency and reduces costs.

Another solution to increase production efficiency is the implementation of visual management. The marking of the trolleys with production makes it possible to track the movement of the details, technological units, semi-finished or finished products from the order, and this can be done from a distance, Figure 42.



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Figure 42. Visual management

Positioning of the workplaces for inspection and packaging of the finished products, is considered that their direction should be towards the exit for transportation of the finished products. This facilitates the transfer, reduces the time and workers needed to transport the boxes, figure 43.

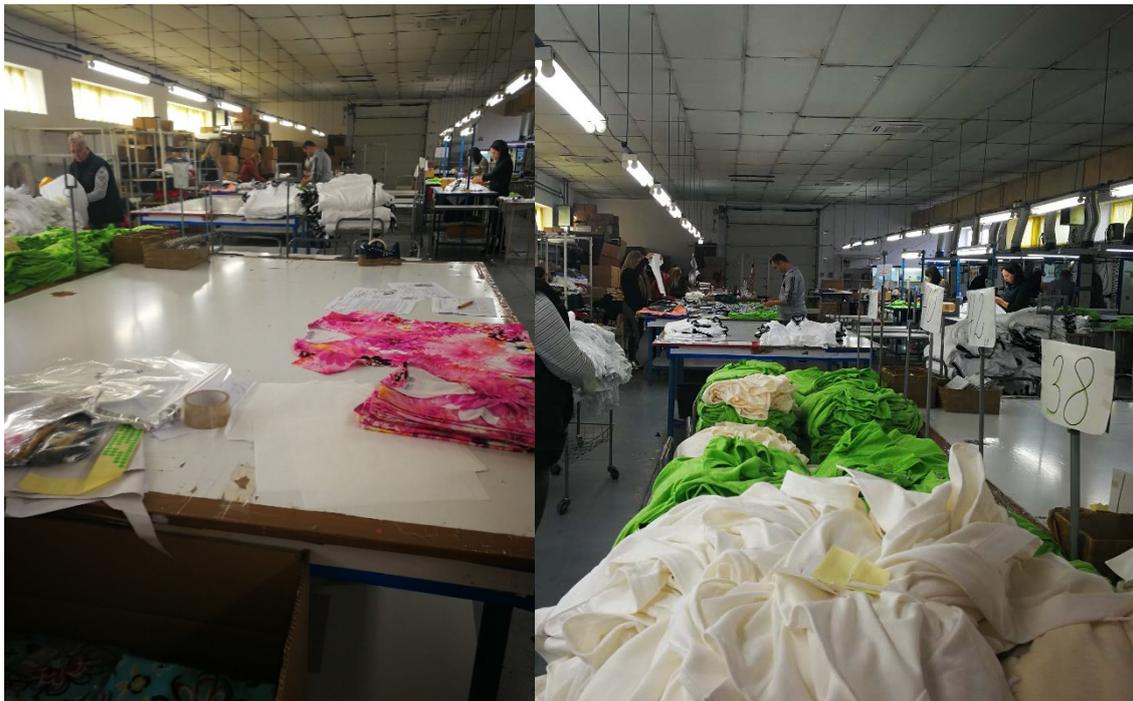


Figure 43. Positioning of the workplaces for inspection and packaging



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All presented examples are projects of companies, developed and implemented after studies, research and observations related to increasing the efficiency of production processes. Ergonomics and modernization are a key aspect in their introduction.

The way for future modernization of the companies is to analyze all activities in the sewing company, to develop and implement new solutions.

In this regard, it is necessary to specify and indicate all activities in the sewing company in order to make a precise selection and implementation of innovations. The use of external consultants - specialists in the field of industrial engineering, is important for the improvement of working conditions and mechanization in production enterprises, as successful results are achieved through teamwork.

In order to achieve the presented modernization solutions and developed innovations, part of the necessary financing of the companies is with own funds, but main is realized through:

1. participation in European projects, operational programs with a specific focus - financial support to producers in order to modernize production through the purchase of modern equipment and introduction of new technologies. These are the main sources of funds for companies in the region.

2. Interaction and joint work with the main sales representatives-importers of equipment for the sewing enterprises. It is important to note that in addition to manufacturers, commercial companies are members of the association. This is a prerequisite for the exchange of information and good practices, and the supply of equipment is on preferential terms for manufacturers.

3. Financing option are bank loans, which are subject to individual negotiation between the company and the banking institution.

IV. PROGRAM FOR MODERNIZATION OF THE TEXTILE INDUSTRY IN THE CROSS-BORDER REGION

Currently in the garment industry, the most important processes are the organization of production and optimization of the production cycle. This is expressed in the proper planning and forecasting of production processes and a change to improve the factors on which they depend.

IV.1. Principles for development and implementation of a system for planning, management and control of processes in the company

One of the essential directions in modern enterprises is the creation of an organization for achievement the production activity. This could be achieved by developing and implementing a system for planning, managing and controlling the processes in the company, covering the supply chain of materials, the production cycle of SP, financial and warehousing operations, human resources, logistics activities or overall comprehensive monitoring and production control.

For this aim, it is necessary to take steps to create documents containing all the information about the production cycle of a sewing product.

It is appropriate to develop (or purchase) and implement a software product for planning and organizing the production of garments.



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The development is preceded by a comprehensive study and acquaintance with the relationships in the production processes. This facilitates the refinement, structuring and redirection of information, which in turn is a prerequisite for reducing communication time. The correct selection of the input information, the design and implementation of templates for systematization of the data from the output information **is of key importance**.

In the production of SP on CMT, this information is generally grouped as follows:

- A. bidding and negotiation-
 - 1) contacts with new customers, search for new orders and negotiation;
 - 2) resource analysis;
 - 3) production of samples for the client (the assignor);
 - 4) pricing - determining the price for 1 piece of the product from regular production
- 5) sending information about the sample (virtual and physical, by post) - receiving a comment;
- 6) coordination of the conditions, terms and negotiation.
- B. Planning, supply and marketing of finished products-
 - 1) planning - seasonal, monthly, weekly, daily;
 - 2) resource provision of the order (if necessary) with materials;
 - 3) report and analysis of the implementation of the plan for the month, re-planning;
 - 4) organizing the deliveries and drawing up the necessary documents.
- C. Preparation of production
 - a) constructive
 - 1) preparation and/or correction of patterns (if necessary);
 - 2) production of a sample or fitting series;
 - 3) summarizing and declaring the necessary materials
 - 4) receipt and acceptance of the materials;
 - 5) planning of the markers for the layers order;
 - 6) preparation of plan for material spreading;
 - 7) preparation of documents for the markers.
 - b) Technological support of production-
 - 1) obtaining the technical and technological documentation for the model;
 - 2) production of a pre-production sample/samples (PPS);
 - 3) development of technological sequence and standard times for the model;
 - 4) determination of the necessary equipment;
 - 5) floor plan design;
 - 6) compilation of documents for the bundles;
 - 7) implementation of new operations.
- D. Production control-
 - 1) organization of the production process;
 - 2) redirection of equipment;
 - 3) report on fulfillment of the terms on orders;
 - 4) report and analysis of the implementation of the labor norms - daily reporting of the work;
 - 5) control of the reporting of the hourly schedule and filling in the board "SCHEDULE" by brigades;
 - 6) control of labor costs caused by non-compliance with labor standards;



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7) control of the usability of the materials and the formed savings.

8) Current applications -

8.1. for auxiliary materials, such as needles, chinks, etc. ;

8.2. for repair of equipment used in production, such as sewing machines, equipment for ironing, etc. ;

8.3. for maintenance of installations and buildings;

8.4. for other expenses, such as medical, stationery, etc.

E. Human resource management

1) receiving applications for new workers;

2) training and retraining of workers;

3) monitoring of absences due to leave for illness;

4) control of labor discipline - incentives and sanctions. But it is necessary to specify its capabilities for:

- registration of data specific to the given production;

- data exchange;

- real-time corrections - change, addition, access.

The developed and implemented technological documents for the planning and preparation of the production are according to approved standards [EuStandarts, Government National standart classification etc.] and adapted to the specific production, according to a certain methodology and/or requirements.

When creating such documentation, it is important to include and provide information on:

- Document flow schemes;

- Samples of these documents;

- Instructions for completion, management and use;

- Terminology requirements;

- Methods for data protection in documents;

Another requirement for the normative, technical and technological documentation is its unification, both of separate forms and copies, as well as of its entire structure. In the conditions of fast-changing models, small series of products and short product life cycle, the issue of unification is very relevant.

The unification of the system contributes to:

- reduction of manual labor in the information processes (as a result, minimal efforts are required for preparation and review of documents);

- the unified forms of the documents are suitable for electronic processing (this is achieved through integrated software, with technical and information compatibility of the documents, or by developing appropriate forms of documents, classifiers, dictionaries, etc.);

- rationalization of information flows;

- reducing the number of documents, further improving the use of the document and, in general, the information environment.

IV.1.2. Measures for improvement of operational and managerial practices for equipment fully properly exploited

A methodology for improvement of operational and managerial practices is proposed. It is designed as a matrix model of a system for planning, management, and control of processes in the company.



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The model is designed in the form of a matrix sheets/files, in a computer integrated program, allowing the application of information of the desired type. The information elements are arranged as follows:

- a) describe;
- b) illustrate - where necessary;
- c) summarize;
- d) calculate by setting formulas in Excel spreadsheets;
- e) provide information on the stages of the process;
- f) a link / references to necessary supplementary files or data are provided.

The data are selected and arranged in the matrix document, divided by:

a) model; b) relations; c) groups of elements; d) other data (relating to each step of the processes).

In order to develop a program for the modernization and mechanization of the sewing companies, it is necessary to specify all the activities performed on the production of SP on CMT. This will determine the necessary resources to shape and complement the production processes. Therefore, it is appropriate to arrange in groups, stages, etc.

The data must be real in order to be applicable to all documents through a link and data projection in Excel development. Thus, in real-time, all related documents and information are updated.

An example, applicable to any sewing company, producing of SP on CMT, may contain the following modules:

1. Grouping of activities for preparation of a client sample (CS) for production;
2. Grouping of activities for preparation of PPS for production
3. Grouping of activities for preparation of the production of an order from the model;
4. Grouping of production planning activities- terms control;
5. Grouping of production management activities-cost control;
6. Grouping of production quality control activities.

It is necessary to include in the groups thus proposed all activities belonging to them, which should cover the entire production cycle per unit of SP.

According to the study and the established predominant production of SP on CMT in the cross-border region of the Republic of Bulgaria - the Republic of North Macedonia, the proposed option is developed and applicable to this type of production.

The following activities are defined for **group 1**:

- Receipt of documents and materials for CS - the contracting authority sends samples with all materials for the production of the first SP, as well as material trim cards.
- Complete set of documents with requirements for the CS. For the implementation of the activities - obtaining documentation for CS, the Internet is used for connection with the clients/assignors. This ensures accurate and timely communication and reliability of the received data. The sending of the materials for the production of the product is delivered through courier companies.



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- All necessary technical and technological documentation must be accompanied by a translation of technical terms, specifics of the model, as well as a list of patterns;
- Quality control of materials – testing and examination of materials (sampling for shrinkage during ironing, washing, dry cleaning, finishing and refining, stamping). The test conditions for all tested materials shall be noted. It is recommended that the testing activities of the materials be performed by a group of specialists in the enterprise. The machines and equipment available and implemented in the production are used for conducting the tests. Depending on the required activities, external services are used for some of them (or entirely).
- Reflection of the parameters for adjustment of the machines and equipment for ironing of the materials (in this case fusing equipment/ presses).
- The data are compared with the requirements for the final appearance and properties of the product, given by the contracting authority, as well as with specific samples [BNS , clients quality standarts].
- It is recommended to check the patterns, templates, technical requirements, and data table of the product, as well as check the technical and technological requirements for SP. All important data for the details of the product, the necessary basic and additional equipment and devices for regular production, information for checking the measurement data according to various requirements specified by the customer, data on the quality of workmanship, as well as standards [BNS , clients quality standarts].
- Development of the sample SP product - activity performed by a chief technologist or another specialist in the enterprise, responsible for the activity per client.
- Qualification – for the purpose is to check all activities from cutting, preparation of small details and units, sewing and finishing operations, as well as the general appearance of the product, consumption of basic and auxiliary materials. At this stage, a planned technology is developed, thus forming and calculating the total cost of a one regular product. All these data are taken from the activities based on the development of CS.

The following activities:

- sending CS to the client through the use of courier services;
- receiving a comment from the client, correction of the CS, if necessary, making a new one and sending it again;
- receiving a comment from the client, and the last activity at this stage-
- negotiating quantities and terms for production.

In the last 3 years the presentation of the made samples through a video connection, sending of photo material, and commenting in real-time has become widespread. The Internet and data exchange applications are used for this type of communication.

Grouping of activities for the preparation of PPS for production - **group 2**. The activities here are similar to the activities described in the first group. But:

- in group 2 a document developed and applied in othersewing companies for information support of the activity “Quality requirements to the operation” can be used. These maps illustrate the operations and activities of each workplace to ensure their quality implementation. This is a type of visual management, which is also recommended by the LEAN production system.

- Production of PPS (or fitting samples) - the SP itself (or a series of products) is made, and during the work the technologist designs an approximate technological sequence and checks for corrections and differences between "Client Sample" and PPS.



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- Sending a PPS to the client - the activity is carried out and it is possible to make a preliminary audio or video connection to specify details about the PPS.
- Receiving a comment from the client about PPS. This comment is sent by the customer, and the person in charge of the customer or order informs about changes or necessary corrections. The decision to act is taken jointly by managers, customers and managers - middle management of the company.
- A technological sequence for the production (TSP) of the model is prepared, based on planned one (in group 1). The technological sequence is designed during the development of CS and PPS, and the data are registered in a file.
- The next step of planning (and the TSP) is the preparation of the line loading plan on the basis of SAM - for unit of product and available number of workers, the daily workers of the brigade - the daily schedule. The volume of work to be performed among the available workers at the workplaces is distributed so that they are loaded according to their capabilities. There are developed methodologies for calculating the necessary final parameters of the technological process. The formulas are set in the matrix model of tables in Excel.
- To achieve an easier and faster division of operations by working places/workers, the next step is to design a workplace planning document. It provides information on jobs for existing, new or change of old operations and is especially applicable when necessary for the establishment of an alternative place for transfer of work in a diversion, absence of staff and others. A sketch, drawing or photo illustrative material for the operation in the place indicated for the purpose is also presented. The main equipment, Sewing Machine Devices (SMD) and the auxiliary equipment at the workplace are also described- work place engineering.

As this document is in itself a type of monitored and registered activity, it must accurately and clearly describe how to perform a specific operation. It is designed for the workplace and takes into account the specifics of operations or activities. The developed method achieves: correct presentation of the quality requirements of the performed operation and reduction of the time for its execution- work method.

In order to achieve accuracy and speed in performing an operation, the worker must be well trained. But regardless of his abilities and skills, a common problem is a distraction and involuntary mistakes at work. Therefore, the use of technical documentation for visual management makes it possible to control the standard performance of work, identify defects and reduce losses from products of lower quality and the need for repairs to already completed.

In tabular form, according to the specifics of the production, the following basic information about the developed model is presented, which includes:

- type of the product - (men's, women's, others), as in a separate section are described data about the model of the manufactured product - number, name, season, etc. ;
- information about the brigade or unit in which the given operation is performed;
- exact and clear name of the operation, class and type of the machine for the given activity, the SMD, the number of the operation is registered (according to the table for the technological sequence for the made sewing product);
- a description of the material to be processed, including a sample, the number of the workplaces/employee's name,
- as well as the measured time- SAM, required to perform the operation.



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In a special field is added a real photo of the operation taken during the production of PPS, or a drawing, both cases are described and indicated in detail: dimensions (length, width, bevel, etc.), start and end of the operation, tightening, stitch step. It is essential to note the ways of gripping, placing, and processing the elements. All this should clearly visualize the work techniques and the expected end result.

Group 3 summarizes and describes the activities for the preparation of the production of an order from the garment model.

Each step of the preparation of the production is in a certain order to ensure the continuity of the processes and to avoid mistakes in the selection and processing of materials.

- The first activity is the reporting of the received materials for the given model. The necessary information about the materials is submitted and all needed data such as length, width, pattern, material codes, possible differences or discrepancies between the parameters of the materials are registered. This information is essential because it is the basis for the subsequent activities of preparation and supply of production, minimizing the risk of error in the search for specific material. It is important to note that some textile materials require additional activities such as unfolding and leaving the fabrics in normal climatic conditions for at least 12 hours to ensure "relaxation" of the material, ie. to take into account the plastic deformation of textile materials.

- Planning the garment cut for the respective model. In the cases when working with a CAD / CAM system, the assignment is filled in approximately, and the documents from the marker planning program must be described sequentially and the compliance with the assignment must be monitored.

- Planning of markers and layouts/ layers of fabrics for the order. Here the number of clothes (gamrents/size distribution), peculiarities of the details are planned, specific characteristics of the model, the fabric, and the marker are taken into account. By means of formulas, set in the developed document, after filling in the performed activities, a balance is automatically reported according to the set parameters for material costs, used and remaining.

- Providing of a "Document for layers/ cutted details". Here it is important to reflect the information for planning the cost of the spreaded material, layers of fabrics itself, cutting, etc. Through the ability to set calculation formulas in Excel, timely information can be received about the average material consumption for 1 product, material consumption in meters, differences between received and used material in meters, irrational residues, and more. In the presence of a CAD/CAM system for designing the markers, these data are marked in special fields, and in the modules of the software itself, there is an automatic calculation of the material consumption. **This is a reduction in the time to systematize data.**

- With regard to the above and the cutting of the layers of fabrics - cutting with a straight knife cutting machine (for large details) and cutting with a band knife cutting machine (for small details), a document for recording times must be designed, applicable for manual cutting. The use of automated equipment for fabric spreading and cutting, in particular cutter, the time to perform these activities depends on the parameters of the machines.

In addition to the above, the implementation of computerized cutting machine-cutter reduces the need for large human resources engaged in this activity.



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The requirements for evaluation of the type of markers and the way of laying the materials depending on the type of the made model SP are set.

- The control of the cutting must be reflected in a document. Like previous documents, it must be designed for use in the manual performance of activities - marking and complete the cut details, parts and their preparation for production. When working and submitting information from a CAD/CAM system, it is an accompanying, automatically generated document.

- Under the activity "Control of the layers and markers" it is necessary to follow the made markers for the layers, of the layers themselves and to carry out a random check to establish deviations in the plan.

- Instructions for ways of spreading - a document in which the activities for spreading and laying the materials are visualized - stepped spreading. The output data needed for planning can be:
 - the number (№) of the planned assignment;
 - section passport of the materials and the model;
 - planned length marker of a section;
 - length marker with accumulation;
 - the number of planned number/sizes.

It is possible to visualize and calculate the number of plies from each spreaded material by graphically expressing the number and sequence of layers.

- For the activity "Control of the order cutting" the times necessary for the execution of each of the indicated operations or activities are described and peculiarities in their execution are marked. The ways and methods for determining these times have been studied in detail and systematized by a number of authors.

- Preparation of accompanying documents- "Distribution documents/sheets/labels" for the model, if the reporting of the accomplishment of implemented labor standards and SAM, is manual, on paper. When using visual management, the area of the document that the employee must attach to his daily sheet is marked in color. It is still the preferred way to control production, especially by operators. The low qualification of the people from the executive level makes it difficult the use of the possibilities of modern special technical devices (STD or tablets). **This situation can be improved after proper selection and appropriate training of staff aimed at learning how to handle such tools and software.**

- Activity - calculation of the line loading plan/flow for a brigade, or the implementation of the technological sequence for the section supervisors or manager, consists in relocating the workers to the workplaces. The location of workplaces depending on the technological requirements for a given model is called a floor plan. Relocation is necessary when a special machine or special working place (WP) is required for the new work of the operator. When the operation can be performed on the old WP, no transformations are required. But if the natural sequence of the technological operation requires a shift of jobs, it must be done in order to maintain movement in one direction of production. **This rearrangement is done once**, otherwise the unfinished production moves crosswise during the production of the entire order.



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Quality control (QC) is carried out in two stages: intermediate and final. In order to be able to react in time to quality problems, they need to be detected quickly and in a timely manner. This QC can be done in steps, for:

- incoming materials;
- control in cutting section;
- intermediate control- in sewing section, chosen samples;
- ready garments before ironing- 100%;
- before warehouse- 100%;
- ready, packed production- chosen samples.

One of most successful type of QC is intermediate control. It is performed by interoperative (intermediate) qualifiers, in sewing section.

The main task of the intermediate systematic control is to detect as many errors as possible in the sewing section, to inform the section supervisor or manager,) about the quality status, the most important mistakes, and the operators who made the most mistakes. both for the day and for the week, respectively. The information provided to the company's management must be periodic, timely, and readable, in digital way.

For this purpose, a document is needed in which to register quality control data. This document may be part of the "Quality Control System" used in an enterprise, developed on the basis of established requirements and standards [BNS, other standards], and must provide a quantitative assessment of the quality of products. The information about the quality condition is prepared by the qualifiers and is passed on to the respective managers - supervisors, managers, and chief production for making relevant decisions.

100% final quality control of the finished products is performed. When controlling the production ready for shipment, a sample control is made according to a system offered by the client.

- Activity "Controlling the measurement of the SAM for new operations". All measurements are performed in established ways and methods by a specialist, technologist or supervisor, reflecting changes in the organization of the workplace, employee qualifications, features of materials, and more. The most important is the calculation of the number of manufactured parts, the actual total lead time for the production of 1 piece, the time for the production of 1 batch, and the workload of the worker in percent. These measurements provide relatively accurate data on the measured time. This activity is carried out after the starting of regular production.

- The last activity is check the readiness to start production. The analysis of the activities is important for the information support of the production.

The systematic monitoring of the implementation of all activities provides an opportunity for quick and accurate decision-making for updates, corrections, and coordinations regarding production planning!

For **group 4** activities, it is appropriate to record and track data on:

- seasonal planning - after analyzing the data from the survey, it was found that most companies have the opportunity to plan their production for at least 3-4 months ahead. This is a significant resource of time, suitable for proper design and implementation of the planned production program.

- For systematic reporting and control of production processes, it is appropriate to introduce "Monthly work planning of brigade capacities".



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- Another important task is the pricing for the new models for the season.
- Monthly work plan/brigade efficiency report - plan for the produced SP (in quantity/number) for a month.
 - Weekly planning of sewing tasks - preliminary preparation of resources.
 - Annual plan of due leave for brigade workers.
 - Planning/retraining of workers competencies.

Group 5 activities include production management. They are separated in order:

- design of a document for attendance form for a month - to register the presence of employees at work, as this is done by the managers of units/supervisors.

• The information can be transmitted by projecting the data in a graphical form, allowing timely analysis and control.

- Next in line is the reporting of workers' earnings based on the quantity produced by the worker and accomplishment of the work activities. With the help of precise formulas set in the Excel format, all the necessary data for the production of SP for a worker, SAM, brigade, etc. can be calculated.

• Another activity subject to control and systematic registration is a report on the accomplishment of the labor standards (ALS) of workers - daily, weekly and monthly control of compliance with labor standards and losses from irregular work. At pre-specified by the managers intervals/hours of the day, information about the ALS for the day is applied for each of the workers. Based on the time present and the time worked, it is possible to track the implementation of the planned tasks for the day. **This method of control allows the easier formation of individual earnings, noting downtime and loss of time for other reasons.**

• For a more complete and correct analysis of the professional opportunities of workers, a monthly report of workers with a low percentage of ALS can be designed. It systematizes information about workers who showed lower results than planned, noting the reason for the incomplete ALS. Thus, these data can help to anticipate and plan jobs according to the capabilities of the worker, the options for retraining, or employment.

The information is analyzed by the Human Resources Management (HRM) department to develop a system for improving staff qualifications.

• Document-register of available equipment and production resources - machines and equipment

The basis of all activities of the company is the mandatory description of all available equipment and production resources. The registration is specified by machines, factory № of each machine or equipment, description of the machine - class (subclass), specific features, installed SMD, etc.; location - brigade, group. This is a suitable way to track information, the current arrangement of machines, and anticipate shifts in a new floor plan.

If the available machines and equipment are not sufficient, or it is impossible to fulfill an order due to their remote location, the managers of the enterprise are obliged to anticipate and formulate a request for obtaining the necessary equipment and devices for the production of a new model. This also applies to the necessary SMD, as well as to the purchase of the same.

Many companies do not have modern specialized machines, which in some cases complicates the implementation of the production program. A solution to the problem



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could be found as the available resources can be modified, adapted, or completed. This is possible for the company and does not requires big financial investments.

Examples of implementation are given in the proposed program for modernization and mechanization.

Activities - group 6: it is necessary to design documents with specific requirements and systematized quality control activities. Important elements of the statistics are:

- information on factory defects in materials concerning the customer and the supplier in the supply chain.
- Reflection of errors during operation. They give an information of how the contractor works, increase attention in terms of control and more precise execution of certain operations.

The constant monitoring and continuous improvement of the qualification of human resources is the main aspect of the activity of each company. In order to monitor and systematize the data on the achievements of the operators, it is necessary to systematically and accurately reflect the information correctly entered by the heads of sections.

The roles of production planning and control is presented in figure 44.

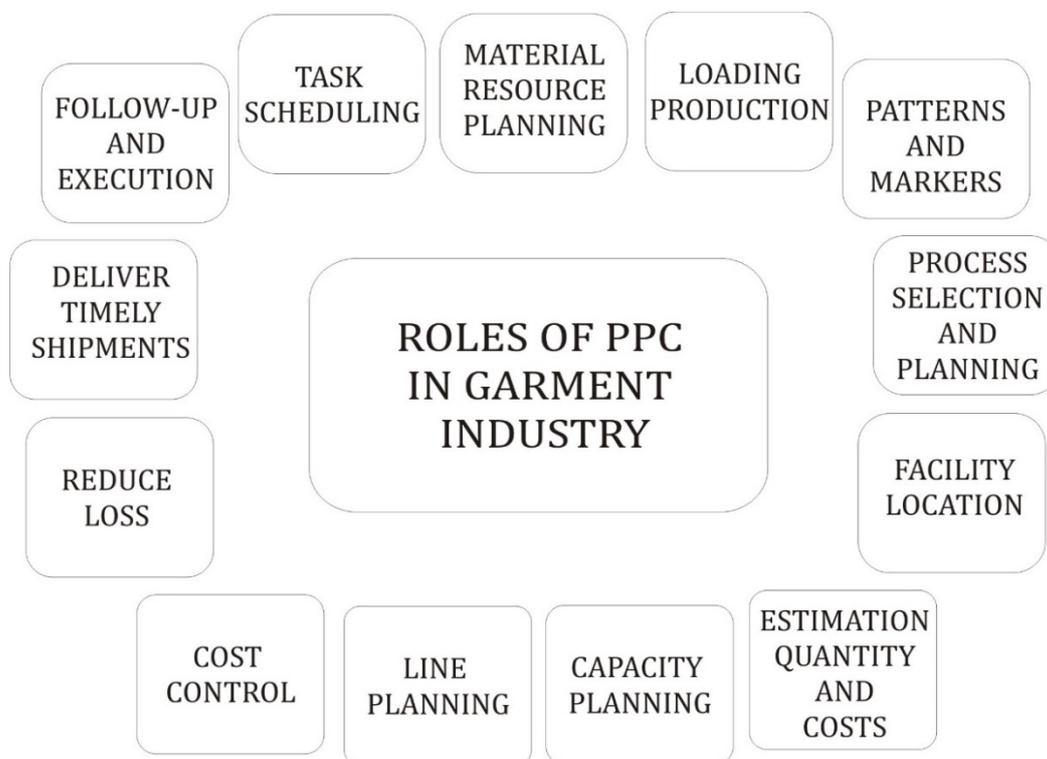


Figure 44. Scheme of production planning and control

The main steps for mechanization and modernization of T&C companies are presented in a synthesized form:



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1. Implementation of efficient production models in the sewing production, ensuring the quality and flexibility of the production process.

2. Introduction of appropriate LEAN tools.

3. Creation of company policies for personnel management according to the specifics of the production process and the professional qualities of the employees - policies for increasing the competencies of the personnel.

4. Improving working conditions in view of the high labor intensity in the garment industry - has a direct impact on productivity and will make the industry more attractive to free labor.

5. Increasing the level of labor productivity by introducing good practices in the organization of labor and policies for incentives and training of employees. The training of workers in sewing companies should be subordinated to the formation of skills for faster adjustment to new models, ie. achieving labor flexibility. The speed of adaptation to changes in the workplace is primarily a personal quality, but it can also be a subject of training, as some of the reactions can be standardized.

6. Improving the qualification and the role of middle management staff in the production process. Currently, there is a relatively low organization of processes in enterprises due to the lack of specialists in the organization to deal with these issues. It is expedient for the direct managers (supervisors, chiefs of lines or sections) to receive sufficient knowledge on the organization of the processes. They are closest to the jobs and staff and can quickly identify problems as well as solve them in a timely manner within their competencies.

7. To establish contact with branch organizations and clusters at regional and national levels in order to exchange information, training, good practices, and joint projects and participation in operational programs. Development of modern education and training centers for human capital development in the entire border region. Some of them can be:

- general projects for updating educational program;
- development of cases to be solved in educational institutions;
- organizing seminars and competitions with business participation;
- organization of competitions between students in different educational institutions as the results of the competition projects are announced at specially organized events with fashion shows and media presence.
- To implement measures to make the textile profession attractive.
- Gradual increase of the remuneration received in the branch.
- Motivation of employees with financial and non-financial measures.
- Organization of promotional events for young people to present the profession as attractive for their future careers.

8. In order to take measures for R&D activity, it is necessary to create an expert group, including industrial engineers, technologists and designers, for the design, creation and implementation of company innovations and improvements, according to the requirements for quality and reliability.

These proposals must be consistent with the type of production, the size of the company, and its views on future developments and market positions.



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IV.2. Program for modernization of textile industry in Cross-Border region.

IV. 2.1 Measures and activities for improvement of the technical capacity in the sector through introduction of effective methods and production systems in the sewing production

Based on the research conducted among the companies in the cross-border region and theoretical ones, it was found that the need for modernization and introduction of effective methods and innovations for SP production is of key importance.

There are many technological processes that have a direct impact on the production of clothing. Therefore, it is appropriate to offer improvement and implementation of innovative solutions in each section of the sewing company.

The production and technological cycle of garments depend on the organization of production, transport, the specifics of the product and the production technology. Therefore, the introduction of more advanced ways of working, as well as / or the automation of the processing process, inevitably lead to a reduction of this time.

The composition of the time for technological cycle – LEAD, depends largely on the specifics of the product and production technology. Therefore, the introduction of more advanced methods and ways of working, as well as / or the automation of the processing, inevitably lead to a reduction in production cycle.

PROGRAM FOR MODERNIZATION OF TEXTILE INDUSTRY IN CROSS-BORDER REGION		
INTRODUCTION OF EFFECTIVE METHODS IN GARMENTS PRODUCTION		
№ in order	Company section	Modernization activity and introduction of effective methods and production models in the sewing production
01.00	material warehouse	
01.01	External part / entrance of materials	Provide a convenient external platform for unloading materials. The movement of the materials should be done with a suitable vehicle – trolleys, fig. 45.



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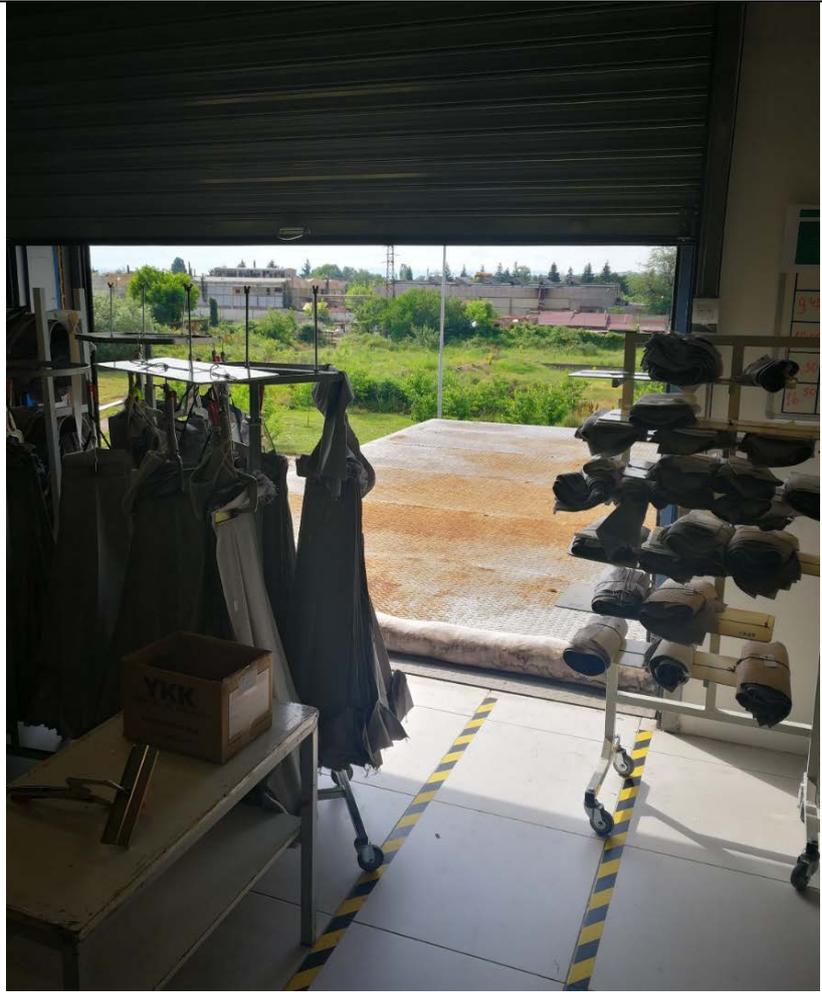


Figure 45. External platform for unloading materials

To place shelves, trolleys, etc. with the possibility of easy access and movement for storage purposes, fig. 46.



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		<p>Figure 46. Trolleys with the possibility of easy access and movement for storage purposes</p> <p>For this purpose, it is necessary for the company to establish places and to develop and implement and/or purchase facilities.</p>
01.02	Storage/arrangement of materials	<p>To put information marking of the materials for::</p> <ul style="list-style-type: none"> • client; • order; • parameters - purpose, width, length, batch, etc. <p>For this purpose to provide technical and technological documentation, developed according to the specifics of the company.</p> <p>Marking can be done with a barcode (if the company has a barcode printer and readers) or according to the classification established in the company, fig. 47.</p> <div data-bbox="742 824 1273 1395" data-label="Image"> </div> <p>Figure 47. Marking with a barcode</p> <p>The arrangement of the materials (main and auxiliary) should be done by priority, with provided access to each of them - on marked and accessible shelves, racks, and others, with visible markings.</p> <p>Provide facilities for placement and storage of textile residues. To create a “library” - a section for defective details, fig.48.</p>

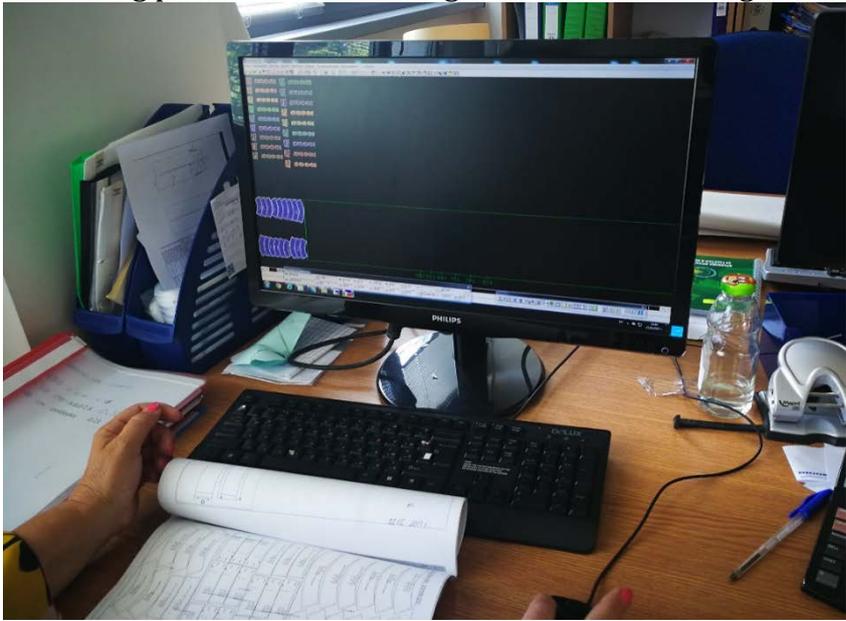


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		 <p>Figure 48. "Shelves- library" - a section for textile residues and defective pieces</p> <p>All necessary facilities must be designed depending on the capabilities of the company - floor plan, available area.</p>
02.00	Cutting section	
02.01	Movement and placing the materials for each of the orders	<p>The request of the materials by the section manager must be carried out by customer, by code, by order, with the relevant accompanying documentation - developed and implemented technical documentation supporting all necessary data for production processes.</p> <p>Move the materials from the warehouse to the cutting area with a suitable vehicle.</p> <p>The positioning of the materials and markers designed for this order should be done in marked, visible places - trolleys, bundle tracks, racks, shelves, etc., fig.49.</p>



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		 <p>Figure 49. Shelves and trolleys for positioning of the materials</p> <p>All necessary facilities must be designed depending on the capabilities of the company - floor plan, available area.</p>
02.02	Design and cutting section	<p>To provide a CAD / CAM system for designing clothes, creating patterns and markers (fig.50), plotters for printing markers on paper (fig.51), digitizer (digitizing board, fig.52) - for creating and transferring patterns from existing ones, and cutters, fig.53.</p>  <p>Figure 50. CAD / CAM system for pattern and marker design</p>



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Figure 51. Plotter



Figure 52. Digitizer- digitizing board



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Figure 53. Cutter-automated cutting machine

To provide a connection of the CAD/CAM system with a cutter.
To provide an opportunity for positioning of the cutting materials for:

- unfolding and relaxation (if necessary);
- place for inspection of the materials - mechanical, factory, transport, and other defects are established (if such is not provided in the warehouse of incoming materials), fig.54.



Figure 54. Workplace for manual inspection and spreading of the fabrics/materials

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		<p>To set aside a place for storage of ready-made plans markers, divided by customers, orders, and specifications of materials.</p> <p>To provide a trolley for fabric spreading and laying with the possibility for direct movement and laying of the relaxed materials or according to a cutting plan, fig.55.</p>  <p>Figure 55. Automated machine for spreading and laying of the materials</p> <p>All necessary facilities must be designed depending on the capabilities of the company - floor plan, available area.</p>
<p>In order to reduce the consumption of unproductive time, it is necessary to provide in the cutting section:</p> <ul style="list-style-type: none"> -accurately the planned number of products/orders; -SP orders with embroidery, preliminary and final finishing and dyeing; -products with prints on the details, requiring additional technological time; -preliminary inspection of textile materials to avoid re-cutting, - not to allow tailoring of details before approval by the client, etc. <p>Proper planning of the markers is carried out in the presence of a CAD/CAM system for designing clothes, equipped with the - digitizer, plotter, cutter. These systems are important for the company, providing it with optimization of the processes in the cutting area, increasing the quality and reliable design of "waste-free", environmentally friendly production, while the loss of materials is minimized. With their help, it is possible to quickly adapt the company to the design and production of new products that are absent from the nomenclature, ie. rapid readjustment of production in accordance with market demand.</p>		
02.03	Completing and arranging the details	To perform numbering the details - to avoid fabric shading in the finished SP. The worker must be trained to perform the procedures for numbering and dividing the parts into bundles.



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Figure 56. Workplace for manual marking/numbering and dividing the parts into bundles

To accurately track model, size, order, lot, color, etc. for each SP, by using special marking tools that are adjusted and the order of marking is automatically monitored.

All details of one SP should be from one ply of the layed material or from two adjacent plies when the sreading and lying is a pair (paired).

All details in one order should be marked-numbered consecutively from the first to the last so that there are no details with repeated numbers in one order.

For orders of one color, the numbering sequence should follow the cutting order.

For orders with several colors, it is necessary to number in a way that will lead to the differentiation by color of the order - with additional symbols, color designations, and more.

The size of the batches is determined by the possibilities for transport of the parts, by the optimal conditions for the processing of one batch and by the need to complete a certain number of parts for assembly.

The complete of the batches should be done after specifying the possibilities - by the production man organizer and/or technologist, foreman.

The activities should always be performed after coordination with the production planner, organizer and/or technologist.

02.04.	Moving the cut details to the pre-production/se wing section	To ensure the optimal connection of the workplaces with each other - the relevant elements of the organization of the workplace are used both as vehicles and as a depot for delivery and collection of parts. This achieves integration between service jobs.
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		<p>To provide (design and develop) boards, trolleys, means for transporting the cut details, marked with signs, plates, holders etc., fig.57.</p>  <p><i>Figure 57. Shelves for cutted pieces with additional place for boxes</i></p>
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03.00	Sewing section	
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In the sewing sections of the enterprises producing clothes, it is necessary to provide:

- organization of production groups - mainly on a flow basis with a design of the workplace and flexible transport;
- shaping the workplace in accordance with the following aspects - improving working methods, reducing workload and requirements, compliance with the appropriate degree of workload for the worker, ergonomic, socio-psychological and organizational aspects;
- use of the correct means of production and additional equipment;
- use of rational sewing methods;
- use of optimal means of transport.

For this purpose, the workplaces should be arranged so that they can be used individually, but also in sequence, following the flow of materials.

This provides the following advantages:

- the workplace can be adequate to the relevant requirements of the job.

For the production it is essential:

- development of production data catalogs, which must contain process and production information and will be useful for managers to solve problems just in time;
- use of production planning and management software.



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03.01	Pre-preparation	<p>The details should be divided into those for preliminary processing and assembling.</p> <p>To provide tables and countertops for arranging the details, designing separate shelves or sections for placing details for the respective brigade, unit or operation. To avoid mistakes, it is necessary to place clearly distinguishable markings on the corresponding equipment and brigades.</p> <p>To differentiate places for distribution - tables, stands, shelves, boxes, etc., fig. 58.</p>  <p>Figure 58. Places for distribution the cut details</p> <p>To provide equipment - fusing presses, irons for preliminary ironing, fig.59.</p>  <p>Figure 59. Workplaces for irons - preliminary ironing</p>
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		<p>To provide aids for making small parts: equipment for processing the finished parts; cutting and sorting, etc.</p>
03.02	Main sewing section	<p>To provide automated sewing machines for making small details, fig.60, as well as designing separate places for positioning the details - countertops, boxes, boards, etc.</p>  <p>Figure 60. Workplace- automated pocket sewing machines</p> <p>To implement adapted/redesigned available machines for making parts or separate technological units, and training of workers to work with adapted machines.</p> <p>To provide machines and equipment for execution of loop stitch, being completed with additional devices (fig. 61) made for the specific technological operation with available means. These can be limiters, guides, etc., installed in the working area of the machine, designed:</p> <ul style="list-style-type: none"> - to fix the exact position of the workpiece, which saves time and ensures quality execution of the operation; - for automatic cutting of the threads in the absence of one, which saves the expenditure of thread, time, eliminates technological operation - "cleaning of excess threads" and increases the quality of the operation;



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Figure 61. SMD on sewing machine, subclass 301

- a programmable control unit may be added to universal stitch sewing machines of subclass 301. In this way, the sewing machine can perform operations such as: making stitch rows with/without tightening at the beginning and end, with the exact number of stitches (for stitching parts/details); positioning of the needle in upper or lower position depending on the requirements of the performed operation, positioning of the needle and the presser foot when stopping work, etc.;

- if it is necessary to rewind a thread on a cone, the existing mechanism for winding the bobbin thread can be modified by installing an additional device allowing the desired activity to be performed;

To supply with SMD for positioning the details - light indicators (guides);

Optimally structuring the workplaces (by increasing or decreasing the worktops, additional worktops, additional equipment, etc.)

To place markings on the countertops in order to control the parameters of the manufactured parts.

Provide a control area - the materials and aids should be located so that they fall within the normal working area, fig.62.

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		 <p>Figure 62. Proper location of the details, parts and devices</p> <p>The tools and materials should be arranged in such a way that the worker can use them in accordance with the optimal sequence of body movements.</p> <p>To use appropriate means of transport - trolleys, boards, baskets, cassettes, top or belt transport, creating an unobstructed passage of semi-finished or finished SP in the technological line.</p>
04.00	Section finishing activities	<p>To provide automated sewing machines for making special operations - tightening, buttonholes, sewing buttons, placing metal accessories, machines of subclass 103 (for making hidden seams), for cleaning threads, for removing excess SP material .</p> <p>To adapt machines for non-professional use to perform specific technological operations - by using the capabilities of the machine itself or the development and installation of additional devices.</p> <p>The workplaces should be optimally designed (by increasing or supplementing the worktops, additional mobile auxiliary worktops and transport, additional equipment for hanging the finished products, etc.), fig.63.</p>

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Figure 63. Additional equipment for hanging the products, with colour marking, for defective products

Provide for the use of appropriate storage means - boxes, boards for arranging the threads, trim cards with information on the conformity of materials, providing easy and unobstructed access to the material used, with the ability to perform the technological operation by the worker with minimal effort and manipulation, ensuring their correct positioning, fig. 64.

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		 <p>Figure 64. An appropriate storage means, ergonomic workplace</p>
05.00	Section Ironing	<p>To provide automated ironing facilities for intermediate and final ironing of the products.</p> <p>To design and implement templates for ironing specific technological units and sections - shaped pockets, belts, etc.</p> <p>To develop and put into use special bucks in the form for ironing on specific constructural elements, sections of the clothing.</p> <p>To provide the ironing equipment with pads and materials for the protection of the processed material.</p> <p>To provide protective and functional means to the operators when performing the technological operations - gloves, brushes, and others.</p>
06.00	Section Quality control	<p>To provide equipment, tables, mannequins with the possibility of unobstructed view of the products, with optimal lighting of the workplace and space, fig.65.</p>



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Figure 65. QC workplace - tables

To provide means for measurement and control, conveniently installed and with the possibility to perform measurements quickly, accurately and with minimal effort; possibility to perform control measurements without additional relocation of the product from its position, in order to prevent creasing, contamination and others.

The documents with the quality requirements to be positioned in a visible and accessible place, convenient for the employee when reporting and applying data from the performed activity, fig. 66.

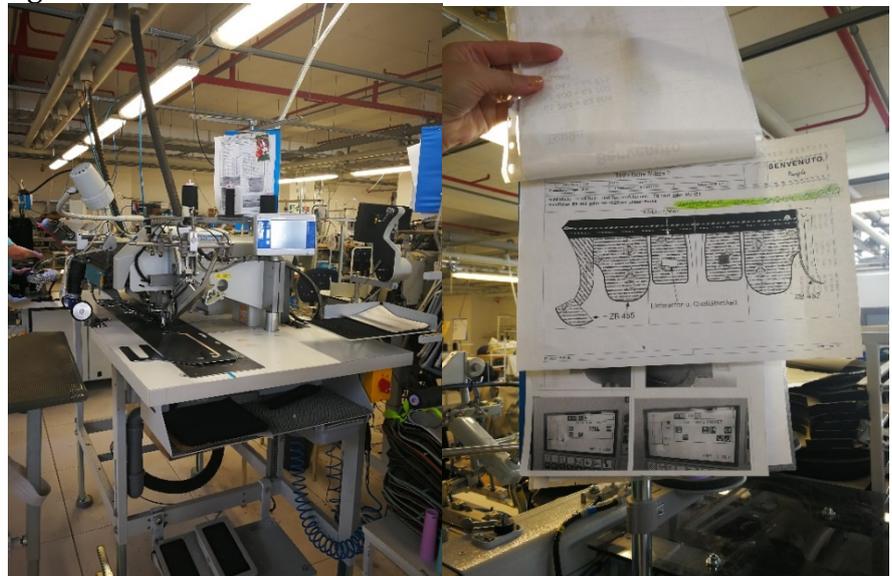


Figure 66. Visible and accessible place for documents with the quality requirements

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07.00	Packaging and hanging- Warehouse	<p>According to the type of production, it is necessary to provide suitable workplaces, with good visibility, and sufficient area and space for packaging, stacking and arrangement for proper storage, ensuring the preservation of the quality of finished sewing products - plastic bags, cartons, hangers, boxes, stands, aids for positioning the packaged products, racks and others.</p> <p>It is necessary to provide reliable and safe facilities and means for carrying out the activities of packaging, gluing, arranging, labeling, and storage.</p>
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IV.2.2. Ways for lower the operational costs and supports the quality of the production.

According to the proposed program, the following results should be expected:

EXPECTED RESULTS		
Techniques for streamlining production	Action	Effect (result)
Reducing the production time per unit of product	<p>Speed of execution of the individual stages of production through proper planning of technological processes (use of special-purpose software).</p> <p>Reduction of Non-Vat time between operations - optimal floor plan in and between units, sections, and the company as a whole.</p> <p>Elimination or merging of some operations through the implementation of automated sewing machines, design and development of special technical devices, separation of machines for special purposes.</p>	Reduced energy use per unit of output by improving planning and productivity accordingly.
Reduction of labor costs	<p>Automatisation of production.</p> <p>Change in the production processing organization – labor saving.</p>	Reduction in energy use due to reduction in the number of low quality products produced / waste.
Reduction of used resources	<p>Optimization of the process of creating markers, cutting and automated marker arrangement by introducing CAD/CAM systems.</p>	Optimal use of resources, materials, human resources; reducing sections costs.
	<p>Improving the qualification of workers through training, demonstrations of techniques and methods, etc.</p>	Reduction of production time per unit of product.



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Factory layout/ floor plan optimization	Improving the organization in the production premises by developing and putting into operation facilities for transport and storage of materials. Transport optimization - in / between the production lines transport	Less energy losses when improving the floor plan/factory production planning and organization. Reduction of time for implementation of activities.
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An absolutely mandatory prerequisite for achieving the shortest possible LEAD time for the production/ unit of product, while maintaining a high degree of load and uniformity in the work of all production sections, is the availability of extensive exchange of specific information and coordination of individual organizational units. The actions for reconfiguration of the machines and organization of the processes related to the processing and transport, as well as the monitoring of them, must be performed in accordance with the work assignment (information on the essence of the work) and in compliance with the time set in the plan on terms of execution time).

RECOMMENDATIONS FOR MODERNIZATION OF GARMENT FACTORY ACCORDING TO THE PROGRAM FOR MODERNIZATION OF TEXTILE INDUSTRY IN CROSS-BORDER REGION		
SUGGESTION/ RECOMMENDATION	VERSIONS FOR IMPLEMENTATION BY:	FINANCING
Transport and storage facilities	1. Development and implementation by mechanics/technicians of the company; 2. The hiring of external consultants and contractors *; 3. Purchase of finished products available on the market.	Implementation is possible with minimal investment by the company.
Sewing machinery and equipment	1. Development and implementation by mechanics/technicians of the company of the necessary improvements based on the existing ones; 2. The hiring of external consultants and contractors *; 3. Purchase of modern automated machines and equipment from leading world manufacturers on the market.	Implementation is possible with minimal investment by the company. If more investments are needed, it is desirable for companies to take advantage of project financing programs.
Implementation of planning and	1. Development and implementation by specialists working in the company;	Implementation is possible with minimal investment by



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management systems	2. Using the potential and recommendations of external consultants and contractors *; 3. Purchase of modern systems for production planning and management from leading world manufacturers of such software products and offered on the market.	the company, using the capabilities of available computer integrated software products. If more investments are needed, it is desirable for companies to take advantage of project financing programs.
Human Resources	1. Proper selection of new workers; 2. Training of new employees by specialists working in the company; 3. Qualification and retraining of the available staff by employees of the company; 4. Hiring of external consultants and contractors *.	Training is possible with the company's resources using its own, well-trained specialists; Creating a training center in the company; In case of a need for specific training, it is desirable for the companies to take advantage of the project financing programs.

*** Note: In order to facilitate the companies and to ensure the correct and quality implementation of the mechanization and modernization activities, it is recommended for external consultants to use established specialists. These can be experts-engineers in industrial engineering, operation, maintenance and repair of sewing machines and equipment from companies, as well as teachers of machines and equipment in sewing production and clothing technology in secondary and higher schools.**

It is recommended to create such a group of experts, which will support small and medium-sized companies that do not have sufficient funds and resources (technical staff) to carry out activities for mechanization and modernization of existing machinery, equipment, and resources.

In order to maintain the competitiveness of the companies from the T&C sector in the region, but also at the national level, it must be work towards increasing labor productivity by implementing:

- new modernized equipment with new technological methods of production;
- new production systems;
- new solutions in the field of labor organization and new systems in the organization of management.



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