



ASSOCIATION FOR DEVELOPMENT NERDA

**Contemporary analysis of plastic processing sector in
The North-East Bosnia and Herzegovina**

CREDO PROJECT

FINAL REPORT

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Abbreviations

ABS	Acrylonitrile Butadiene Styrene
BENELUX	Belgium, Netherlands and Luxemburg
BiH	Bosnia and Herzegovina
BOOP	Biaxially-Oriented Polypropylene
CAD	Computer Aided Drawing
CAE	Computer Aided Engineering
CAM	Computer Aided Manufacturing
CNC	Computer Numerical Control
CREDO	Competitive Regional Economic Development
ECEBD	Eastern and Central European Business Development
EPS	Expanded polystyrene
ERP	Enterprise Resource Planning
EU	European Union
EUPC	European plastics converters
EUROMAP	European plastics and rubber machinery
FP	Framework Program
GDP	Gross Domestic Product
HDPE	High Density Polyethylene
HGK	Croatian Chamber of Commerce
IT	Information technologies
LDPE	Low Density Polyethylene
LLC	Limited Liability Company
MTTC	Machine Tool Technology Center
NAFTA	North American Free Trade Agreement
NC	Numerical Control
NEBiH	North East Bosnia i Herzegovina
NERDA	Northeast Regional Development Agency
PA	Polyamide
PC	Polycarbonate
PP	Polypropylene
PS	Polystyrene
PVC	Polyvinyl chloride
REACH	Registration, Evaluation, Authorization and Restriction of Chemical substances
SME	Small and Medium size Enterprises
SPSS	Statistical Package for Social Sciences
SWOT	Strengths Weakness Opportunities and Threats
TPO	Thermoplastic polyolefin
UNZE	University of Zenica
VW	Volkswagen

CHAPTER I

INTRODUCTION AND METHODOLOGY

1.1 Introduction

This document comprises the analysis of the industrial sector of plastics processing and tool making in the region of North-East BiH (NEBiH), as integral component of the CREDO¹ project that is being implemented by NERDA².

The analysis is based on primary and secondary research. Primary component is related to the distribution of the questionnaire to SME firms (small and medium enterprises) operating in plastics processing and tool making³ industrial sector, including the discussions with managers of surveyed firms, while the secondary part takes into account available up-to-date analysis, with an aim to broaden the picture about state of this sector in the NEBiH region and business settings in general.

Knowing that tool making has great importance for the plastics processing industry, this analysis assess this subsector as well, since design and tool production represent one of the most essential factors in plastic processing industry.

After the introduction and methodology (CHAPTER I), the analysis provides an overview of global market outlook followed by the effects of the financial crises and world recession (CHAPTER II), followed by (CHAPTER III) the description business environment, state of the sector in the NEBiH region, effects of world recession on this sector, the state of infrastructure, human resources development, state of technologies, marketing and quality management. CHAPTER IV introduces the GAP analysis assessing the gaps between current situation and desired state of the sector, as well as the set of interventions required to bridge these gaps in order to improve the competitiveness of the sector in next 3-5 years. CHAPTER V is devoted to value chain analysis in the sector.

The analyses identified several options that would improve the competitiveness of this sector and the economy of NEBiH region. However, confronting key challenges faced by sector requires clear translation of the mission, vision and strategy of the sector, human resources development, applied and fast transfer of know-how, networking among firms along the value chain and joint infrastructure development.

1.2 Methodology

The methodology approach of this analysis is based on:

- Quantitative data, derived through carrying out the survey of the firms across the sector of plastics processing and tool making industry and other relevant data from various sources.
- Qualitative data, derived during roundtable sessions with managers of firms, while filling out the questionnaires.
- Qualitative data, derived from other studies, publications, available analysis and other relevant documents for this analysis.

¹ Competitive Regional Economic Development

² North-East Regional Development Agency

³ Tools for plastics-Molds and dies

The survey is based on a sample of 19 firms, operating in the industrial sector of plastics processing and tool making, mainly located in Gračanica and neighboring municipalities, where this industry is concentrated. All firms in our sample are privately owned with an average of 24 employees. Knowing that the concept of competitiveness is closely associated with the sectoral export capacity, we selected legal limited liability companies (LLCs) since they are allowed to export. The results are obtained through utilization of SPSS software.

CHAPTER II INDUSTRY OUTLOOK; GLOBAL, EUROPEAN AND REGIONAL MARKETS

Since 1950, there has been an average annual increase in the production and consumption of plastics by 9%, mostly due to rapid innovations and application of plastic materials, through substitution of traditional materials: metal, wood, glass and paper, and became one of the fastest growing global industries.

In 1950 the world production of plastics was 1.5 million tons while in 2008 it reached 245 million tons. The consumption of plastics in North America and Western Europe, per capita basis, has grown to approximately 100kg annually, while according to some analysts the consumption of plastics, in these regions, might go up to 140kg⁴ per capita by 2015. The highest growth potential is expected in rapidly developing Asian economies (excluding Japan), where current per capita consumption of plastics is around 20kg on average.

The positive trend in consumption of plastics was increasing until mid 2008 when the world production of plastics⁵ fell down to 245 million tons from 260 in 2007, as a consequence of global recession.

It is expected that the global plastic processing industry⁶ will experience a recovery by the 1st or 2nd quarter in 2010 with estimated growth of 1-2% and continue to grow at rate of 3-4% for the period 2011-2013. The global demand for plastics, in 2009 was 7% lower than previous year. The most severe hits were experienced by manufacturers of plastic parts for the automotive industry, while the plastics industry managed to stay in business mainly on account of packaging for consumer goods, medical and engineering parts.

From January to June 2009 the production of plastics, in Eu27 fell down by 26% compared to the same period in 2008, while total demand for plastics in these countries fell down by more than 30%. The demand from automotive industry has dropped by surprising 40%, while significant drop in demand was also recorded in building and construction industry.

Europe⁷ produces around 60 million tons of plastics annually, which constitutes 25% of the world production, slightly more than NAFTA⁸ countries that account for 23% of global plastic processing production, followed by China (15%), Middle East and Africa (8%), Japan (5.5%). Germany is major producer of plastics in Europe with share of 7.5% in the world production, Benelux⁹ (4.5%), France (7%), Italy (2%) and the UK and Spain (1.5%).

There are around 20 distinct groups of plastics, among which 5 families account for 75% of total plastics demand¹⁰ in Europe: LDPE and HDPE polyethylene¹¹ (PE), polypropylene (PP), polyvinylchloride (PVC),

⁴ Source: PlasticsEurope Market Research Group (PEMRG)

⁵ The Compelling Facts about plastics 2009

⁶ <http://mcgroup.co.uk/news/2009/10/13/3///US%20Consultants%20Predict%20Plastics%20Growth%20in%202011.html>

⁷ PlasticsEurope Market Research Group (PEMRG)

⁸ USA, Canada and Mexico

⁹ Belgium, Holland and Luxemburg

¹⁰ PlasticsEurope Market Research Group (PEMRG)

¹¹ LDPE-Low Density Polyethylene; HDPE High Density Polyethylene

polystyrene¹² (PS and EPS) and polyethylene terephthalate (PET)¹³. During 2008 the demand for these groups dropped by 7.5%, on average.

Packaging remains the biggest end-use for plastics with the share 38% of total production of plastics, followed by construction and building industry (21%), automotive industry (7%), electronics (6%), while other industries including medicine account for 28%.

The European plastic industry (polymer producers- represented by PlasticEurope, converters- represented by EuPC and machine manufacturers- represented by EUROMAP) within the EU27 countries provide employment for 1.6 million people.

SMEs account for 80% of global tool and die industry. The supply of products in manufacturing industry to a large extent depends on tool and die and machine tooling industry, which do not only represent value added component in supply of product manufacturing, a backbone of all manufacturing industries in developed countries. Competition has been increasing at astonishing pace every day, and it is based on the best working practice and short lead times through utilization of advanced 3D CAD/CAM&CAE technologies. Many tooling shops, especially SMEs with limited pool of resources, hardly manage to stay in business due to several obstacles and competitiveness factors, particularly related to customer response to deliver an offer related tool design and manufacturing, which is the most critical element in contract commissioning winning especially in cost estimating to make actual tools. The process of tool manufacturing starts with relatively expensive tool design followed by procurement expenses in procurement of standard tool components, NC (numerical controlled) programming, cutting of expensive steel alloys by using expensive CNC multi-axis milling machines followed by tool testing runs.

To small sized tool making shops this often represents a cash flow problem due to deployment of high cost resources and high cost associated with expensive know-how of skilled professionals able to utilize advanced technologies. Countries with high labor wages and rigid labor laws are in disadvantaged position comparing to countries where this is not the case. On the other hand, one of the most important aspects to create competitiveness is the systematically policymaking of countries with tailored development programs.

2.1 Plastics processing industry outlook in Western Europe

According to EUROMAP¹⁴ the association of plastic and rubber machinery manufacturers, despite the negative impact of recession on the world economy, during the last quarter 2008, the industry has recorded positive results, with a growth of 1.2% and gains in exports by 1.5%. Moulds and dies industry recorded similar results while peripheral equipment had a positive growth of 4.1%. Flexographic printing machines experienced negative growth of -7.0%.

This industry's global market share remained above 50%, while revenues and number of orders fell down in autumn of 2009, with substantially lower utilization of production capacity, comparing to the previous year. The most severe hits were experienced by automotive suppliers and construction companies, construction and building sectors, excluding insulation. Packaging for home appliances also

¹² PD- Polystyrene solid; EPS-Expandable polystyrene

¹³ PET- polyethylene terephthalate

¹⁴ European Association of plastics and rubber machinery manufacturers

felt the recession, while packaging for the food industry recorded better results. Medical industry continued a positive trend in plastics consumption.

Majority of exporters of machinery for plastic and rubber processing have suffered losses as a result of world economic crises. In the first half of 2009 export to North and Latin America and Eastern Europe dropped significantly. According to statistical reports, an average export of manufacturers of equipment for plastic and rubber processing machinery, in Italy and Germany, dropped by 35%. Overall fall in production is estimated to be 22% in 2009, which is approximately 13.6 billion Euros, where this sector holds a market share of 62.7%. There are signs of recovery for the industry, but financial markets remain an obstacle for the industry. The European plastic industry represents one of the major sectors in the EU economy with 50,000 firms, mainly SMEs, operating in plastics processing, as they provide the employment for 1.6 billion people with total turnover of 300 billion Euros. The European industry is made of polymer producers, represented by PlasticEurope¹⁵, plastics converters EuPC¹⁶ and machine manufacturers led by EUROPAP¹⁷.

2.2 Plastics processing industry in Central and Eastern Europe

According to ECEBD¹⁸ during the last decade, the plastics industry recorded good development, much faster than in Western Europe. The plastics processing, in the Central and East European region, is approaching per capita consumption level of 60-80kg/year in Western Europe. Due to significant influx of foreign investments in this region, the plastics processing technology is relatively high, particularly in the area of injection molding. The opportunities for further development of plastics processing in Czech Republic, Hungary, Poland, Slovenia and Slovakia are limited, but still better than in Western European countries.

In the countries of Eastern Europe (Russia, Ukraine, Romania, Bulgaria and Ex-Yugoslavian countries) technologically plastics processing is still at low level, with some exceptional cases. The consumption of plastics, in per capita terms, in these countries reaches 20-50kg/year. Production of polymers, in Central Europe, takes place in modernized and large manufacturing plants, which provides an adequate supply to feed the regional and Western European markets. In Eastern Europe the reconstruction of old manufacturing plants rapidly takes place, especially in Russia. Resins are not produced in the region of Central and Eastern Europe, since the needs of the regional industry are satisfied through imports from Western Europe.

There are about 1,600 plastics processing firms in the region, where injection molding dominates the plastic processing industry. These companies supply the following industries:

Application	Share %
Automobile	45
Building and construction	23
Electronic, IT	11
Electric	6

¹⁵ <http://www.plasticseurope.org>

¹⁶ www.plasticsconverters.eu

¹⁷ www.euomap.org

¹⁸ <http://www.plasportal.com/WebArticleShow.aspx?AGM=PlasticIndustry&AN=VehicleComponents&MN=Menu5&LN=English>

Engineering	5
Others	10
Total	100%

Source: www.plastportal.com¹⁹

By methods of processing: Extrusion constitutes 31%, Film production 26%, Injection molding 25%, Blowing 10% and Expansion 4%. Final applications for end products are: Packaging 45%, Building and Construction 28%, technical parts 10%, household products 6%, agriculture 4%. Major resin consumption per country: Russia 21%, Poland 19%, Hungary 8%, Czech Republic, Ukraine and Romania 7%. Remaining countries in the region is below 5%. According to resin type: PA 38%, ABS 30%, PC 25%.

Resin types used for technical parts production

PP 42%, PA 11%, ABS 10%, HDPE 10%, PC 8%, PS 5%.

Processing methods used for converting of engineering resins:

Injection molding 69%, Extrusion 17%, Blow molding 8%, Film Extrusion 5%.

Distribution of plastic technical parts by country:

Czech Republic 21%, Russia 20%, Poland 18%, Hungary 13%, while other countries in the region account for less than 10%. In automotive industry 36% of 420 bigger firms use PP for technical parts production, while 53% of bigger companies, them 245 use PA.

Distribution of plastic vehicle component by firm size is mostly related to SMEs using injection molding plastics processing.

- The share of firms using 100-1000 tons of resins per year constitutes 34% of number and 29% in volume.
- The share of firms using 1000-5000 tons of resins per year constitutes 7% of number and 39% in volume.
- The share of big firms is less than 1% but they account for 20% in total volume.

2.3 Trends in the region of Central and South-East Europe (CEE) and effects of global recession

Global economic and financial crisis hit plastics processing companies in CEE region more severely than their Western European competitors. The hardest times for the business were the last quarter of 2008 and the first quarter of 2009. Packaging manufacturing companies were not hit severely as companies producing technical parts, especially those supplying automotive industry. According to ECEBD²⁰ the industry can expect recovery in second half of 2010. It is expected that in the next 10 years the share of injection molding will increase from 23 to 26%, while the share of films production will drop from 30 - 25%. Notably, the automotive industry is expected to be the biggest plastics consumer. SESSI²¹ indicated that in 1985, there was 4% of plastics of a car weigh, while in 2000 it exceeded 10%.

¹⁹ <http://www.plasportal.com/WebArticleShow.aspx?AGM=PlasticIndustry&AN=VehicleComponents&MN=Menu5&LN=English>

²⁰ Eastern and Central European Business Development

²¹ www.industrie.gouv.fr-sessi/4pages/pdf/4p189-anglais.pdf

According to AMI²² Poland, Hungary, Czech Republic and Slovakia are countries which have been experiencing strong economic over the last 5 years as it benefited from EU membership and relocation of manufacturing plants from Western Europe and establishing of new ones eastwards to cut the costs and to improve profit margins. Significant advantage, in these countries, represents the availability of qualified workforce, willing to work for lower wages, and notably reduced bureaucracy when starting the business, which altogether stimulates the influx of foreign and domestic investments, while making these countries ideally placed locations to feed the western and growing markets to the East. AMI estimates the demand for polymers in these four countries reached around 4.28 million tons in 2008.

Poland represents the largest market with more than 1,700 companies involved in plastics processing whose demand continued to grow at average rate of 7%, as we observe the period from 2004 when Poland joined the EU and onward. The demand for polymers has been driven by significant influx of foreign direct investments mainly in packaging, home appliances, electronics and auto components plastics processing sectors. Foreign direct investments were driven by low-cost of the labor and availability of highly skilled workforce. With an estimated demand of 2.3 million tons and plastics consumption of 61 kg/capita, Poland is well ahead of the average of Central and Eastern Europe of 45kg/capita but still behind the average for Western Europe of 88kg/capita. The largest number of plastic processors, 52% of them, is in injection molding sector, while film extrusion remains the most important market, in terms of material consumed.

Czech plastics market is underpinned by strong economic growth by an average rate of 7% annually, reaching approximately 800,000 tons. Economic growth has been driven by strong export growth since Czech Republic became the member of EU, resulting in strong inflows of foreign and domestic investments. The polymer consumption is around 70kg/capita, driven by packaging, automotive and home appliance industries. It is believed that there are 650 plastics processing companies, where injection molding is the largest sector driven by foreign investments in automotive industry. Czech and Slovak international molders (Visteon, Key Plastics, Mollertech, Faurecia, Plastic Omnium, Delphi and Hanwha) benefited from new production plants set up by Hyundai and Kia in the Czech-Slovak cross-border region.

Slovakia industry experienced similar course of its neighbors, characterized by relatively high economic growth. It is estimated that there are around 130 companies operating in thermoplastics processing with the polymer demand growing by 9%/year to around 400,000 tons. Similar to other Central European countries, plastic processing in Slovakia is largely driven by automotive sector, which have made Slovakia become a country with the largest per capita production of cars in the world. Yet, film production represents the largest sector by volume of polymers used. With the acceptance of Euro, the Slovak Plastics industry will continue to benefit from investment flows coming into country.

Hungary has recorded significant economic growth as a result of joining EU, although its GDP slowed down in 2008 comparing to figures in 2007, and it is likely to remain at 2% annually due to decline in foreign investments. The polymer demand is believed to be around 745,000 tons accompanied by 600 plastics processing companies. The largest processing market is film extrusion which accounted for 24% of the total demand for thermoplastics in 2008. The leading extruders of polyethylene films are Partium 70, Nordenia Hungaria, Kabaplast i Rotapack. BOOP²³ films is now produced by Taghleef Industries by taking over Radici films in 2008. Injection molding is the second largest processing market for

²² Applied Marketing Information (2008) – <http://www.amiplastics-na.com/PressReleases/newsitem.aspx?item=1000084>

²³ Biaxially-Oriented Polypropylene

thermoplastics, supplying mainly the teleelectronics, electrical, packaging and automotive industry but not significant as elsewhere in Central Europe.

Slovenia Due to world recession and financial crisis in September of 2009, Slovenian industry recorded a fall in output by 14.7%, comparing to September of 2008. Comparing the period from January to September 2009 to same period in 2008, industrial production dropped by 20.3%. Plastics and rubber processing sector experienced a drop by 10.7%, while comparing the period from January to September 2009 to same period in 2008 there has been a fall by 18.5%. According to statement made in press some Slovenian leading exporters experienced a drop in exports by almost 40%. Slovenian economy is characterized by strong network of manufacturing firms. The Cluster of plastics processing companies has developed a good cooperation among members and business associations, universities, research institutes and their EU counterparts, through mutual collaboration in applied research and development of the advanced nano-technologies led by prominent industry experts participating in FP 7 programs. Slovenia has 250 tool making SMEs, which represents the backbone of Slovenian industry. Slovenian SMEs gained well-known credibility while working with leading conglomerates in automotive and aircraft industry (VW, PSA Group, Mercedes, Audi, Benteler, BMW, Chrysler, IN Alfa, Magna, etc). The plastics and rubber processing sector holds a share of 5.6% of total sales of Slovenian²⁴ industrial products.

Croatia – According to HGK²⁵ processing of plastics and rubbers, had 3% share in total industrial production in 2008. The plastics and rubber processing sector participates with a share of 3.2% of total employment in Croatia, with the tendency to grow. The industry had a continuous growth of 10.8% for the period 2004-2007. Comparing to 2007, the industry recorded export growth of 20.1% and import growth of 14.6% in 2008. The Croatian industry of plastics and rubber processing accounted for 1.6% of total export of processing industry in 2008, while its share in total imports of processing industry remain unchanged at 4.1%. Annual consumption of plastics in Croatia grows at 5% rate.

Serbia – According to Serbian bureau of statistics, the industrial production in September of 2009 recorded the drop by 6.3%, comparing to September of 2008, while in 2009 on average basis industrial production dropped by 4.7%. For the period January-September in 2009, there was a fall in manufacturing sector by 15%, compared to the same period in 2008. In September of 2009, Plastics and rubber processing sector had a drop by 17.8%, compared to September in 2008.

²⁴ Slovenia in Figures 2009, ISSN 1318-3745

²⁵ Croatian Chamber of Commerce

Source:http://www.hgk.hr/wps/portal/!ut/p/ s.7 0 A/7 0 PT?WCM_GLOBAL_CONTEXT=/wps/wcm/connect/HGK+Web/Vijesti/Najave/Me_u_narodna_konferencija_Odr_ivo_upravljanje_polimernim_otpadom_39.927169574422884

CHAPTER III
THE BUSINESS ENVIRONMENT IN THE NEBiH REGION
AND STATUS OF THE PLASTICS PROCESSING SECTOR

3.1 The business setting of NEBiH region and BiH, in comparison with countries in the region

Each year the World Bank provides objective measures of business regulations and their enforcement across 178 world economies. Knowing, that in 2006 BiH occupied 87th position, in only 2 years, according to World Bank's "doing the business 2008"²⁶ report, neighboring countries in the region have substantially improved their status, especially Croatia, while BiH dropped to 105th position. It takes 54 days and 30% of income per capita to register business in BiH²⁷.

Economy	2006	2008	2006-2008
Slovenija	63	55	+8
Makedonija	81	75	+6
Crna Gora	92	81	+11
Srbija	92	86	+6
Hrvatska	118	97	+21
BiH	87	105	-18

Source: Doing the Business 2008

The business setting in BiH is still unfavorable, compared to neighboring economies. There is less and less, of domestic as well as foreign investments in processing sector, which requires considerable investments in technologies, equipment and human resource development. As a consequence of this uninviting business environment in BiH, there have been fewer investments in value added manufacturing businesses.

3.2 Plastic processing sector outlook in the NEBiH region

The baseline study of industrial sectors²⁸ in the NEBiH region indicates that for the period 2003-2006, plastics and rubber processing sector had a share of 9.9% (cumulative value) of total turnover of the region, with profit margin of 10%, and 6.1% share in total exports with relatively high employment growth of 22.1% and cumulative profits of 42.6%. Comparative analysis shown that this industrial sector outperformed other industrial sectors in terms of: turnover per employee, profit per employee, export volume per employee and final ranking among all sectors in the NEBiH region, plastics processing sector greatest potential for growth compared to other industrial sectors in the region.

There is a rising presence of consuming industries in BiH that use plastics as integral component of their products, potentially offering market opportunities for local firms for the plastics processing and tool making industry, which opens up opportunities for local firms to increase the production capacity, utilization of machinery and to boost their productivity levels. Yet, those opportunities are sizable only for companies with the business policy based on human resource development, market knowledge, use of advanced technologies, which are prerequisites for competitiveness.

There is a positive trend in accessing EU market, and free trade agreement with partner countries in the region. Yet, the response of BiH firms has not been adequate, particularly in implementation of

²⁶ Doing The Business 2008

²⁷ Doing The Business 2008

²⁸ Baseline Study of IndustrialSectors in North-East Bosnia and Herzegovina, NERDA

European norms related to product and quality requirements. At the same time, custom barriers were suddenly removed, while leaving the door open to competitive imports of products. Therefore, an increase in supply and intensifying competition will force local firms to modernize and to develop competitive business policies or they will lose the market.

According to BiH²⁹ Agency for statistic, in September 2009 index of total industrial production in BiH (based on monthly production average of base year 2005) was higher than index of August 2009 by 8.3%, while the average monthly production index in 2008 was 101.2.

Compared to September 2008, the index of sector of plastics and rubber processing in 2009 was lower by 28.7%. In plastics and rubber processing sector, the index of average monthly production was 85.8% while the cumulative production rate fell down by 18.1%. Compared to August 2009, in September base index of plastics and rubber processing was lower by 14.9%. The drop in indexes was the result of financial crises that triggered world recession.

INDEX	INDEX (ϕ2005 = 100)		Change rate		INDEX (ϕ2008 = 100)
	VIII 2009	IX 2009	IX 2009 / IX 2008	I-IX 2009 / I-IX 2008	IX 2009
Industry Total	122,0	130,3	0,0	-3,9	101,2
DH Plastics and rubber products	127,8	112,9	-28,7	-18,1	85,8
25 Plastics and rubber products	127,8	112,9	-28,7	-18,1	85,8

Source: http://www.bhas.ba/Arhiva/2009/sao/IPI_2009_001_01.pdf

3.3 The world recession and impact of the financial crises on plastics processing industry sector in the NEBiH region

The world recession had different effects on the firms in the region. The cash shortage in circulation had an immediate impact on liquidity position of the firms in sector, affecting more those firms that were occupied with investments. On the one hand, high price of crude-oil, before the recession, resulted in high price of raw materials (resins), followed by financial market crises, causing sudden drop in the market price of crude-oil, which on the other hand caused a stockpiling of expensive raw material inventories.

As the demand for products plunged, most of the firms lost the access to sources of cash as revenues and cash flows drastically diluted. Access to capital became suddenly difficult, as banks increased interest rates while decreasing the loan revolving allowances, while on the other hand there were cases in which customers required an extension of their account payables dues up to 200 days.

Fulfilling the payment obligations suddenly became a problem for the industry. On the other hand, firms were following the practice of taking short term loans to finance long term investments, while debt service capacity was solely based on revenues which dried out together with account receivables which resulted in losing of capacity to service credit obligations. Those firms which used to rely on a single or few large customers, found themselves in a disadvantaged situation if one of buyers decided to withdraw his orders, which usually resulted in serious deterioration of revenues.

²⁹ http://www.bhas.ba/Arhiva/2009/sao/IPI_2009_001_01.pdf

3.4 Infrastructure of the plastics processing and tool making industry in the NEBiH region

Business Association "Cluster of plastic and Tool Manufacturing Companies" was established in 2007 by private firms, as response to global market consolidation, determined to increase competitiveness of the sector through networking of small, medium and large enterprises and institutions, in order to: tackle the obstacles in economic development, provide the access and application of new technologies, boost productivity, decrease unemployment, better use of resources, increase innovation, enhance research projects, increase the product quality, improving quality of jobs and to establish the value chain within the sector with the following goals and activities:

- The networking of SMEs operating in plastics processing and tool making industry across BiH
- To improve and promote interests of its members in BiH and abroad
- To protect the interests of its members at all levels of policy making authorities in BiH
- To channel relevant information to its members
- To assist its members in solving problems related to: solve the problems they face in doing the business, providing the access to advanced technologies through various activities: Establishment of MTTC Center for Advanced Technologies, promoting the cooperation with technology centers and parks, and other prominent institutions in BiH and abroad.

Even though it was established an association, Cluster still faces obstacles to work towards its goals. It was established as association of business entities, and due to current set of laws it cannot perform business activities, which is contradictory with its mission. Up till now the Cluster of plastic and tool manufacturing companies has not gained the recognition of policymakers at any level of state authorities, even though the concept of clustering is mentioned in many development strategies.

MTTC (Machine Tool Technology Center) – Center for advanced technologies, was established by 7 members of Cluster of plastic and tool manufacturing companies from Gračanica: Plamingo, BEMA BA, Helioplast, IDEA-CO, Fragmat Izolirka, Variplast and Mirna and project Excellence in Innovation (www.ei-bih.ba). The mission of the Center is to improve competitiveness of firms operating in tool and die sector, as it offers broad range of services based on utilization of advanced technologies of virtual engineering. Broad and diverse range of high-value services CAD/CAM/CAE (computer aided design, computer aided manufacturing, computer aided engineering) professional services are offered BiH companies with the focus on mechanical engineering and plastics processing sectors, through deployment CAD/CAM/CAE integrated systems required for 3D modeling, simulation and visualization of manufacturing process in metal processing, tool and die design as well as rapid prototyping offering SMEs incomparable high-speed prototyping in contrast to times when firms had set up the production in order to deliver the product sample with no guarantees that business will be made. **3D tool design** services are related to 3D tool modeling, which enables designers to virtually test and modify the tools, before the commencement of production while avoiding postproduction modifications. Tool design prepared in 3D CAD applications significantly speeds up the process of tool manufacturing and at the same time considerably reduces overall production costs. Once, the 3D tool design is completed, code generation takes place by using CAMWorks 2008 application, which enables the simulation and validation of production processes. An optimized process, high production quality, and just in time delivery are the requirements that many firms face in global market. 3D tool design services are provided by using licensed SolidWorks 2008 software, which offers parameter design, visualization, simulation and validation of production processes through use of the latest workstations utilized by trained engineers.

3D scanning services enable digitalization of physical objects. The digitalized data are used for CAD modeling, product modification and product prototyping. Digitalization services are provided by using ZCorporation Scanner 700. **3D printing** is a unique form of prototype making (rapid prototyping). 3D printing enables a creation of three-dimensional objects, layer by layer in color with an identical appearance as the actual product. 3D printing services are delivered by use of the newest Z-corporation Spectrum Z510 printer with resolution of 600X540 dpi and printing volume of 254 X 356 X 203 mm. This prototyping service is delivered within 24 hours. **CNC programming** services are available to firms requiring accurate and optimized processes before tool production begins to run on CNC milling machines. These services include: detailed settings and simulation runs of the most demanding configurations of multi-axis CNC machines while meeting complex programming requirements, design, visualization, simulation and validation of processes that are tested before actual production commence, offering firms to the analysis and tool optimization of CNC path cutting flows and program validation. The Center utilizes licensed CAMWorks 2008 software that offers real simulations which can early detect the problems, collisions and inconsistencies among tool components, equipments and tools. **Rapid CAD/CAM system integrations trainings** are available as a service to SMEs in solving problems related to limited number of highly educated professionals with applied know-how in CAD/CAM technologies, including: numerical simulation, 3D modeling and visualization, installation and operation of CNC machines and tools, CNC programming, etc.

Regional board for industrial sector of plastics processing in the NEBiH region – Initiated by Regional Development Agency NERDA and regional firms operating in plastics processing sector, with the goal to improve competitiveness of this sector through CREDO project³⁰.

3.5 The status of human resources and training needs of the industry

There are less and less graduates at mechanical engineering faculties due to loss of attractiveness to study technical science, while there is the unbridgeable gap created, between the skills available at universities and those demanded by industry. It is necessary to take into account the fact, considering mechanical engineers and those who will become a part of labor force, that there is only limited number of highly educated professionals with applied know-how, while on the other hand, there is an urgent need to improve the skills of employees all the way along the value chain, from product design to the final production.

Petković³¹ pointed out (2008, pp 20-21) ***“Today there are 8 state universities (public) and large number of private ones, which opened during the last 2-3 years. While public universities educate young scholars in all areas of interest, private universities-faculties are mainly specialized for “all kinds” of management, economics, law, political science, diplomacy, public affairs, and other education, which in essence requires no laboratory equipment and infrastructure. All this, year by year, takes BiH into disadvantaged position, particularly considering revitalization of old factories and new investments with modernized equipment. By only looking, at the data of graduates at UNZE³², one becomes easily aware of huge disproportion between 455 graduates against 15 graduates at mechanical engineering faculty. In terms of percentage, only 3% of students decide to study in the technical fields and this by no means assures the sustainable economy.***

At BiH universities in the areas of engineering studies, the studying is concentrated on the broad theory **“about”** certain topics, rather than **“how”** to orient students towards acquisition of skills and know-how required by labor market.

³⁰ www.credo.ba

³¹ D.Petković Gdje smo kada je u pitanju razvoj tehnoloških parkova u BiH?, Centar za inovativnost i preduzetništvo Univerzitet u Zenici, Zbornik Radova iz Preduzetništva, Juni 2008 godine.

³² University of Zenica

95% of the surveyed managers believe that there is no applied know-how at universities that firms could benefit from. 47% of the surveyed firms do not have a single mechanical engineer. Managers deem very important to have an access to fast and professional education, particularly training modules for those working at engineering and technical departments, whose skills represent a key ingredient of quality assurance and ability to have the fast response to customer requirement.

47% of respondents think that universities and technical schools do not have educational programs to meet the demands of the industry, while 80% of managers believe that they do not maintain close cooperation with companies in order to align education with industry demands.

Firms in the region have partially solved the problem of recruiting skilled workers thanks to collapse of national conglomerates during the postwar privatization. With the rapid advancement of new technologies, there has been created a gap related to applied know-how, evident in deficit of mechanical engineers, technologists and knowledgeable technicians. Today, those working in private firms have a little or no access to trainings. The training of such employees is usually treated as expense, while business owners seek quick return on their capital.

Another significant problem is employee turnover in local firms due to lack of human resources policies. Firm that offer structured career paths to the young talents are rare. In a meanwhile, international employment agencies with their offices scattered across BiH, continue to stimulate the brain drain, particularly seeking skillful engineers and technicians working in production, which worsens already chronic state of human resources in BiH. What firms makes particularly vulnerable, in the region and across of BiH, is the fact that the key-core processes in local firms are usually based on one or few key professionals (mechanical engineers, technologists, chiefs of production). Once those employees, for some reason leave, the firms a confronted with a problem how to find substitute to keep business running.

The pressure of global competition intensifies, particularly in the areas of complex tool and product design. The commodity and technology prices is well consolidated, which means that competitiveness is solely based on the degree of applied know-how and available technologies, quality assurance and cost reduction, which are all dependent on the know-how of employees. Managers we talked to, usually do not see problems in procurement of equipment, but how to find the market and to recruit skilled workforce capable to utilize equipment at its full capacity, while stressing that access to skilled workforce remains a key barrier for the development of sector. According to managers, critical know-hows for the sector development are:

- Marketing research and product development
- Knowledge about value chain
- Acquisition, transfer and distribution of applied technology know-how and skills
- Fast, accurate and improved design of complex tools
- Quality management system
- 90% of the surveyed firms, do not have the policy concerning human resource management
- 53% of them have no annual plan for the training of employees
- 79% of the surveyed firms have never carried out performance appraisal of their employees, while 84% of managers have never measured the employees' satisfaction

Having in mind the importance of mechanical engineering in plastics processing sector, particularly in view of tool manufacturing and production management, the current deficit of engineers directly has an

effect on competitiveness of the firms. In addition, 84% of the surveyed firms follow the practice of a follower in the industry which does provide the base for building the competitiveness of the industry.

The training needs of the firms in sector

As we carried out the survey, we identified the following needs of the firms for trainings:

- 90% of the firms are ready to start the cooperation with an institution capable to deliver additional trainings to their employees
- 84% of the surveyed firms believe that the improvement of skills of their employees and their superiors are crucial factors for the improvement of the competitiveness
- 42% of firms think that shortage of skills and competencies represents the greatest barrier for investing in development and upgrading of existing processes

Therefore, the training needs can be broken into two categories:

- 1. Education and trainings related to acquisition and the development of special skills relevant for plastics processing and tool making sector**
- 2. Education or trainings related to acquisition and development of business skills**

- 1. The needs for education and trainings related to acquisition and the development of special skills relevant for plastics processing sector**

- 84% of the surveyed managers, think that certified professional trainings are the most required type of education for production managers
- 68% of managers believe that the most important experiences for employees working in production, is the know-how acquired elsewhere
- 63% of respondents believe that the training concerning CAD/CAM technologies is very essential for improving their competitiveness
- 53% of respondents believe that the trainings related to tool design are also very important for achieving competitiveness

- 2. The needs for education or trainings related to acquisition and development of business skills, according to surveyed firms**

- 95% sales
- 68% marketing
- 63% system of quality management
- 58% customer services
- 47% product development
- 32% human resource management

3.6 The state of technologies, machinery equipment and manufacturing capacities

The state of technologies can be analyzed through several segments: Technologies of materials, CAD/CAM/CAE technologies, Production technologies (machinery) and technologies for business process management (ERP and other systems).

Technologies of materials – The resin producers turn the petrochemicals into resin. The key buyers are producers of paint, plastics and adhesions. The largest global resin producers are international companies with well-developed network of distributors and agents across the globe. Some of them are: NOVA Chemicals, BASF, Bayer, Dow Chemicals, DuPont, Royal Group, Imperial Oil, Oxy Vinzls, Basell, Sabic, Borealis, Petromount, KoSa, AT Plastics, Estman Chemical, etc. The resin producers are generally global firms focused on continuous development of new polymer technologies. These companies intensely form strategic alliances to share the cost of the development of new technologies with firms that enrich the resins through adding and mixing of additives, pigments, stabilizators and plastizators.

The sector is well covered by resin distributors across BiH. There is no producer of resin in BiH, and it is entirely imported material. The import firms are generally trading companies and agents of major EU and regional distributors. The resin price is in direct correlation with the crude-oil price so the price is entirely set in the global market. Firms in the region individually buy materials regardless of the opportunity to gain their bargaining power through the clustering. Since there is no producer or resin in BiH and the fact that resin is completely imported, production of raw materials cannot be taken into consideration as potential factor for improving the competitiveness in this sector. 74% respondents, in our survey, believe that reduction in price of the raw material represents important factor for competitiveness.

CAD/CAM/CAE technologies - There are ever-present tool design customer requirements, based on utilization of advanced 3D CAD/CAM/CAE technologies, which in essence demand continuous training of engineers and technicians as well as procurement of relatively expensive software applications, which require substantial investments. These software tools are crucial for the product development and tool design, since 2D based applications have been completely taken out of use and substituted by modern 3D CAD/CAM/CAE software packages fully integrated with production processes. That is one of major reasons why large number in the region as well as BiH shifted from traditional tool design towards tooling of metal components.

Local firms mostly use unlicensed software applications and as a consequence face unreliable workflows while losing time, resources and numerous benefits. On the other hand, the learning and using of such software applications, in local firms, is based solely on learning by doing practice, instead attending professional trainings. All this aforementioned, makes very difficult and even prevents firms to respond with an offer towards customer requests, mainly due to lack of adequate knowledge and fear of making wrong costs estimates when commissioning the contracts, as even a minor negligence in estimation, can be fatal for the firm.

Although the legalization of software provides to its legal owner right to acquire postprocessors for automatic generation of G codes, which is one of the key requirements for using CNC machines while assuring the quality of work, local firms, by using of illegal software, are forced to rely on manual code programming or modification of existing ones, which often results in errors while programming the work paths of cutting tools on multi-axis CNC machines. This is one of the main reasons for error occurrences in tool making and it prevents firms to respond to customer requirements.

Plastics processing companies do not only own the processing equipment, but also tool shops to support production process. With advancement in development of new CAD/CAM/CAE technologies there is an increasing trend in integration of these software applications with equipment in production. Such integration demands significant investments in human resources and technologies, in order to utilize capacities of tooling machinery. Among all surveyed firms, there is only one that owns licensed CAD/CAM software applications. 68% of the surveyed firms believe that their development progress is mainly driven by customer requirements.

Production Process Technologies – are mainly based on supply side of machinery and peripheral equipment used for mold making and equipment for plastics processing. The plastics processing equipment that converts resins into actual products made of plastics, includes wide range of technological processes among which, the most popular are: Injection molding, extrusion, blowing and thermoforming. The leading machine and equipment manufacturing companies for plastics processing companies are: HASCO, Husky, Mold Masters, Alpha Maraton, Compact Mold, Corma, Engel, Ryka Molds, Wentworth Mold and Die, MacroEngineering. Over the last several years a number of tool component manufacturing companies emerged from the East. As the plastics consumption increases, there has

been also an increase in demand for equipment and tool components, while leading equipment and tool component manufacturing companies increasingly merge with each other to consolidate and keep the market share. Equipment manufacturers usually originate in developed economies: Germany, Italy, USA, Japan, etc. The plastics processing equipment belongs to advanced manufacturing technology³³.

Plastics processing machinery, in local firms, is usually 5-10 years old. Yet, there are firms with the latest technology that meets the world-class standards. The age of machinery, according to opinions of managers, is not a key factor in doing the business, but the skills of employees vital for tool design, quality in manufacturing and market development. Although there are firms with new machinery capable to deliver high product quality, while potentially increasing economies of scale, the current products of local firms are in essence low value-added and usually used as integral component of buyers' products.

One of the greatest dilemmas faced by local companies is the selection of optimal technologies. That choice usually depends on suppliers, which intentionally promote their own technologies, instead of selecting optimum technologies based on product and market requirements. 68% of the surveyed firms work below or up to 75% capacity.

53% of firms possess relatively new equipment and share an opinion among them think that acquisition of new technologies represents no obstacle, but finding and retaining the market and recruiting skillful employees competent to exploit equipment and technologies at full capacity. 47% of firms own production machinery of 2-5 years old, while 5-10 years old equipment is owned by 28% of them. 47% of respondents think that use of new software applications for the automatization of production processes should be treated as the top priority.

63% of the firms follow the market developments, while 74% of the surveyed managers believe that the greatest barriers for investment in new equipment are doubts in behavior of the economy caused by recent recession. 53% of the firms think that new customer requirements require new investments in machinery, as 58% of them share the opinion the greatest obstacle for the investments and improvement of current processes is actually the lack of access to large strategic customers.

Technologies for business process management – are associated with business information systems and currently they are very poor due to the fact, according to opinion of managers, that companies in sector still do not have capacities to justify investments in ERP³⁴ software.

3.7 Marketing

Marketing as a business function in local firms, remains relatively underdeveloped, as it for some reason the term marketing has been perceived as promotional activity by majority of managers. Local firms usually sell their products to domestic market.

Significant problems faced by local firms are related to: market research, quality assurance, and recognizing the position of the firm along the value chain.

The NEBiH region at the moment does not have recognizable final products produced in sector.

Generally, companies are unfamiliar with their market share, as 74% of the surveyed firms confirmed this claim, while only 47% of them practice to do some market analysis.

³³ AMT - Advanced Manufacturing Systems

³⁴ Enterprise Resource Planning

The barriers faced by firms, concerning the marketing, are particularly evident in providing the quality proof for products, with the lack of capacity to meet the requirements of international quality standards, which in the early stages prevent firms to export to EU and other markets. Most of local firms do not own even an outline of the marketing plan, while only 47% of the surveyed firms possess annual business plan.

With no practice to perform market analysis as well as business planning, firms are incapable to assess their own export capacities, and for that reason they do not see the export as their market opportunity. This has been confirmed by our survey findings, as for 84% firms in our sample, have less than 30% of their total revenues generated by export. On the other hand, 37% of firms have no information about the number of their competitors, as 47% of them believe that their key competitors reside within 50km.

58% of managers, in our sample, do not use any tool for customer relationship management; since they have been focused only on few of them, as 21% of the surveyed managers are not familiar with the exact number of their customers. On average, per single firm, 43% of the total revenue comes from a single customer, which turns out to be a significant risk for firms in the sector.

Yet, the cooperation among the firms, when meeting the customer requirements is insufficient. 84% of respondents think that ability to respond quickly on customer call is very critical component for building the competitiveness. 100% of the surveyed firms believe that quality management system is very critical factor in building the competitiveness.

Regional firms are mainly focused on the domestic market, acting as suppliers for various industries:

- Food processing (packaging, packaging for consumer goods, packaging for media carriers CDs-DVDs, films, PET packaging and PET tubes)
- Building and construction (Plastic pipes, pipes for installations, water pipes, protective pipes, drainage pipes, junction boxes, corner skirting, polystyrene panels, plastic items used in telecom installations)
- Textile (coat hangers)
- Furniture (Various parts)
- Plastics Processing (Molds for single-component injection molding)

53% of the surveyed firms do not practice to carry out market research, nor define their product mix in line with customer needs, while 26% of them think that product design improvement is an important element for building the competitiveness. 58% of the surveyed firms believe that pricing policy of their products is limited by competition pressure from competition.

Products of local firms are in essence low-value added and usually based on replication of existing products found elsewhere, since 90% of the surveyed firms has not developed a single innovation or patent over the last 5 years.

Only 26% of the surveyed firms have implemented ISO 9001-2000 quality standard, while only 21% of them think that international certification and obtainment of CE label is significant for building the competitiveness.

3.8 Quality Management

Managing quality symbolizes quality assurance of products through implementation of international quality standards, confirmed by possession of internationally recognized certificates. Although baseline ISO 9001-2000 offers basic quality management, as vast majority of firms have not implemented this standard, yet. There are various reasons for the delay in implementation of quality standard: starting

with the cost and complexity of the certification process to affirmation of employees to implement the quality standards. 74% of 19 surveyed firms, do not own ISO 9001-2000 quality management standard.

It appears that the importance of international products certification has not been understood by local managers. On the other hand selling products in EU market requires a minimum number of safety requirements fulfilled concerning the safety of people, health and environment. Majority of products, sold in EU, according to EU directives must be labeled with CE sig as a proof that the product complies with all legal requirements and norms. Manufacturer marks the product with CE tag. If the manufacturer does not reside in EU member country then its representative has obligation to do CE marking. CE sign intended for institutions which monitor EU market and CE cannot be replacement for other labels nor represents the customer requirements. Surprisingly, only 21% of the surveyed firms think that CE certification is necessary.

On the other hand, new challenges for the industry are imposed by new EU regulation REACH³⁵ (European directive EC 1907/2006) which regulates registration, evaluation and authorization of chemicals as it came into effect in June 2007. The objectives of the REACH are protection of human health and environments, while preserving market competitiveness while stimulating the development of chemical industry development. This new regulative will replace current laws and regulations that include around 30,000 chemicals including products made of plastics.

3.9 An overview of the most important factors for the development of competitiveness according to managers of the surveyed firms

Factors	% of the surveyed firms
a. Improvement of the product quality	100
b. Improvement of the capacity to respond to customer	84
c. Improvement of skills of employees	84
d. Improvement of the know-how of managers	84
e. Reduction in price of raw materials	80
f. Improvement and increase of use of the advanced technologies	79

3.10 An overview of some the most relevant options for the competitiveness development according to managers of the surveyed firms

The competitiveness strategy options	% of the surveyed firms
Quality improvement (introduction of new materials and processes)	84
Price reduction through cost cutting and increase in productivity	79
Improvement of customer service	63
Improving the satisfaction of customer through specialization	47
Investing in brand equity and business communication	37
Design improvement	32
Price reduction through outsourcing	26

³⁵ REACH – (Registration, Evaluation, Authorisation and Restriction of Chemical substances)

3.11 An overview of needs for services that could significantly improve the competitiveness of local companies

Type of service	% of the surveyed firms
Tool Design	79
Production management consulting	68
Product quality control consulting	63
NC programming	58
Product quality certification	58
Quality control product testing	53

3.12 SWOT analysis of the plastic processing sector in the NEBiH region

STRENGTHS

- *Geographic position of the sector within broader region of Ex-Yugoslavia and its legacy*
- *Some firms in the region gained the reputation of referral centers plastic processing industry*
- *Experience and tradition in plastic processing and well-maintained relationship with customers and suppliers*
- *Complementary relationships among the firms*

OPPORTUNITIES

- *Vertical and horizontal integration of firms along the value chain (Clustering)*
- *Capturing new markets*
- *Proliferation of complementary products*
- *Large manufactures in automotive and home appliance industry look for suppliers of plastic components. In order to cut the carbon monoxide emission new EU regulations pressure the automotive industry to go for light components, as plastics materials emerge as substitute for metal.*
- *Positioning through sectoral specialization*
- *Identification of strategic products of the region with the complete product cycle*
- *The labor wages of skilled workforce are still lower than in EU*
- *Strengthening of the sector clusterization and sharing of development costs*

WEAKNESS

- *Fuzzy mission and vision of the companies and sector*
- *Lack of determination of local companies to recognize their own stand within the value chain*
- *Firms in the region face inefficiency and low productivity because of obsolete work practices*
- *Lack of the development of key competencies and specialization along with lack of professional education of employees within the sector*
- *The perception to build the competitiveness through the phrase "Cheap labor force"*
- *The products are based on copying practice rather than product development (there is a tendency of "Follower within the industry" along with low level of innovation*
- *Shortage of technicians with know-how*
- *Deficit of highly skilled professionals capable to use applied CAD/CAM/CAE technologies (At the moment use of applied technologies is way below international standards)*
- *There is no industry referral center to provide technical assistance to companies in the region*
- *Incapacity of local firms to meet demands of large customers*

- *Local firms perceive competition only in domestic market*
- *Tendency of business owners to maximize profitability through low level investments while expecting quick return on investments*
- *Difficult access to capital due to, sector distinctiveness, lower returns on investments and long production cycle, which has been perceived as risky*
- *Lack of human resources development policies in firms*
- *The regional industrial sector in the region has not been positioned with distinguished products in the market*
- *Firms do not practice to carry out the market analysis*
- *Firms are vulnerable in terms of technology and human resources*
- *Local firms face the challenge of managerial succession*

THREATS

- *Current political situation*
- *The falling rating of BiH in terms of doing the business*
- *Non-existence of national development funds, that would stimulate the growth of processing value-added industries (They periodically appear, only through the projects financed by international organizations)*
- *There are no development policies (at state, entity and cantonal levels) followed by action plan*
- *Strong presence of International recruiting agencies stimulating brain-drain*
- *Negative demographic changes*

The SWOT analysis shows that industrial sector of plastics processing is significantly exposed to weakness and threats from outside. It is evident that weakness should be turned into strengths to capture market opportunities through sectoral specialization which is subject to focusing and positioning into value chain through the development of human resources and applied knowledge. In that case, the sector would indentify activities which offer the opportunity to develop unique competencies, enabling the sector to gain competitive advantage in specific market segments; while on the other hand, the clustering among the firms should result in cost reduction.

CHAPTER IV GAP ANALYSIS AND REQUIRED INTERVENTIONS

The mission of the CREDO project aims to identify problems and to select the instruments to achieve the selected goals in the industrial sector of plastics processing in the NEBiH region with the intention of to improve the competitiveness of the industry. As an integral part of the terms of references of the CREDO project, the GAP Analysis was also anticipated in order to analyze the current state of this industrial sector and its desired state. The analysis is based on the number of documents and sources relevant for the sector, among which the following ones are deemed to be important:

- Round table discussions with managers of the surveyed firms operating in plastics processing sector in the NEBiH region
- The results of the field survey
- The data from multiple analysis of the global plastics processing and tool industry
- The study visit of Regional Board for plastics industry in Slovenia, and discussions during the meetings with: Gorenje Tool Factory, Slovenian tool and die development Centre – Tecos and Cluster of plastics processing companies of Slovenia
- The periodic meetings of Regional Board for plastics processing industry
- Consulting sessions with mechanical engineers working in local firms

The table below provides an overview between current and desired state of the sector and required set of interventions needed to bridge the GAP over the next 3-5 years. 8 potential points of improvement for the sector have been indentified as well as the set of actions to bridge those gaps.

Gaps	Desired state of the sector	Current state of the sector	Set of activities required
GAP 1	-Clear development strategy for the sector of plastics processing and tool manufacturing in the NEBiH region, clear vision and mission, the technology road map written	Non existent	The activities of The Regional board for plastics processing and tool making industry should be aimed on identification of the mission and vision of the sector and drafting of the sectoral strategy over the next year. -Preparing the document of the technology road map for the sector
GAP 2	-Established referral center for plastic processing industry to provide the technical assistance to companies in: choosing optimum technologies and equipment and solving problems	Limited activities have been identified in Cluster of plastic and tool manufacturing companies through the initiative of establishing MTTC Machine Tool Technology Center, yet additional capacity development is necessary as well as introduction of new technologies, applied know-how and networking among firms from all industrial sectors.	To strengthen the capacity of Plastic and Tool Manufacturing Companies along with the transfer of the best working practice with emphasis given to creation of the network of industry professionals working in technology fields and engineers capable to deliver technical assistance to firms.
GAP 3	-Developed capacities of Cluster of plastic and tool manufacturing companies	The Cluster of plastic and tool manufacturing companies recorded minor number of cooperation initiatives among the firms in the sector in meeting customer requirements and closure of product life cycle -Cluster's sustainability is at stake since it was founded as non-profitable organization -The Cluster has not managed to gain recognition by policy makers -The Cluster is still in the early phase -The Cluster currently implements the project of interactive web portal of the industry in order to offer interactive networking of industry players via supplier-converter- customer relationship.	-Strategic networking of firms through specialization is required - There is a need to identify products in the region which potentially could offer opportunity to bundle complementary products along the value chain -Develop programs to strengthen the Cluster and to lobby stakeholders and to promote its development role -Establishment of the central data base of the sector across BiH - There is a need to strengthen the degree of cooperation among the firms through networking and specialization -Identification of well-known products in the sector of plastics processing -Creation of the data base of potential suppliers, converters and buyers -Allocation of business activities based on specialization and market positioning

GAP 4	<p>-High degree of applied know-how in areas of CAD/CAM/CAE technologies in plastics processing and tool making sectors with sufficient number of high skilled professionals in the sector.</p> <p>-High Degree of technical expertise of mechanical engineers working in technical departments of firms in the region</p>	<p>-Low level of applied technologies and processes based on copying and replication of products from developed economies or elsewhere</p> <p>-Only MTTC³⁶ offers training modules on CAD/CAM system integration technologies SolidWorks –CAMWorks 2.5-3 i 5-axis milling and practical training on 3-5 axis CNC machines.</p> <p>-The concentration of applied know how is insignificant and limited</p>	<p>-Providing of fast and practical education through vocational training programs based on 3D CAD/CAM/CAE technologies</p> <p>Trainings on 3D design and tool manufacturing</p> <ol style="list-style-type: none"> 1. Introduction to 3D design 2. Advanced 3D design 3. Introduction to 3D drawing 4. Advanced 3D design 5. Assembly 3D design 6. Advanced 3D assembly 7. Advanced surface modeling by using 3D technologies 8. 3D tool (molds) design 9. Tool design for extrusion 10. Tool design for WPC (Wood Plastics Composites) 11. 2-K (two-component) tool design 12. Plastic deformation 3D technologies 13. CNC machine programming for metal processing 14. CAD/CAM system integration 15. Advanced surface modeling for tool and die <p>SEMINARS</p> <p>Tool and die manufacturing</p> <ol style="list-style-type: none"> 1. Tool and die manufacturing by use EDM technologies (Electrical Discharge Machining) 2. Laser technologies in tool and die production 3. Steels for tool and die 4. Machining of hard materials <p>Plastic Deformation Tool manufacturing:</p> <ol style="list-style-type: none"> 1. Introduction to plastic deformation 2. Processes and characteristics of plastic deformation 3. Accuracy in plastic deformation 4. Machines for plastic deformation 5. Applied micro technologies in plastic deformation <p>Plastic Processing</p> <ol style="list-style-type: none"> 1. Technical requirements for plastics materials and testing in plastics processing 2. Thermoplastic materials 3. Plastics Thermoforming 4. Recycling of plastics 5. Plastics part design 6. Bending of plastic part 7. Computer simulations in injection molding 8. Basic design of tools for plastics processing 9. Advanced design of tools for plastics processing 10. Cold water cooling systems 11. Hot water cooling systems 12. Cooling of molds for plastics 13. Systems of guiding, closing, ejecting and airing 14. Injection molding machines and peripherals 15. Modern technologies in plastics processing 16. 2K injection molding 17. Errors in injection molding 18. Injection molding optimization systems 19. Injection molding process rationalization 20. Extrusion of plastics and blowing
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³⁶ MTTC- Machine Tool Technology Center www.mttc.ba

GAP 5	Use of hybrid materials polymer materials in plastics processing	-Firms in sector use plastic resins mostly for single component products or product parts. -There is significant deficit of highly skilled professionals in the industry	-Active networking with institutions with the mission focused on the development: of nano-materials, bio-materials, intelligent packaging and 2K-injection molding -Better cooperation needed through FP7 programs and establishment of linkages with EU development institutions
GAP 6	Production based on high value added products (Shifting from low value added to higher value added products)	Low level of technological processes and less technologically driven production mainly focused on domestic market (food industry, construction and building, furniture) with poor quality assurance and no focus on exports	-Vertical integration of firms in the region -Cost sharing of the development and introduction of new technological processes such as 2K-injection molding, production of intelligent packaging, manufacturing of products for construction industry based on composite materials -Shifting to high end niches markets (medicine industry, home appliances, technical components) -Focus on high value added products
GAP 7	Quality assurance- Quality certification ISO 9001-2008, Acquisition of CE sign in order to pursue strategic buyers so the in international markets	According to rough estimates 70% of firms in the sector do not have a basic standard ISO 9001-2000. No firm owns CE sign for existing product. There is only one company which has ISO 14000 standard. Some companies managed to acquire large customers due to quality standards, yet those are individual cases. Firms in the region are solely concentrated on domestic market since they lack internationally recognized quality standards.	-Raising awareness of management in firms about the importance of quality management systems. -Developing support programs for companies willing to implement quality management systems
GAP 8	Possession of adequate organizational skills of the top and middle management in companies in sector	Lack of organizational and managerial know-how: -Human resources managers -Business planning -Investments -Risk management -Sales -Marketing and marketing research -Communication -English Language	Corporate management and communication skills education

4.1 GAP 1 The Sector Strategy

Sector has no strategy, no mission and vision

Set of interventions

- There is a need to draft the strategy of the sector, to define the mission and vision of the sector and to create the sector technology road map with an aim to define strategic directions in gaining competitive advantage.

4.2 GAP 2 Establishment of referral center for the industry

The region needs to referral centers for the industry, made of the network of prominent experts from the industry to provide technical assistance and solve the problems concerning technological processes as well as the selection of technologies, especially when firms decide to invest in new machinery. Very often, firms look for product mix or individual product which requires the selection of optimal technology and optimization of technological processes, but the access to this type of services is very difficult, due to deficit of industrial experts. The selection of technology is usually based on available supply rather than market segmentation and product development that would influence the selection of technologies particularly when firms tend to enlarge production capacities or make new investments.

Set of interventions

- Establishing a base of professionals and companies from the industry capable to provide adequate technical assistance to firms. This initiative should be initiated on interregional level across BiH due to deficit of skilled professionals and relatively small and fragmented market in BiH.

4.3 GAP 3 Limited capacity of Cluster of plastic and tool manufacturing companies

Established by private sector in 2007, with an aim to: raise competitiveness through networking among small, middle, large enterprises and institutions, remove obstacles for the development, enable access to applied and advanced technologies, increase productivity, reduce the unemployment rate, better use of resources, increase the level of innovations, support research projects, improve the quality of jobs and create the value chain in the industry. Yet, it still faces the obstacles that seriously undermine its clarity of purpose. The Cluster was founded as association of legal entities and due to current regulations cannot engage in business activities, which contradicts its role to gain the benefits for its members. So far, the Cluster of plastic and tool manufacturing companies only managed to gain recognition by firms in the sector, local community and NERDA Regional Development Agency, while support of policy makers is still missing (Including cantonal, entity and state authorities), unlike in Western Europe, where clustering has been seen as an instrument for building the competitiveness of various industries. Firms in the region still perceive each other as competitors instead of networked entities along the value chain. The sector has no strategic directions since majority of firms engage in business ventures non-related to sector, which weakens their core competencies. The clustering in the region is still in the early stage and requires better organization of firms and institutions, vertically and horizontally along the value chain. On the other hand, single firms cannot achieve the negotiating power on their own, particularly concerning the gaining bargaining position with suppliers and buyers.

Set of interventions

- Promote the affirmation towards clusterization and further networking among firms, organizations and institutions with the aim to build competitiveness of the industry in the region
- Identification of recognizable final and complementary products and launch the initiative of inter-sectoral cooperation
- Integration of all available relevant data about industry into single data base through supplier-processor-customer principle, which in turn will provide the information to firms about machinery suppliers, raw materials and potential buyers

4.4 GAP 4 Poor knowledge of how to utilize applied CAD/CAM/CAE technologies

One of the key factors of the competitiveness is the degree of applied know-how in using 3D CAD/CAM/CAE technologies. The sector suffers from the deficit of professionals with applied know-how, particularly concerning application of advanced technologies in tool design and manufacturing. Unpopularity of studying mechanical engineering and other engineering disciplines represents a major problem, resulting in small number of graduates with no know-how demanded by industry.

Set of interventions

- Enabling access to tailor-made education and introduction of quick vocational training programs in the areas of 3D CAD/CAM/CAE technologies with focus on new materials, technological processes and product and tool design

4.5 GAP 5 Use of hybrid polymer materials in plastic processing

Limited availability and price increase of non renewable resources, such as crude-oil, is considered to be a permanent change in macroeconomic setting. Local firms are generally vulnerable to external shocks of commodity pricing.

Set of interventions

- Shifting towards production based on new composite materials (mixing of plastics, wood, metal, ceramics and other materials) while using existing machinery and technological processes
- Initiating cooperation with regional and EU partners concerning FP7 programs

4.6 GAP 6 Shifting from low to higher value added production

This GAP implies the shifting from focus on cost cutting to product manufacturing for high end markets. Yet this adjustment requires ability to spot market opportunities as they arise and application of know-how in using existing production machinery through use of now polymer materials and advanced technologies. Firms in the sector usually act as suppliers of low value-added components for buyers who sell final products to end users. On the other hand, there is a lack of knowledge about how networking among firms can create a mutual benefit in cases when a single firm cannot respond to customer requirement. Due to loss of market, some firms slowly migrate from processing towards service-trade sectors.

Set of interventions

- Vertical and horizontal integration among the firms in the sector
- Specialization of firms in the region and aggressive approach towards market research
- Creation of the value chain through identification of the well-known regional products with export potential

4.7 GAP 7 Quality assurances through introduction of quality management systems

Based on the field survey and round table discussions with the firms in the plastics processing sector, it is evident that majority of firms do not have a base quality standard ISO 9000-2001. This situation represents a significant gap when building the export capacity. Firms decide to take on quality certification mainly because of customer requirement, rather than having own instrument for continuing business improvement. On the other hand the certification process is perceived as cost rather than investment for building the competency. Audits forced by buyers are becoming increasingly present and apart from ISO 9001-2000 standards in sight, look for more rigorous proof of quality. Very often going for international markets includes acquiring the product attest which represents a big barrier for local firms. It is worth mentioning that in BiH there is the BiH institute for standardization which introduces new BiH standards aligned with international and European standards. Out of 40 committees there is a Technical committee BAS TC/50 that comprises the standards related to plastics and rubber packaging. Corresponding European and international standards comprise the following standards:

1. CEN/TC 218 Rubber and plastics hoses and hosing equipment
2. CEN/TC 249 Plastics
3. CEN/TC 261 Packaging
4. CEN/TC 145 Packaging machines
5. CEN/TC 45 Rubber and rubber products

- 73% of the surveyed firms do not have the basic ISO 9001-2000 quality standard, while only one firm in the plastics processing sector owns ISO 14000 environmental quality standard.

Set of interventions

- Identification, promotion of existing and initiation of new co-financing programs, related to implementation of quality management system by firms in the region.
- Launching of educational programs that cover the topics of introduction and benefits of quality management systems, particularly considering upcoming standards and getting firms ready for the norms that will be specified by these new standards.
- Considering the establishment of the regional quality excellence center in cooperation with European institutes.

4.8 GAP 8 Shortage of organizational and other managerial skills

The skills of managers associated with management of business processes are inadequate, particularly concerning the principles of the value chain, international marketing, sales and human resources management.

- 95% of managers, in our sample, believe that the highest priority should be given to sales training
- 84% of managers of the surveyed firms pointed out that improvement of skills of employees and their superiors is a very important factor for improving their competitiveness
- 63% of firms, in our sample, believe that the most important type of training is the one related to quality management
- 53% of companies, pointed out that training related to customer service should be treated as the highest priority

Set of interventions

- Introduction of fast business education programs based on the needs of industry particularly concerning the following disciplines: marketing, sales management and management of human resources

CHAPTER V

VALUE CHAIN ANALYSIS OF THE SECTOR

5.1 Value chain analysis

Value chain analysis comprises the mapping of subsequent core and supporting activities, all the way from raw materials procurement to delivery of products and customer service. The value chain can be observed as a set of total, detached and connected activities that make the value chain for customers through: the product design and product development, manufacturing technological processes, promotion, distribution, sales and other business functions. In this part of the analysis the sector is described through strategically essential activities with an aim to understand and to examine all core and supporting activities in the sector and their interaction with the aim to identify the sources of competitive advantage.

This analysis describes five generic categories of the core activities in the plastics processing and tool making sector

1. **Inbound Logistics** represents activities associated receiving, moving, warehousing and dissemination of inputs required to make products, including material handling, storing, inventory management and transporting.
2. **Production Processes** include activities associated with transforming the inputs into the final products such as: product and tool design, plastics processing, packaging, maintenance of machinery and capacity management.
3. **Outbound Logistics** relates to activities associated with collecting, storing and distribution of products to buyers including order processing delivery planning and transportation of products.
4. **Marketing and Sales** is associated with identification and satisfaction of customer needs and all activities that influence buyers to acquire the products. Marketing covers areas of: market research, managing the promotional mix, pricing, distribution channels management and promotion.
5. **Service** relates to all activities associated with services that enhance the value of the product, as well as installation, repair services, training, spare parts and product adjustment.

The sectoral activities are illustrated in the Table 5.1 and their interaction with support activities which cover four generic categories: Procurement, Technology Development, Human Resource Management and Sector Infrastructure.

Procurement Although the large number of firms in plastics processing sector use identical resources, the firms have their own procurement, which in turn does not provide a competitive advantage in the market concerning the bargaining power towards supplier. The resin producers turn the petrochemicals into resin. The key buyers are producers of paint, plastics and adhesions. The largest global resin producers are international companies with well-developed network of distributors and agents across the globe. Some of them are: NOVA Chemicals, BASF, Bayer, Dow Chemicals, DuPont, Royal Group, Imperial Oil, Oxy Vinzls, Basell, Sabic, Borealis, Petromount, KoSa, AT Plastics, Estman Chemical, etc. The resin producers are generally global firms focused on their new polymer technologies with the tendency to form strategic alliances to share the cost of the development of new technologies with firms that enrich the resins through adding and mixing of additives, pigments, stabilizers and plastizators. The sector is well covered by resin distributors across BiH. There is no producer of resin in BiH, and it is entirely imported substance. The imports are done by trading companies and agents of major EU and

regional distributors. Since resin material completely imported input, as well as equipment the sector cannot be rated as competitive regarding the status of raw materials.

The plastics processing equipment converts resins into actual products made of plastics, includes wide range of technological processes among which, the most popular are: Injection molding, extrusion, blowing and thermoforming. The average age of the machinery in the sector is 5-10 years old. The leading machine and equipment manufacturing companies for plastics processing companies are: HASCO, Husky, Mold Masters, Alpha Maraton, Compact Mold, Corma, Engel, Ryka Molds, Wentworth Mold and Die, MacroEngineering. Equipment manufacturers usually come from developed economies: Germany, Italy, USA and Japan. During the last decade, a number of tool component manufacturing companies emerged from the East. Some plastics processing companies also own the tool shops with tooling machinery for molds making for plastic products. Tool shops are mainly used for the maintenance as support process to manufacturing, but they are one of the most critical factors for manufacturing of competitive products made of plastics, since the quality of plastic products directly depends on the quality of tool design and manufacturing. Tool shops are mainly printed towards manufacturing for the single injection molding. There are firms in the sectors with the latest technology, but mostly used for the manufacturing low value-added product intended for domestic market.

Human resources in the sector of plastics processing still could be described as non-satisfactory due to significant deficit of skilled mechanical engineers and technologists with applied know-how in areas of technical groundwork as well as in the production. As attractiveness to study technical disciplines, with unbridgeable gap between skills provided by universities and those applied that are demanded by the industry. The formal education does not have the resources to produce professionals capable to utilize available technologies, and to enable firms to make better and higher quality products. Firm in the region suffer from poor human resource management which makes very difficult to attract the prospective talents as future employers, while firms also face the problems of high employee turnover of those with university education. The education of employees mainly encompass on job training practices and the activities associated with internal audits while implementing ISO quality management standards and education related to accounting and finance since these functions must comply with state regulations. The trainings concerning the technology based skills are very poor and it is usually the employees who bear the cost of education, or the training is provided by equipment suppliers. The systematic planning and approach towards education in firms are very rare. Only 47% of the surveyed firms has annual training plan for their employees without allocated share of budget for the purpose of education. Such environment does not provide the basis for building the competitiveness based on the human capital development.

- 90% of the surveyed firms do not have the human resource policy
- 53% of respondents do not have the training annual plans for their employees
- 79% of the managers have never performed the performance appraisal of employee
- 84% of managers do not practice to measure the satisfaction of employees

Technology Development covers various processes such as document management, customer relationship management, supply management, development, control of process management in production, etc. The technologies and manufacturing equipment in the sector optimally meet the product requirements of the domestic market. The product and tool design in plastics processing is mainly based on outdated 2D technologies used in technical departments. Large number of firms utilizes illegal 3D CAD/CAM/CAE software applications technologies which results in the loss of capability to respond to customer request, followed by errors in technical groundwork and tool manufacturing, forcing firms to improvise and manually configure CNC machines. The sales, distribution and use of illegal software applications stimulate the shadow economy and undermine the growth of new engineering firms which invest substantial amount of money in acquiring licensed technologies.

Managers of firms believe that buying the machinery and other technologies does not pose an obstacle as long as there is a secured market for their products, yet meeting market demands requires market research activities and spotting the market opportunities on time as well as adequate know-how for product development through use of 3D CAD/CAM/CAE technologies. There are firms in sector which have the latest available equipment, but such equipment is mainly used for manufacturing of low value-added products (Food packaging, Building and construction and furniture industry). Firms usually base their production on products easy to copy from elsewhere. The higher value-added products (Hi-Tec, medicine, technical components for electronic industry) are way too advanced for the current level of technologies in local firms.

Speaking of technologies associated with business functions in local firms it is worth mentioning that those technologies are usually based on accounting and finance software applications and inventory management. There is no a single firm with integrated ERP system that enables monitoring and control of business functions, since managers believe that the purchase of such software still does not justify investments.

Sector Infrastructure – So far there are three elements of the sector infrastructure available to all firms in plastics processing sector (See Chapter III, pp. 10-12). They are:

1. Association of legal entities “ Cluster of plastic and tool manufacturing companies of BiH”
2. MTTC Center for advanced technologies
3. Regional board for plastics processing industry of the EBiH region

The Figure 5.1 illustrates the current value chain of plastics processing industrial sector and its potential status (shown in Figure 5.2). The potential value chain of the sector will be determined by strategic willpower of the firms operating in sector.

SECTOR INFRASTRUCTURE					
Human Resource Management	In the early development stage (Cluster of plastics and tool manufacturing companies, MTTC-Center for Advanced Technologies, Regional board for plastics processing industry of the NEBiH region)				
	Education mainly based on learning by doing on-job training	Poor level of human resource management, poor performance appraisal of employees, lack of motivational instruments, lack of structural career path offer to attract young talents, significant employee turnover, poor professional training, learning by doing acquisition of skills. Absence in systematic education and building of competencies.	Learning by doing	Poor level of human resource management, poor performance appraisal of employees, lack of motivational instruments, lack of structural career path offer to attract young talents, significant employee turnover, poor professional training, learning by doing acquisition of skills. Lack of competencies for international markets.	Education mainly based on learning by doing on-job training
	Low level of technologies. Accounting and finance and inventory management software systems. Tailor-made IT software applications.	Product and tool design manly based on outdated 2D technologies or by use of illegal 3D CAD/CAM/CAE software applications. The management of technological processes, production controlling and maintenance is inadequate. Evident lack of CAD/CAM integrations with manufacturing. Noticeable lack of the engineering development	Low level of technologies. Accounting and finance and inventory management software systems. Tailor-made IT software applications.	Poor utilization of IT technologies in market research and sales. Inadequate management of market research, Customer relationship management and distribution channels.	
	Own transportation or outsourcing of transportation services.	Each firm owns or does its own procurement of raw materials, equipment, tools and tool components peripheral equipment, education, maintenance, utilities. Poor outsourcing practices.	Own transportation or outsourcing of transportation services	Purchasing of media channels and other promotional channels without focus on target markets, Inadequate management of distribution channels.	Field visits to buyers , travel allowances
	Manual inbound material handling with no sophisticated IT systems in place or automatization. Manual data entry.	Tool manufacturing, plastics processing (single component injection molding) of thin and tick walls, extrusion (single component extrusion) film production, thermoforming, expanding, etc.).	Order processing and distribution mainly based on manual entries and accounting software	Firms practice to individually carryout mass advertising, promotion, sales, attendance of fairs ,	
INBOUND LOGISTICS	PRODUCTION OPERATIONS	OUTBOUND LOGISTICS	MARKETING AND SALES	SERVICE	PROFIT
No relationships established among firms			No relationships established among firms but buyer-supplier		

Figure 5.1 Current value chain in plastics processing sector in the NEBiH region (Model based on Michael .E. Porter, Competitive advantage p. 63, Figure 2.3 (Subdividing a Generic Value Chain))

	SECTOR INFRASTRUCTURE				
	<ul style="list-style-type: none"> Strengthened association of plastic and tool manufacturing companies as strategic network that enables bargaining power of supplier-sector-buyer The establishment of a strong referral center for the industry MTTC-Center for Advanced Technologies – The core of the industry development offering fast and demanding services which firms cannot afford to develop individually, but required to quickly respond to customer requirements Regional board for plastics processing industrial sector- strategic leadership of the plastics processing and tool making industry in the region Clearly defined the strategy of the sector, mission and vision 				
Human Resource Management	Top training for employees	Top level of human resource policy, top level of motivation, structured career path offered to talents, top performance measurement of employee in place, Low employee turnover, top training s for employees, Fast and applied training related to system integration of CAD/CAM/CAE technologies.	Top training for employees	Top level of human resource policy, top level of motivation, structured career path offered to talents, top performance measurement of employee in place, Low employee turnover, top trainings for employees. Top rewarding systems for top performers.	Top training for employees
Technology Development	Top processing technology followed by top quality assurance	High level of use of licensed and sophisticated 3D CAD/CAM/CAE technologies and processes. Top level management of technological processes (2K injection molding, 2K extrusion, production of intelligent films, the development of new products based on plastics expanding technologies, fully automated production control and top quality maintenance of the equipment and manufacturing plants.	High level of ERP systems integration	High level of the utilization of IT technologies in sales and marketing departments. Intensive market research activities. Utilization of top CRM applications.	
Procurement	The most reliable transport	Procurement through clustering among the firms. Top raw materials with the highest quality of attested components	The most reliable transport	Selective approach in choosing of promotion for target groups.	
	Use of top ERP systems	Top product and tool design for two component injection molding, two component extrusion. Prototype development, product digitalization, hughlz sophisticated production of intelligent films, development of new products made of EPS materials. Top printing quality for plastic products. Production based on composite polymers, top product quality control, top management of process and production capacities. High level of innovations, top design, decreased level of defects, shortened production lead time. High flexibility in production.	Fully automated order processing and fast delivery	Top competencies of sales teams, top promotional materials	
	INBOUND LOGISTICS	PRODUCTION OPERATIONS	OUTBOUND LOGISTICS	MARKETING AND SALES	SERVICE
	Strategically defined interrelationships among production firms (cost sharing in development and technologies)		Established Interrelationships among the firms in the market through mutual collaboration (Cost sharing in marketing , joint response to customer requirements)		

↑PROFIT

Figure 5.1 Potential value chain in plastics processing sector in the NEBiH region (Model based on Michael .E. Porter, Competitive advantage p. 63, Figure 2.3 (Subdividing a Generic Value Chain)

THE MATRIX OF POSSIBLE SOURCES OF INTERRELATIONSHIPS AMONG FIRMS IN THE SECTOR

PROCUREMENT INTERRELATIONSHIPS		TECHNOLOGICAL INTERRELATIONSHIPS		INFRASTRUCTURE INTERRELATIONSHIPS		PRODUCTION INTERRELATIONSHIPS		MARKET INTERRELATIONSHIPS	
source of interrelationship	possible forms of sharing	source of interrelationship	possible forms of sharing	source of interrelationship	possible forms of sharing	source of interrelationship	possible forms of sharing	source of interrelationship	possible forms of sharing
Common purchased inputs	Common procurement	Common product and tool design technology	Joint Technology Development	Common infrastructure needs	Shared financing	Common location of raw materials	Shared inbound logistics	Common buyer	Shared brand name
		Common process technology		Common relationships with policy makers	Shared relations with policy makers	Identical or similar production processes	Shared production of identical components	Common distribution channel	Cross-selling of products
		Common technology in other value activities		Common capital	Shared hiring and training	Identical procedures concerning quality management, product control	Shared assembly facilities	Common market	Cross-selling of complementary products
		Complementary products			Other shared infrastructure activities	Shared maintenance	Shared Testing and quality control facilities		Shared marketing and sales activities
							Shared maintenance		

Figure 5.3 Model based on possible sources of interrelationships of firms in the sector (M.E. Porter str. 339/340)

POTENTIAL SOURCES OF COMPETITIVE ADVANTAGE FROM PROCUREMENT INTERRELATIONSHIPS			
<i>Source of interrelationship</i>	<i>Possible forms of sharing</i>	<i>Potential competitive advantage</i>	<i>Most likely sources of compromise cost</i>
Common purchased inputs	Joint procurement of common inputs	-Lower costs of inputs -Improved input quality -Improves service from suppliers	-Input needs are different in terms of quality and specifications
POTENTIAL SOURCES OF COMPETITIVE ADVANTAGE FROM TECHNOLOGIES INTERRELATIONSHIPS			
<i>Source of interrelationship</i>	<i>Possible forms of sharing</i>	<i>Potential competitive advantage</i>	<i>Most likely sources of compromise cost</i>
-Shared Technology of product and tool design -Shared Technology of Technological processes	- Difference in technological processes of plastics processing -Different applications of technology	-Lower costs of product and tool design (shorter design time) -Concentration of critical mass of know-how and capability to attract talents -Improved innovation -Improvement of the product -Transfer of know-how in using of advanced 3D CAD/CAM/CAE technologies	-Technologies might be identical but not applications
POTENTIAL SOURCES OF COMPETITIVE ADVANTAGE FROM MARKET INTERRELATIONSHIPS			
<i>Source of interrelationship</i>	<i>Possible forms of sharing</i>	<i>Potential competitive advantage</i>	<i>Most likely sources of compromise cost</i>
-Common buyer -Common market -Common distribution channels	-Shared brand name -Shared advertising -Shared promotion -Cross-selling of -Complementary products -Common marketing activities -Common distribution channels -Common service network -Joint order processing	-Lower cost of market research and market development -Lower: advertising costs, finding new buyers, selling, distribution, etc.	-Different products and market segments -One product with diluted reputation might endanger others -Products positioning is different in the market -Customer demands differ -Target groups diverge -Ordering cycles are inconsistent with order processing needs
POTENTIAL SOURCES OF COMPETITIVE ADVANTAGE FROM PRODUCTION INTERRELATIONSHIPS			
<i>Source of interrelationship</i>	<i>Possible forms of sharing</i>	<i>Potential competitive advantage</i>	<i>Most likely sources of compromise cost</i>
-Common location of raw materials -Identical or similar production processes -Identical procedures concerning quality management, product control -Shared maintenance	-Shared inbound logistics -Shared production of -Identical product components -Shared assembly facilities -Shared Testing and quality control facilities -Shared maintenance	-Lower transportation costs -Better technologies -Just in time ordering of raw materials -Better utilization of production capacities -Products and production processes are complementary - Lower costs of maintenance	-Sourcing of inputs from different locations -Needs for quality among firms vary -Different production processes -Different technologies -High set-up costs for different types of manufacturing processes -Testing procedures and quality standards differ

Figure 5.4 potential sources of competitive advantage from interrelationships (Model based on Michael .E. Porter, Competitive advantage pp. 343-344, Table 9.2)

5.2 Conclusions and recommendations for the value chain creation

The analysis of possible sources of interrelationships among firms in the sector (Figure 5.3) it is possible to gain competitive advantage through networking among the firms with the aim to take advantage of potential sources of competitive advantage originating in interrelationships and possible forms of sharing through.

- Joint procurement to achieve better price of raw materials, technologies, equipment, education, promotion and other resources from suppliers.
- Joint investment in technologies and creation of interrelationships to lower the costs of: product design and transfer and development of know-how
- Joint activities in marketing and sales that are based on creation of long term relationships along horizontal and vertical value chain, including the activities that would be otherwise more expensive for individual firm (market research, managing promotional mix, sales, international marketing, selling complementary products while negotiating business deals with larger buyers)
- Joint investment in the development of infrastructure. The private sector has established the Cluster of plastic and tool manufacturing companies with initiative to create MTTC - Machine Tool Technology Center-Center for Advanced Technologies, yet further integration of these institutions with development institutions, particularly with the institutions of higher education.

There has been an increase in the demand for engineering services related to tool design. Since the prices of tooling steels and steel alloys are established in global markets, the technology development, product quality, fixed and variable cost reduction will determine the competitiveness of this industry.

Plastic processing companies are facing with customers demands and pressure from competition to adjust to existing know-how, technologies and standards or they will jeopardy their market sustainability. Therefore the human capital development represents the key challenge for building the competitiveness in this industry in time to come.

Apart from automotive sector, there are a range of industries offering opportunity for supplier network for this industrial sector. With an aim to adopt and to focus on good working practice, new technologies and high value-added production, it is evident that sustainability of the sector in the NEBiH region and BiH, will without a doubt depend on ability to absorb the applied know-how and technologies required to attain and sustain the competitiveness of this sector and its integration into global value chain. The greatest challenges for this industry are related to absorption of new technologies and the development of polymer materials.

New technologies

Continuous transformation in technologies is certain and includes three types of change:

1. Improvement to existing technologies
2. Emerging technologies
3. Breakthrough technologies

These technological changes will be particularly present in areas of:

- Rapid prototyping
- Nano-materials as additives and reinforcing agents in many applications and technological processes

- Process production oriented innovations

New polymer materials will have a significant impact on plastics processing industry in: packaging, building and construction and automotive industry:

Packaging

- Intelligent packaging of consumer goods
- Polylactic acid (PLA) resins made of corn and organic oils
- Nano-materials as additives that improve stiffness in light weight materials
- Increasing number of the layers to improve the structural properties with reduced thickness
- Use of advanced PET resins with improved properties
- Advanced printing and decorating processes

Construction and Building

- Extrusion of WPC products (Wood Plastic Composites)
- Coextrusion of different materials
- Production of hydronic pipes with composite layers
- Injection molding with composite resins including fiber composites
- Intelligent roofing – (a combination of solar cells and recycled plastics)

Automotive industry

- Renewable bio-fibers and bio-materials for interior parts
- Laser welding of thermoplastics
- Injection molding of composite materials
- Manufacturing of TPO³⁷

³⁷ Thermoplastic polyolefin

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