

Report on the Electronics Sector in Pomerania

May 2022

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# INTRODUCTION

"Semiconductors are in shortage!" – that is what the headlines of newspapers, web portals, and the news strips of TV stations were screaming in mid-2021. Some car assembly plants came to a standstill, the wait time for a new car extended to a year, the prices of most electronic devices skyrocketed.

The semiconductor shortage made us aware of several things, including the dependence of supply chains on Asian factories, the scarcity of resources and production capacity in Europe, the fragility of the just-in-time operating model. Most of all, however, we have come to realise how dependent we are on electronics, our smart cars, phones, computers, refrigerators, stoves, apartments, factories. Today, electronics are everywhere, and determine the effectiveness of our activities in professional life and convenience in private life. And there will be even more of it.

Our report looks at the electronics sector primarily through the lens of current trends in manufacturing, supply chain organisation, and foreign investment. We focus on Poland and Pomerania, but we also show a broader picture. The pandemic has exposed all the weaknesses of the global production model while stimulating, at least in part, a return to safe, just-in-case solutions, which in turn brings the need for new investment projects to be delivered as close as possible to end markets. How will Pomerania find itself in this new reality? Can we count on new investments? Will the companies that already manufacture in our country grow? If so, in what directions? Finally, are we likely to have a semiconductor factory? We invite you to read our analysis and feedback from our investors.

Invest in Pomerania team

# METHODOLOGY

The aim of this report is to present the general situation of the electronics sector in Pomerania and to show the most important trends that are currently taking place in the sector. Keeping in mind the interdisciplinary nature of electronics and keeping in mind the goal of presenting the sector in the most comprehensive way, our study also discussed software development in addition to electronics manufacturing itself. This industry is closely related to, and even determines the operation of electronic devices.

We also mention component manufacturers who, nominally belong to the electrical equipment sector, also have a significant influence on the development of electronics in Pomerania. Energy storage systems are also included in the report. Although formally such systems are not electronic devices, because of the electronics integral to them, this is an important element that should be included in the report. Manufacturing and installation of energy storage systems is one of the most promising industries with significant potential for development in Pomerania.

As our primary research method, we adopted face-to-face interviews with representatives of the key companies we identified in the sector in Pomerania that responded to our invitation to collaborate: Flex, Aptiv, Lacroix Electronics, Radmor and Intel. The information obtained from these companies constitutes the axis around which the report was created and then supplemented with additional data illustrating particular phenomena.

In preparing the report, we used foreign balance sheet figures consistent with the most common tariff classification (CN – combined nomenclature and HS – harmonised system). The data sources we relied on are SWAID (analytical portal of the Central Statistical Office) and Trade Map (analytical portal created by the International Trade Centre UNCTAD/WTO).

In most cases, category 85 of this classification, which accumulates a diverse group of electrical and electronic products, was analysed. [1]

In the labour market analyses, the main source of data, other than interviews with local businesses, was employment data by PKD (business code) classification [footnote at end of report: In order to calculate the total employment in the sector for Pomorskie Region, we took into account the following PKD categories: C.26, C.27 and J.62).

The report was produced in collaboration with:





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# I. POLAND - ECONOMIC OUTLOOK



As of 2018, Poland is among the developed economies (FTSE Russell) with a stable rating of A2 (Moody's). [1] It has also been classified as one of the countries with the most friendly conditions for doing business and investing (Ease of doing business). [2]





GDP growth in 2021

The largest economy in Central and Eastern Europe

In 2021, Poland's GDP grew by 5.7 percent compared to the previous year (in which Poland, like most economies around the world, experienced a recession due to the Covid pandemic). The strong rebound was primarily due to positive consumer sentiment, which naturally influenced the standing of the industry. [3]

125 **105,4** 104,7 **105,7 105,7 100 97,5** 2018 2019 2020 2021

Poland is one of the most important markets in terms of the inflow of foreign direct investments (FDI) in Europe. In 2021, it ranked 4th in terms of FDI capital invested and the number of projects. At the same time, it ranks 1st in terms of new jobs created by foreign investors (FDI report 2022). [4]

In March 2022, the PMI for manufacturing was at 52.70 points. It has remained consistently positive since July 2020 (with a score above 50). [5]

**4TH RANK** in terms of FDI inflows

Gross domestic product in 2018 - 2021

**52.70** 



# TRADE THE VOLUME OF POLISH EXPORTS AND IMPORTS

Both Polish imports and exports show similar responses to market stimuli. 2019 was a difficult year for Poland's trade, reflecting a decline in the volume of domestic imports and exports. Despite the COVID-19 pandemic outbreak, 2020 data do not support a continued downward trend. Both imports and exports saw a slight increase compared to 2019.

The balance of Polish trade is currently negative. In 2020, Polish exports totalled USD 254.2 bn, while the value of imports is USD 254.7 bn. The value of imported products, particularly from China, continues to exceed the results of manufactured goods shipped out of Poland. [6]



	Value of Imports [USD k]	Value of Exports [USD k]
2016	188 517 819	196 455 270
2017	217 978 576	221 307 621
2018	217 978 576	261 815 269
2019	246 653 880	251 864 773
2020	254 660 433	254 169 032

# II. POLISH ELECTRONICS SECTOR



The electronics sector has been the driving force of the Polish economy for years. Due to continuous technological advancements, the industry is characterised by a remarkable growth rate. Foreign-owned companies, which have been around since the 1990s, remain the main players in the market. They launch new manufacturing plants in the country.

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# TRADE



Since 2016, the advantage of imports over exports of electronics in Poland has been steadily increasing. Especially notable is the hike between 2019 and 2020, when the difference was at USD 5.4 bn. The outbreak of the coronavirus pandemic forced society to adapt to completely new conditions and to change its habits in terms of work The study. demand for and consumer electronics, especially mobile computers, has been growing steadily since 2020. [3]

#### **IMPORT EXPORT**

Despite the noticeable difference between the value of Poland's electronics imports and exports, both have responded similarly to current economic trends over the years. Both imports and exports of electronic products from Poland have increased every year. Poland's overall trade growth in the electronics sector was disrupted by 2019 results, which saw declines of USD 2 bn for imports and USD 2.5 bn for exports.





## MAIN PARTNERS IN IMPORT AND EXPORT OF ELECTRONIC PRODUCTS [2]







# **EXPORT HITS**





Poland's biggest export hit are TV sets, radio sets and equipment for recording or reproducing sound and video. In this case, the value of exports amounts to PLN 23.8 bn [4]. It is a group of products attractive both in terms of exports and sales in Poland. In total, the value of consumer electronics production in Poland in 2020 was at over PLN 36 bn [5]





In addition, Poland is successfully exporting telecommunications products (PLN 12.7 bn) and electric cables (PLN 11.9 bn). [6] The fastest growing product group in terms of sales are electric batteries and separators. In this case, Polish exports reached a value of PLN 20.6 bn [7]



For years, Poland has also remained a key European market for manufacturing household appliances. In 2020 alone, 24 million units of large household appliances were manufactured. Thanks in part to foreign investment, Poland is now responsible for 35% of all EU white goods production. [8]

# IMPORTING ELECTRONIC PRODUCTS FOR POTENTIAL INVESTMENT

The most frequently imported products to Poland are telecommunications equipment (PLN 21.7 bn). Electronic integrated circuits also make a significant contribution to Poland's electronics imports (12.8 bn PLN). [9] The overall balance of trade in electronics products of CEE countries is negative. It was at -USD 4.2 bn in 2020. Against this background, Poland, despite having both the third largest value of imports and exports, has the largest negative balance. As a country with one of the largest populations in the CEE region, Poland has a high level of demand for such products, while manufacturing far less of them. This high value of imports across the region may also reflect the potential profitability of locating new manufacturing investments here in the context of shortening supply chains. [10]



# +15%

## SALES OF ELECTRONICS IN POLAND

In 2020, the electronics market in Poland grew by 15% and reached a value of over PLN 36 bn. Consumer electronics, which emerged as the top item of interest among electronic products in Poland during the COVID-19 pandemic, is responsible for the bulk of this value. Referring to data provided by PMR, it is expected that over the next five years, the consumer electronics and home appliances market will grow at an average annual rate of 3-5%. Along these lines, if PMR's predictions prove correct, the value of the consumer electronics retail market in 2022 alone in Poland could exceed the PLN 40 bn mark. [11]

# PRODUCTS AND INVESTMENTS - POLAND'S POTENTIAL

Among the largest electronics sector players investing in Poland are Samsung, Dell, LG Electronics, Flex, Nokia, Jabil, Aptiv, Whirlpool, Indesit and Electrolux. Companies are steadily increasing their production capacities and developing the processes they carry out, which indicates a positive perception of Poland as a foreign direct investment (FDI) destination. [12]



# III. ELECTRONICS IN POMERANIA



The electronics sector is one of the key economic sectors in Pomerania. Pomerania's dynamic development is indicated by the presence of international companies, educational and human resources potential.

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## SECTOR STRUCTURE

Globally, the electronics sector is characterised by a high degree of geographic dispersion and, at the same time, a highly integrated supply chain, which naturally allows multiple locations to exist in the value chain. Importantly, the high value-to-weight ratio of the product largely offsets transportation costs between locations where different stages of production take place. As a result, a common business model is outsourcing and offshoring those processes that are more labour intensive and require more employees.

In a very simplistic way, the structure of the sector can be described as follows:

# OBM

#### **EMS** original brand manufactures electronics manufacturing services

On the one hand, we have manufacturers - owners of OBM brands who concentrate production and high value-added services, i.e. R&D, design, marketing or sales, within their own organisation. On the other hand, we have global contract manufacturers (EMS providers), which are companies that turn finished concepts into final products. It is worth noting that this does not mean that EMS providers are only responsible for uncomplicated, labourintensive manufacturing. On the contrary, they increasingly integrate high-value-added processes by taking over, e.g. design of new products from their clients. Finally, suppliers of components, such as semiconductors and printed circuit boards should be mentioned. Here, too, manufacturing processes are very often characterised by high added value.

When discussing the electronics sector in Pomerania, it is worth taking into account this broader context and the structure of the industry. This is because the region has had both OBM and EMS companies as well as component suppliers for years. It is also important to highlight the hardware-software paradigm shift that is occurring.

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Traditional model, slowly becoming obsolete, of developing electronic products assumes that we first design and create the hardware to then develop the software that will enable full functionality of the product. Today, a project is approached comprehensively, working on hardware and software takes place simultaneously, so that already at the initial stage the possibility of errors is excluded and maximum integration is ensured.



says Bartosz Ciepluch, Vice President, Datacenter, Al and Networking Poland General Manager w Intel

## HISTORY OF ELECTRONICS IN POMERANIA -TRICITY, KWIDZYN, TCZEW

Kwidzyn

**Tricity** 

zachodniopomorskie

1947

Undoubtedly, the OBM company that initiated the history of electronics sector development in Pomerania is Radmor. The company, which derives directly from the company Morska Obsługa Radiowa Statków, has been manufacturing radio communication equipment for the military and private sectors in Gdynia since 1947.

Tczew

"The company was founded by employees of the Gdańsk University of Technology, who were engaged in the repair and servicing of equipment that came to Poland as reparations after the war" - says Zbigniew Furman, Sales Director at Radmor. "In the following years, the company focused on manufacturing equipment used on ships: sonars, navigation equipment and then radio communication equipment. In the 1970s, the company employed as many as 2,500 people. It was then that Radmor began making audio equipment, including the famous Radmoryna."

# 1991

However, we can talk about the real development of the electronics sector in the region only since the 1990s, when foreign capital began to flow into Poland on a larger scale. In 1991, in Kwidzyn, Brabork opened a TV factory under license from Phillips. 4 years later, a JV was formed between Phillips and Brabork to eventually spin off a company manufacturing heads and sell it to Jabil Circuit in 2002.

"At that time, a local supply chain began to form in Kwidzyn. Phillips began to attract its suppliers to the region and that is how the Lacroix factory was established in 1997" - says Andrzej Mrozik, General Manager, Member of the Board in Lacroix Electronics Sp. z o.o.

# 1995

Similarly, the history of Aptiv's Gdansk branch goes back to the 1990s. The company has operated since 1995. During the 27 years of its history, the plant has developed dynamically and has been expanded several times. Aptiv's Gdańsk branch is a vertically integrated factory (apart from final assembly, the plant manufactures electronic components - PCBs, cameras and plastic components)

"Aptiv is a global technology leader with more than 190,000 employees in 127 manufacturing facilities and 12 major technical centres worldwide. We are present in 46 countries and tackle the toughest mobility challenges through our deep expertise in software and systems integration, delivering market relevant solutions to our customers." - explains Rafał Brejza, General Manager of Aptiv plant in Gdańsk.

# 2000

Tczew, on the other hand, developed a little differently as a key electronics production centre in Pomerania. Here, there was a massive greenfield investment when, in 2000, a major contract manufacturer, Flextronics, announced the construction of an industrial park to serve Scandinavian markets for telecommunications systems manufacturing.

# 1990s

## Software development

This part of the sector began to develop very dynamically in the Tricity in the early 90s, mainly due to Polish entrepreneurs, and in this context Prokom should undoubtedly be mentioned. Over time, companies with foreign capital became more and more important. Here, we can mention Olicom, Lufthansa Systems or Jeppesen, A Boeing Company. In 1999, thanks to the global acquisition of the Danish Olicom, Intel came to Gdańsk, and in the following years it became the key representative of the IT sector in Pomerania, and at the same time it developed as the largest R&D centre of the corporation in Europe, employing 3000 engineers. Currently, in the region there are 25 thousand people working in the sector related to software development, both in smaller local software houses and in large international corporations that over the last decade have located their centres in Tricity (e.g: Amazon, Sii Poland, Dynatrace, Epam Systems, Ciklum, Kainos).



## SELECTED BRANDS

RADMOR	1947
PHILIPS	1991
ΙΚυ	1995
GEMALTO	1996
LACROIX ELECTRONICS	1997
INTEL	1999
FLEXTRONICS (FLEX POLAND)	2000
DELPHI	2001
JABIL CIRCUIT	2002
ΑΡΤΙΥ	2017
THALES	2019



# **PRODUCT PORTFOLIO**

The electronics sector is currently one of the fastest growing sectors of the economy in terms of products offered. This is undoubtedly related to the ubiquity of electronic devices in our lives and, as a result, has a very strong impact on the operations of manufacturers (especially in the context of an EMS company), which, on the one hand, have to adapt to the business cycles of individual industries and, on the other, offer production flexibility to their clients. In this respect, the examples of Pomeranian companies perfectly illustrate this characteristics of the sector.



R&D





plastics and

metal

processing



I



system integration



clean room

assembley



testing



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In 2018, our plant has definitely changed its production profile by moving from mechatronics to optoelectronics. This value stream is currently growing the fastest, and our plant has been selected within the group as the leader in this area.



says Rafał Brejza, General Manager of Aptiv plant in Gdańsk

# Flextronics, on the other hand, began by manufacturing telecommunications infrastructure:



We are among the few that have both electronics manufacturing and sheet metal and metal prefabrication in one place. The idea was to manufacture housings in one building, electronics in another, assemble everything into a final product, wire it, add software and have a ready base station for the telecom sector.

For the first 15 years of our business, about 95% of production was telecommunications infrastructure, hence the choice of northern Poland - at that time the top companies in the telecommunications sector were Scandinavian companies. Logistics were extremely important.

says Stanisław Motylski, General Manager of the Flex plant in Tczew.

In order to be independent of business cycles, Flex has been developing new business areas for the past 7 years. Currently, telecommunications (including solutions for 5G) account for 55% of production. The remainder includes industrial electronics, cameras, and electric car chargers.

In turn, 80% of the products manufactured at the Lacroix plant in Kwidzyn go to the automotive sector - these are mainly lighting systems and, to a lesser extent, amplifiers. This part of production did not begin to be developed until the early 21st century. Other products go to the smart home/industry sector.

We are an EMS company, but our ambitions go much further - we have our own R&D department and our goal for the future is not simply to provide electronics manufacturing services, but to design and manufacture new components or devices developed by us. At the moment, this part of our business represents only 5-7% of our turnover. In the next 5 years, we want this ratio to increase to minimum of 20 - 25%,

which will naturally also mean the development of our plant in Kwidzyn. For example, we are currently developing electronic systems that control gear shifts in electric bicycles.

says Andrzej Mrozik, General Manager, Management Board Member in Lacroix Electronics Ltd.

The issue of expanding services to include NPI/R&D is certainly a direction that EMS companies have been pursuing in for some time.

In the last 10 years, there has been a strong demand from clients not only to manufacture the product itself based on a finished design, but also to support the product implementation by working with the client's R&D department. These collaborations include, but are not limited to, validating the materials, verifying the design, overall assessment of quality and time-criticality of a given product.



#### says Stanisław Motylski, General Manager of the Flex plant in Tczew.



cameras

















lighting

control systems

telecommunicatio ns equipment

ID documents

data centre and ICT infrastructure

software/ firmware

Radmor, on the other hand, has been basically focused on radiotelecommunication solutions since the beginning of its existence (and for some time on audio equipment), however, the recipient of the products has changed.



Just as we have always been a supplier to the public sector (transport, police, rail), production for the military sector only began in the 1990s when we partnered with Thomson (now Thales) and offered The Ministry of Defence our radio stations, which to this day

are produced by us and are used by the Polish armed forces. Since then, the company's production profile has changed. We have developed our own radio station models, including a software-defined radio station.

says Zbigniew Furman, Sales Director at Radmor

The scope of Intel's R&D centre is also evolving. During the first years after the acquisition of Olicom, the Gdansk branch worked mainly on the architecture of mobile network devices. In 2005, when the company's corporate policy took a turn, computer graphics became a new area of research. In the following years, other specialisations were added.

Among other things, we are currently working on software for data centre platforms. These solutions are used by both government institutions and private companies. In part, the firmware we develop in Gdansk for the autonomous vehicle industry is also a specific application of these solutions. Such a flagship product is Intel Manageability Engine Ignition Firmware, which is used in premium cars and enables comprehensive monitoring and management of vehicle performance.



We are also working in areas related to artificial intelligence accelerators, which are based on neural network architecture, we are developing solutions related to networking and data processing, so that will be next-generation network card software and network hardware, we're working on graphics card software. Security systems should also be mentioned. Intel created the SGX solution, a modern technology located very close to the hardware and isolating the back-end from the user-accessible components. We are also working on this in Gdansk.

says Bartosz Ciepluch, Vice President, Datacentre, Al and Networking Poland General Manager at Intel

The use of AI through audio and video recognition, and numerous open-source projects complete the picture of technologies created by Intel in Gdansk. It should also be noted that Pomerania is home to a number of companies that integrate hardware design and prototyping with dedicated firmware development. Key companies such as Vector, Sprint and Carrier can be mentioned in this context. Component manufacturers also play an important role, especially in the area of cabling. Also in this case, numerous companies with foreign capital such as AQ Wiring, PanLink, Plati or WH-Technologies have developed their production in Pomerania in recent years.

# MAP OF KEY COMPANIES IN THE REGION FROM THE ELECTRONICS SECTOR



## **POMERANIAN ELECTRONICS FOR MOBILITY**



Just as most foreign investments in the electronics sector in Poland has focused over the years on consumer electronics and has created a fairly strong cluster in central Poland, Pomerania has developed a unique potential for locating projects that leverage on synergies and integration opportunities in diverse industries such as mobility or artificial intelligence and industry 4.0. From the perspective of the analysed companies, it is the modern trends in the automotive industry and its progressive electrification and electronification that set the direction of development for Pomeranian companies in the electronics sector.

Projections from NXP suggest that by 2030, electronics will account for up to half the cost of a car. Vehicles with autonomy level 4/5 need 8 to 10 times more electronic components including semiconductors than those with zero autonomy level. This means that as the automotive sector grows, and its ties to the electronics sector will continue to grow.



24.8 USD BN



Poland is one of the largest producers of cars and car parts in Europe. The value of Poland's automotive sector exports in 2020 was at USD 24.8 bn, the highest in all of CEE. Worldwide automotive brands such as Daimler, Volkswagen, PSA or Volvo are present in Poland. Pomerania also has a very large development potential in the sector. The automotive industry employs nearly 21,300 people at key companies in the region, which include Northvolt, Aptiv, Intel, Federal Mogul - Tenneco, Nippon Seiki, Scania, among others. However, the Pomeranian automotive sector stands out from other Polish regions as a supplier of technologies and components for autonomous and electric vehicles.

# **ELECTRONIC SOLUTIONS FOR MOBILITY**



One of the largest projects in the automotive sector in recent years was the investment by Northvolt. In 2022, construction began on a 50,000 sqm factory to produce battery modules used in industry and electric vehicles (including electric mining vehicles). The investment is worth USD 200 million and will be highly automated. During the official inauguration of the factory construction, Deputy Marshal of Pomorskie Region Leszek Bonna said:

"Although our region, quite wrongly, is not commonly associated with the automotive sector, new trends in the industry, especially electromobility and solutions for autonomous vehicles, predestine Pomerania to play an important role in the supply chain for the sector. Thanks to investments such as Northvolt, the perception of Pomerania has begun to change." [20]

# IV. EDUCATION AND LABOUR MARKET



In this chapter, we take a closer look at two related area - the local educational infrastructure and the labour market. We are evaluating the potential of the former to meet the needs of local business. We also try to answer questions about what competencies and occupations currently are and will be in demand in the future electronics industry.

# HIGHER EDUCATION IN POMERANIA

## THE LARGEST UNIVERSITY CENTRES IN NORTHERN POLAND ARE LOCATED IN POMORSKIE VOIVODESHIP

There are 24 universities in the region, 9 of which offer public education. In total, there are nearly 84,000 students in the province, and about 20,000 of them feed the local job market every year. The largest public universities in the region are the University of Gdansk, Gdansk University of Technology and Gdansk Medical University. The three universities in 2021 announced the establishment of Daniel Fahrenheit Universities (FarU) to better leverage resources and increase the potential of their centres. [1] Collaboration within the FarU can further deepen the cooperation between universities and create one of the strongest academic centres in Poland.

**24** universities

**84 000** students

**20 000** graduates



University of Gdańsk

Medical University of Gdańsk

Gdańsk Tech

## **TALENT POOL - ELECTRONICS SECTOR**



In terms of labour market needs, the university that meets the needs of the industry to the greatest extent is Gdansk University of Technology. It operates as many as 13 faculties, which educate about 5.4 thousand students in competencies desired by the electronics industry. Most of them are from the Department of Electronics, Telecommunications and Informatics, which received the highest possible grade, A+ in the national evaluation of the quality of scientific and R&D activities.

### **17 FIELDS OF STUDY AT 8 UNIVERSITIES:**

[number of students]

#### **ELECTRONICS INDUSTRY:**

Automation and robotics [896] Electronics and telecommunications [1047] Electrical engineering [1060] Mechatronics [283] Space and satellite technologies [32] Materials engineering [276] Mechanical and medical engineering [150] Management engineering [421] Production management and engineering [875] Engineering management [495]

#### IT INDUSTRY:

Mathematics [572] Nanotechnology [230] Computer Science [4577] IComputer science and econometrics [670] Mathematical modelling and data analysis [194] Data Engineering [197]





Map of universities and colleges offering degree programmes in the electronics sector

## **TALENT POOL - VOCATIONAL EDUCATION**

Vocational education in the region is currently provided to about 61,000 students. [2] In order to assess the potential workforce for the electronics industry, the number of students studying occupations useful to the industry was verified. In accordance with the classification of occupations, the analysis selected occupations aggregated in two groups: electronic-mechatronic industry and ICT.

# Occupations aggregated within the groups selected for analysis (based on the classification of the Centre for Education Development). [3]

Electronic and mechatronic industry	ICT industry
Automation engineer	Telecommunications network and equipment installer
Electronics engineer	Information Technology technician
Mechatronics engineer	Broadband Electronic Communications technician
Automation technician	ICT technician
Electronics technician	Programming technician
Mechatronics technician	Telecommunications technician
	IT technician for the blind and visually impaired





Students in vocational schools in the region

Students in key vocations for the electronics industry

# THE MOST POPULAR OCCUPATIONS USEFUL IN THE ELECTRONICS INDUSTRY





Number of students of vocational schools studying electronics in individual poviats of Pomorskie voivodeship.

Currently, Pomerania has almost 10 thousand students with education profiles compatible for the electronics industry, of which more than 50% are IT technicians.

The major centres, apart from Tricity, where education in electronics is concentrated, are the city of Slupsk and districts: Wejherowski, Starogard, Chojnice and Kwidzyn.

## LABOUR MARKET



It is worth noting that Pomerania is the national leader in terms of employment of workers in the manufacture of computers, electronic and optical products. More than one-fifth of all workers in this industry are employed here. The presence in the region of companies such as Aptiv, Jabil, Lacroix, Radmor, Intel and Flex creates a strong demand for qualified staff with the competencies needed to support both the manufacture of equipment, its creation and design (R&D, NPI).

## **Employment in the industry**



MORE THAN 1/5 OF EMPLOYEES IN THE MANUFACTURE OF COMPUTERS AND ELECTRONIC PRODUCTS WORK IN THE POMERANIAN PROVINCE

Currently, about 12,400 people work in the production of computers, electronic and optical products in Pomerania, which, as mentioned, is the highest figure among all Polish regions. It is also worth including those working in the production of electrical equipment - over 2,000 employees - which is reflected in this report in terms of the manufacture of components, primarily cables (CSO). Additionally, according to CSO data, 13,150 people work in software-related activities in Pomerania. According to the data collected by Invest in Pomerania, the total number of programmers (including freelancers) is around 25 thousand employees (2020 estimates).



## **NEEDS OF THE ELECTRONICS INDUSTRY**

Companies report difficulties in recruiting qualified staff, especially engineers, automation specialists, robotics specialists, optoelectronic engineers, but also specialists for production support - skilled operators, technicians and electronics engineers. To a lesser extent, companies are facing shortages of logistics, HR and planning professionals. It is estimated that the Polish market lacks about 20-30 thousand engineers in the IT and R&D sector, and the Industrial Development Agency forecasts the demand for specialist engineers to increase by 20% in Poland and 12% in Europe. [4]



Demographic decline and high demand for specialists in broadly defined technical professions to some extent limit development plans of Pomeranian production plants. The consequence of skills shortages is increased competition in the marketplace for workers and wage pressure on the industry. This situation particularly affects companies in the contract electronics (EMS) industry, which are characterised by speed and flexibility of business operations. The requirement to open a new production line in a short period of time is challenging in the face of unfavourable labour market trends. In some areas, immigrants are effectively filling the shortage, although the pandemic has slowed the work permit issuing process considerably. Companies agree on the large role of immigrants in bridging shortages in the local labour market for some of the industry's desired occupations. There is also a need to streamline and speed up procedures related to employment of foreigners in Poland.

According to Stanislaw Motylski, General Manager of the Flex plant in Tczew, companies in the industry in the future will redirect their interest to qualified personnel capable of handling highly automated production processes. This process has already begun to some extent.

At the same time, our interviewees stress that the vision of automating all production work is still far from reality. It is worth noting that despite the insufficient number of engineers on the domestic and European market, Polish specialists enjoy a good reputation. This is one of the reasons why foreign investors, such as Intel, locate their R&D centres here. There will be more and more products that will have an automated manufacturing process, so the need for production operators will be much lower. In turn, the demand for automation and robotics specialists will grow.

- says Stanisław Motylski, General Manager of the Flex plant in Tczew

Confirmation of the exceptional quality of Polish engineers can also be seen in the high scores on the PISA (Programme for International Student Assessment) exams, which Polish 15-year-olds consistently maintain and improve in reading, math and science categories. The 2018 exams placed Polish students in the top of the world in these categories - 10th in reading comprehension competencies and 11th in math and science.

**Programme for International Student Assessment** 



One factor is a very strong attachment to the sciences, from math to physics to chemistry to computer science. The element that distinguishes an engineer coming out of a Polish university is in many cases inquisitiveness. The willingness to ask yourself "why?", "what for?" and attempt to answer those questions. It turns into a passion of sorts. The third element is the ability to communicate in English, which allows you to work in an international environment.

says Bartosz Ciepluch, Vice President, Datacentre, AI and Networking Poland General Manager at Intel

# COOPERATION WITH UNIVERSITIES AND VOCATIONAL SCHOOLS

The industry proactively works to attract valuable employees to its manufacturing facilities by engaging in a variety of collaborations with universities and vocational schools. The companies emphasise, however, that their initiatives are not a substitute for systemic and long-term actions aimed at increasing the attractiveness of studies and specialisations of a technical nature. According to our interviewees, there is still a lot to be done, especially in the field of adapting the quality of vocational education to the business needs of the industry.

One of the interesting industry initiatives is the co-creation of courses at the postgraduate studies at the Gdansk University of Technology, entitled "The Future of the Company". "Electronics Manufacturing Engineering" and "Quality Assurance in the Engineering Industry". It is a joint initiative of the university, Interizon ICT Cluster and companies: Flex, Lacroix Electronics, Assel, Jabil Circuit Poland, Radmor, Kitron and Northvolt. These are dual degree programs that combine theoretical and practical knowledge. Most classes are taught by practitioners - company representatives. Graduates of the above majors later find employment in local companies in engineering positions.

Intel and Interizon ICT cluster are taking steps together to increase women's participation in the IT sector. The aim of the "IT for SHE" and "New Technologies for Girls" programmes is to help talented female students (in the case of the second programme, also high school graduates) to enter the job market and plan their careers and further professional development. The two brands also host an annual festival for women in technology called Intel "Women in Tech Days."


Companies like Flex and Lacroix are committed to working with vocational schools in the local area. They create, among others, patronage classes, whose graduates are prepared to take their first job or internship in the industry. For these efforts, Flex received the 2020 Economic Griffin in the Vocational Education Leader category [5], while Lacroix Electronics was awarded in the same category in 2018. Cooperation with schools focuses on investing in the technical and didactic base of schools, transferring knowledge and skills to students and professional development of teachers. Companies also have the opportunity to co-create the vocational training offer: issuing expert opinions and curriculum development for the profession.

Companies are also involved in initiatives to promote the choice of vocational education as part of students' educational path. One such activity was the robot duels organised as a hands-on activity, where middle school students from the region could programme their own robots to clash in a competition system.

I would encourage other companies to do this type of collaboration as well. Even if one company does not have the resources to create a patron class on its own, you can always communicate with a second and third company and do this together.

stresses Andrzej Mrozik, General Manager, Member of the Management Board of Lacroix Electronics Ltd.



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The classes were organised as part of the broader "School Close to Work" programme implemented over several editions by the Kwidzyn branch of Lacroix [6]

Intel has a very extensive education promotion effort. The company actively works to equalise educational opportunities among diverse groups. They are mainly children and adolescents at different stages of education and women. Noteworthy are programmes that inspire children and young people to work with artificial intelligence - "Pomeranian Wizard" (for elementary school) and "AI for Youth" (for secondary and vocational schools). The latter is an educational programme focused on giving participants the key competencies needed to understand and work with artificial intelligence. The programme of 90-hour practical classes is prepared in cooperation with the Polish government and organisations supporting modern education in Poland.

The "Pomeranian Wizard", on the other hand, has the form of a competition and is designed to get elementary school students interested in mathematics, programming and information technology. The contest is developed and organised by Intel employees as part of their employee volunteer efforts. Since 2010, more than 1600 participants from 70 schools have participated in the competition [7]. In addition, the first edition of the Pomeranian Hackathon for high school students was initiated last year. It was attended by 64 students representing 14 schools from six Polish cities. Intel, as a partner of the event, provided content and training support.



# V. TRENDS IN MANUFACTURING OF ELECTRONICS IN THE CONTEXT OF POMERANIAN COMPANIES



Among all the trends that are changing the electronics sector, we highlighted those related to new technologies, automation and robotisation, the use of clean energy in manufacturing, and changes in supply chains.

### **NEW TECHNOLOGIES**

Technology development is the foundation of the electronics industry. Innovation increases the competitiveness of industries, companies, but also entire regions and countries. New technological solutions allow for extensive product and service development and have a real impact on society and business.

Artificial intelligence, Internet of Things, 5G network or big data are the dominant technological innovations being developed in the market and changing the face of the market. The pioneer in developing these systems on a global scale is Intel.



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If we look at what is happening in the world of technology, the recent years are characterised by a huge increase in the amount of data. Data is the crude oil of the future. One of the major challenges for companies nowadays is how to deal with data. To process it in a correct way and use for further growth.

says Bartosz Ciepluch, Vice President, Datacenter, Al and Networking Poland General Manager at Intel



## **ARTIFICIAL INTELLIGENCE (AI)**

Artificial intelligence plays an important role in dealing with the plethora of information reaching users. According to Google CEO Sundar Pichai – The impact of artificial intelligence will be more significant to our development as a species than the impact of fire or electricity. Artificial intelligence is being used for space exploration, in the fight against climate change, and in the development of many medical treatments. This statement may not be overly exaggerated. [1]

While there has been buzz around AI for quite some time, it continues to be one of the emerging technology trends as its impact on society and business continues to evolve.

"With the amount of data reaching us, one of the challenges for each of us is how to deal with that data. We need a layer of abstracting, which will allow us to probe some information. Artificial intelligence will take on this role, indicating what is important to us and what is not. Obviously, modern technology cannot be divorced from sociology or ethics, but it is certainly an element that will resonate very strongly in the future - artificial intelligence under all sorts of versions. The challenge will be to be open to these solutions."

> says Bartosz Ciepluch, Vice President, Datacentre, AI and Networking Poland General Manager at Intel.

According to MarketsandMarkets, the global artificial intelligence (AI) market will grow from USD 51.27 bn (in 2021) to USD 309.6 bn by 2026 at a compound annual growth rate (CAGR) of 39.7% during the forecast period [2]

According to Forbes, key challenges for artificial intelligence in 2022 will include using AI in cyber security, low-code AI to make it easier to use, or applying AI to creative tasks that were previously seen as typically human skills. [3]



According to the U.S. analytics and consulting firm Gartner, simply adopting artificial intelligence solutions in an organisation is not enough. The need for an engineering discipline to guide the development and deployment of artificial intelligence capabilities, under specific conditions specific to the needs of the business. It is about getting the right staff and developing AI engineering in companies that will be the big challenge in the years ahead. [4]

## **INTERNET OF THINGS (IOT)**

The Internet of Things (IoT) refers to the billions of physical devices around the world that are connected to the Internet, collecting and sharing data through sensors placed in them. The Internet of Things is undoubtedly another of the most important technology trends of recent years. Its use is growing in importance every year.



The projected percentage of all data generated by the IoT in 2025. [5]

In business, IoT saves time and money by streamlining systems, tracking resources, coordinating operations and connecting employees. The Internet of Things is a solution that is constantly being developed in all industries and spheres of human life from private homes where lighting, alarm systems household appliances or are automated, to cities where street lights, traffic lights or information screens are integrated, to specific industries like medicine, energy or transportation. This is certainly just beginning the of the possibilities IoT offers.

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## **5G NETWORK**

With the rise of artificial intelligence and the Internet of Things, technologies that process and will continue to process countless amounts of data, it is imperative that networks have the scalable bandwidth and computing power to handle it. 5G, or fifth-generation connectivity standard, is a whole new level of connectivity that is expected to provide faster data transfer, lower latency and improved functionality to connect more devices on a single system. The advent of 5G is a paradigm shift in the use of telecommunications technology, where we can access the Internet from anywhere, at any time of the day at maximum bandwidth. This is extremely important in the everincreasing volume of data and the need to process it.

- says Bartosz Ciepluch (Intel)

Poland is one of the leaders in 5G innovation in Europe. The Pomeranian Flex factory on behalf of Ericsson has produced 1 million telecommunications devices to support 5G in the last 13 months. As Martin Mellor, head of Ericsson in Poland, emphasizes, the choice of Pomeranian Flex to manufacture equipment for 5G was due to the proximity of target markets, which confirms the trend of nearshoring in production, but also more than 20 years of cooperation between the two companies.

## GLOBAL CONSULTING COMPANIES ON THE IMPACT OF 5G: [6]

🍈 JLL	PREDICTS THAT IN THE UNITED STATES ALONE, 5G TECHNOLOGY COULD LEAD TO TOTAL ECONOMIC GROWTH OF AT LEAST USD 1.3 TRILLION.
QUALCOMM	FORECASTS TO GENERATE USD 13.1 TRILLION OF GLOBAL ECONOMIC OUTPUT
J.P.Morgan	ESTIMATES A REDUCTION IN HEALTH CARE COSTS OF 16% THANKS TO REMOTE PATIENT MONITORING
McKinsey & Company	CALCULATES THAT AGRITECH USING 5G CAN ADD USD 500 BN TO THE GLOBAL GDP BY 2030.

## EDGE COMPUTING

Edge computing, at its most basic level, places the processing and storage of data closer to the devices that collect it, rather than relying on a central location that may be thousands of miles away. This is to ensure that data, especially realtime data, is not subject to latency issues that could degrade application performance. Intel offers the world's most diverse computing, connectivity, storage and memory technologies for edge systems.

The primary benefit of Edge Computing is lower bandwidth requirements or faster real-time processing.



If we want to have all the data available at once, it would take too much time to transfer it to servers that are located in the United States. Hence the rise of edge computing.

explains Bartosz Ciepluch, Vice President, Datacentre, Al and Networking Poland General Manager at Intel

According to the report "Data Age 2025: The Digitization of the World, From Edge to Core" prepared by IDC (International Data Corporation) currently 48% of data is sent to data centres around the world, and it is expected to be at 59% of data within 5 years. This places a huge burden on the infrastructure to process it.

Much of it requires real-time processing. In the perspective of the development of autonomous driving, the information will be exchanged between vehicles and road infrastructure on an ongoing basis, as the safety and lives of the people traveling in them depend on it, which will generate a huge amount of data. [7]



#### AUTOMATION AND ROBOTISATION

The electronics industry is a complex branch of manufacturing engineering. It encompasses many stages of product manufacturing and other engineering activities from design, prototyping, modelling, simulation, testing, inspection and quality control. Therefore, the scope of automation and control in this sector is extremely wide.

Factory automation and robotisation has been a trend for years moving forward in electronics manufacturing. The rapid growth of this industry, the tremendous increase in the complexity of electronic system layouts, the shortage of manpower, and the pressure for faster production from the very beginning required the use of automation measures at all stages of the production of electronic systems and components. This has been particularly exacerbated since globalisation and increased competitive pressures in the international electronic marketplace. [8]

According to the International Federation of Robotics, the electronics sector has been a major driver of robotics growth. This is the sector that accounted for 29% of robot installations in industrial production in 2020, becoming its main client. This is up 6 percentage points from the previous year. The sector has thus overtaken the automotive industry, which was previously at the forefront of manufacturing automation. This is also related to the increased demand for consumer electronics manufacturing and with the help of robots increasing production capacity in this sector [9]



installation of robots in industrial production for the electronics sector

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New technologies are used not only to manufacture new electronic products, but also to optimise processes in companies, making them more efficient and effective.

Lacroix has been investing in solutions to improve production and factory organisation for years. Moreover, new products are also designed in Kwidzyn factories. The Internet of Things is used for communication between machines in a process.

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Pomeranian companies producing hardware for electronics such as Lacroix, Flex or Jabil work at the highest world level, using the most modern technologies and manufacturing products for global brands. What allows companies to increase their competitiveness is to optimise the use of machinery and organisation of work, which leads to an advantage in efficiency and quality of production. For at least three years, we have been building robotic equipment with the support of local suppliers to make manufacturing easier

says Andrzej Mrozik, General Manager, Management Board Member in Lacroix Electronics Ltd.

SELECTED SOLUTIONS USED IN COMPANIES



a digital clone of the factory that allows a more optimal design of new machine positions



automatic guided vehicle (AGV)



3D printing used for prototyping and tooling production



using IoT for machine-to-machine communication



employee training using VR, AR

Rafal Brejza, General Manager of Aptiv's plant in Gdansk, points to two elements driving the trend - automation and robotisation in manufacturing:

The first is the ever-increasing cost of labour, which makes it increasingly worthwhile to automate a manually performed process. The period of return on such investments is often less than 2 years, which becomes attractive to us. The second element is the level of technological sophistication of the products. Some activities need to be automated. The worker's role is limited to managing machines that perform work that cannot be done by humans. These two elements are strongly driving automation and robotisation.

says Rafał Brejza, General Manager of Aptiv plant in Gdańsk

Aptiv is also investing in AGV (automated guided vehicle) trucks that will transport materials around the plant. Automatic transport systems are the answer to the challenges of modern logistics. AGV systems make repetitive tasks fully automatic. This allows you to increase the efficiency of your warehouse processes while often reducing additional costs.

Areas where work is strenuous for humans and jobs that can be hazardous, such as automated welding or grinding machines, are worthy automating and robotising. At our company, we are taking these steps and seeing favourable results.

comments Stanislaw Motylski, General Manager of Flex plant in Tczew Production at the Flex branch in Tczew is also highly advanced. The latest technological developments, as in Lacroix, are used to optimise organisational processes in companies through the use of VR or AR. Automation will also progress where there are significant labour shortages and where production time and efficiency are accelerated. It is also a step toward the complete robotisation of jobs that are strenuous to humans.

### MANUFACTURING USING CLEAN ENERGY

Reducing CO2 emissions and the energy transition to green energy are among the most important topics being raised at many levels of energy policy and economics around the world. Corporations have made a U-turn on renewables, purchasing more and more green energy every year. Bloomberg NEF's research observes significant stakeholder interest in corporate sustainability and the global expansion of clean energy access. Industrial production in 2020 was responsible for:





Source: Bloomberg NEF. Note: The data is for the period through 2020 and is reported in MW of direct current. Onsite PPAs are not included. PPAs entered into prior to Mexico's market reform are not included. The figure for the APAC region is an estimate. This data is subject to change and may be updated as more information becomes available.

While the United States, where companies have announced contract signings for 11.9 GW of clean energy in 2020 and are the clear global leader, has seen a decline from previous years, other corporate procurement markets have risen.

Power Purchase Agreement (PPA) volumes by companies in Europe, Middle East and Africa (EMEA) region nearly tripled, from 2.6 GW in 2019 to a record 7.2 GW in 2020. Investor interest in sustainability is very high. Companies in all sectors, including highly energy-intensive ones such as oil and gas and mining, are feeling the pressure to buy clean energy and decarbonise [11]



Source: Bloomberg NEF. Note: The chart is in MW DC and includes only offsite PPAs. Data based on public announcements.



From our observations as an entity that handles investment projects, all of the key investors in the manufacturing sector that we serve are looking at the need for energy to run production from renewable sources. Sometimes it is even a determinant of an investment decision.

says Mikolaj Trunin, Deputy Director of Invest in Pomerania

Among Pomeranian companies from the electronics sector, which are part of the zeroemission energy trend, there is Flex from Tczew and Aptiv from Gdansk. These companies not only purchase certified renewable energy, but also plan to make them partially independent in terms of their energy supply from outside entities.

> We have more and more inquiries from customers about what energy sources we use and whether these are green sources. I predict that in the next 5-10 years there will be pressure to make the energy we use renewable, or to produce it ourselves in a sustainable way. We at Flex are already implementing measures to reduce CO2 emissions. From 1 January 2022, all the energy we buy is green energy, confirmed by appropriate certificates

says Stanisław Motylski, General Manager of the Flex plant in Tczew

Aptiv's global strategy is to become an environmentally neutral company. By 2021, Aptiv was using 2% green energy globally. By 2025 it is expected to be 25% and in 2030 100% of energy from renewable sources. By 2040, Aptiv plans to become a carbon footprint neutral company. We intend to install renewable energy sources on the premises of our factory in Gdansk. Issues of further development of the project will depend on regulations being introduced in Poland."

says Rafał Brejza, General Manager of Aptiv plant in Gdańsk

Unfortunately, behind the increased interest in green energy, supply has not kept up with demand. Many companies, like Flex, are taking on energy generation in order to become independent of suppliers and, most importantly, reduce the company's emission rate, meet customer demands and fit into a global, low-emission energy policy.

We are in the final stages of analysing a project through which we will partially power our production with our own solar power plant installed in the vicinity of the production facility. This will be an important competitive factor in the future.

adds Stanisław Motylski (Flex Tczew)

#### **CHANGES IN SUPPLY CHAINS**

Transportation bottlenecks, price increases, and material and labour shortages caused widespread supply chain disruptions in the wake of the Covid-19 pandemic, prompting manufacturers to reconsider the reliability of the existing supply models. Recent events have shown that legacy strategies pose a high risk to supply chain integrity in most industries.

The Covid-19 pandemic caused not only supply shortages of semiconductors, which greatly impacted the electronics sector, but also other components like cardboard and plastics. This is largely due to transportation issues during Covid 19

says Andrzej Mrozik, General Manager, Management Board Member in Lacroix Electronics Ltd. Today, electronic component suppliers are rewarding customers who have had long-term purchase agreements that extend for a year or two, prioritising them ahead of panic buyers in the market. This may mean rebuilding their delivery strategies to make them more resilient. The just-in-time purchasing philosophy, where the emphasis is on keeping inventory to a minimum and using short-term, flexible contracts that could be quickly adjusted to changes in demand, may be partially revised in favour of building more inventory. [12]

An example of a company that has not experienced significant disruption in its supply chain is Radmor. Thanks to long-term contracts and the operation of a just-in-case strategy, production at Radmor did not stop during the pandemic.



This is primarily due to the specific nature of military production at this particular company and production in small quantities. However, this shows stability in supply strategies and increased resilience to crisis.

McKinsey research shows that from the time of the first supply chain disruptions in 2020 through mid-2021, companies were much more likely than expected to increase inventories and much less likely to diversify supply bases (with the notable exception of raw material supply) or implement nearshoring or regionalisation strategies [13]

The COVID-19 crisis brought supply chains into the spotlight. Over the past year, supply chain leaders have taken decisive action in response to the challenges of the pandemic: effectively adapting to new ways of working, increasing inventory, and their digital and risk management capabilities. Companies are far more likely than previously to opt for nearshoring and increasing their supplier base, as well as regionalising their supply chain, according to the McKinsey study. But despite this progress, other recent events have shown that supply chains remain vulnerable to shocks and disruptions, and many sectors are now struggling to overcome supply-side shortages and logistics capacity constraints.

## Planned and implemented actions to address supply chain disruptions related to Covid-19

% of responses



Source: McKinsey survey of global supply chain leaders (4 May - 16 June 2021, n=71)



# VI. SEMICONDUCTORS



The crisis in the semiconductor market is currently one of the key drivers in the electronics sectors and all other industries that use electronics solutions, and this has become apparent especially in the automotive sector.

#### CHARACTERISTICS OF THE SECTOR

The global semiconductor market was worth USD 440.4 trillion in 2020 (up 6.8% YoY). The United States has the largest share of the industry, accounting for nearly half of the sector's value (47%). This is followed by South Korea (20%), Japan (10%), EU (10%), Taiwan (7%) and China (5%). [1]

At the same time, the growth trend is projected to continue at 6.6% per year. As a result, the industry is expected to be worth USD 808.5 trillion in 2030. [2]



Manufacturers of computers (32.3%), telephones and other telecommunications equipment (31.2%) are primarily responsible for the demand. Next are manufacturers of consumer electronics (12%), cars (11.4%), and industrial equipment (12%).

It is worth noting that the highest growth in 2020 was observed in the computer market (+21.2%). On the other hand, demand from consumer electronics manufacturers (-3%) and the automotive sector (- 0.3%) declined slightly. [3]

Today, the industry value chain is quite complex. In the past, when the chip manufacturing process was simpler, the dominant model were companies referred to as Integrated Device Manufacturer (IDM), which gathered all manufacturing within their organisation. Today, due to the increasing sophistication of the product, the process is sometimes divided among specialised companies. On the one hand, we have designers (Electronic Design Automation software - EDA) and Intellectual Property (IP) owners, who usually own the brand and continue to perform manufacturing activities by outsourcing the production to other specialised entities. We will refer to this business model as fabless chip design houses or fabless semiconductor companies.

Then we have the contract manufacturers in question, whose foundries produce silicon wafers. Finally, there is the possible process of final assembly, testing and packaging (Outsourced Semiconductor Assembly & Test - OSAT), which can be carried out by the foundries themselves or by other parties. Add to all this the manufacture of equipment for the factories and the suppliers of the raw material itself. [4]



It should be mentioned that many companies integrate several business models within their own organisation, e.g. Intel, which operates both as a classic IDM and outsources production, e.g. to TSMC.



Silicon wafer production itself, on the other hand, takes place primarily in Asia. 63% of the market is held by Taiwan, 18% by Korea, and 6% by China. The largest manufacturer is TSMC (Taiwan Semiconductor Manufacturing Company), which accounts for 54% of of the revenue all semiconductors wafer foundries in the world. These revenues are worth USD 85 trillion in 2020. [5]

#### **CAUSES OF THE CRISIS**



The cause of the crisis in the semiconductor market is obviously the Covid-19 pandemic. On the one hand, due to the transition of many companies to remote working from 2020, we see a significant increase in the demand for computers and communication devices.

On the other hand, 2020 was a rather difficult time for the automotive sector - during the first waves of the pandemic, many assembly plants stopped production, and the demand for cars also temporarily came to a standstill. When markets recovered in 2021, a phenomenon of deferred demand was observed. Good consumer sentiment has encouraged car manufacturers to step up production. This was compounded by the aforementioned increased demand for computers and telephones, piling up orders and resulting in severe supply disruptions.

It is worth noting at this point that at no time has the production of the semiconductors themselves ceased. As of the second quarter of 2020, factories are on average using more than 90% of their capacity. In comparison, they operated at less than 80% in the first quarter of 2019.

It is worth noting that depending on their market position, business model, or customer relationships, companies have been affected by the semiconductor supply crisis to varying degrees.

Historically, EMS companies have typically secured their own supply of key components. However, when demand increased, it was the major customers (in our case, automotive companies) who took it upon themselves to negotiate with component suppliers and distribute these components to their EMS suppliers as needed.

explains Andrzej Mrozik, General Manager and Member of the Board of Lacroix Electronics Ltd.



#### NEW FACTORIES, NEW TRENDS

Given the increasing electronification of all aspects of human professional and private activities, and the resulting increased demand for semiconductors, the sector needs to expand production capacity. Moreover, looking through the lens of pandemic-induced supply chain turmoil, greater geographic diversification of new investment projects is also to be expected.

Currently, 92 percent of the production of the most advanced semiconductors (below 10 nanometers) is done in Taiwan. A break in the supply chain would be catastrophic for the global economy, which would need a minimum of 3 years to rebuild supply levels and USD 350 bn in investment in new foundries.



### GEOGRAPHIC DIVERSIFICATION OF PRODUCTION IS ESSENTIAL.

It is estimated that building local supply chains will require an investment of USD 1 trillion, increasing semiconductor prices by 35 to 65% [7]

This process has already begun.

## 2021

		September		
<b>INTEL</b> starts an ex manufacturing fa Arizona. Planned capita	September 23	INTEL announce	es the construction of 8	
	pansion of its chip acility in Chandler, I expenditures are	total cost of EUR	80 bn. [8]	
	round USD 20 bn. [9]	November 24		
	November 9	<b>SAMSUNG</b> announces the location of its new chip factory in Taylor. Texas. The investment		
<b>TSMC</b> in joint announces co manufacturing fac	venture with Sony nstruction of new ility in Japan for a	will cost USD 17 bn, and the entire complex will cover more than 500 hectares. [10]		
	total of USD 7 bn. [11]	December 11		
		<b>BLOOMBERG</b> r negotiations with new semiconduc	reports that TSMC is in advanced In the German government for a stor factory. [12]	
	20	<b>77</b>		

## 2022

		January 21	
	March 16	<b>INTEL</b> announce plant in Columbu	es construction of a new chip us. Ohio. The investment is
<b>INTEL</b> officially selects Magdeburg as the location for a new factory for the latest generation of semiconductors in 2 nanometer lithography. The investment is estimated to cost EUR 17 bn. [14]		worth USD 20 bn	. [13]

It is important to distinguish between two fundamental layers of the issue. First, where should you produce? Where the clients are. If most of the clients are located in Asia, why expand production capacity in Europe. This is the purely business layer. On the other hand, however, we have a strategic layer. The pandemic made us realise that our subsidiaries in Europe, or in the US, cannot be 100% dependent on supply chains located on other continents. We have seen the need to diversify these chains. Hence the strategic decision to develop the sector also in the European Union, so that we do not have bizarre situations, when in the face of a shortage of individual processors, for example in Germany, leading automotive factories are going to a standstill.

comments Stanislaw Motylski, General Manager of Flex plant in Tczew

Also keep in mind how the sector is structured. The construction of new factories will mean a demand for equipment and machinery used in the production of semiconductors.

Global Market Insights estimates that the global chip manufacturing equipment market will reach USD 80 bn by 2027. In Europe alone, this branch of the semiconductor supply chain is expected to grow at an annual rate of 4.5%. The global polishing tools segment is expected to grow at 5% per year, foundry equipment at 6% per year. This means that new device factories serving new chip factories will be built [15]



#### **SUPPORT**



Important for geographic diversification of production of semiconductors will be supported by the public sector. There is a reason why Asian countries are leading the way. On the one hand, they were able to offer lower labour costs; on the other, electronics manufacturers, including semiconductors, could count on significant government support.

A model example of this is South Korea, which in the 1960s and 1970s implemented extensive programmes to develop the electronics sector by, among other things, supporting exports, subsidising the production of predefined products, new investments, specialised education, and R&D activities.

These activities benefitted primarily Chaeboles, or conglomerates operating in a wide range of industries. An excellent example is in the context of electronics and semiconductors is Samsung [16]

CURRENTLY, SEMICONDUCTOR MANUFACTURERS ARE AWAITING ADOPTION OF TWO KEY PIECES OF LEGISLATION.



First and foremost it is the U.S. Innovation and Competition Act, which includes the Chips Act, which provides for the allocation of USD 52 bn for the development of domestic semiconductor manufacturing, the creation of a new investment incentive system for the sector, and the establishment of a National Semiconductor Technology Centre. The act has already passed the Senate and awaits a decision by the House of Representatives. [17]

From the point of view of EU countries, the European Chips Act is crucial. The proposal presented by the European Commission in February this year calls for the mobilisation of EUR 43 bn in funding by 2030. The support is to be allocated to the construction of semiconductor manufacturing infrastructure, research and development, investment in human capital to create new competencies. [18]

President Pat Gelsinger spoke about the important role of investment incentives during his visit to Intel's R&D centre in Gdansk last year:

Asia has encouraged the building of plants at home, so if we are to build such a large location in Europe, it has to be competitive. Our estimate is that grants and government support are at 25 to 40 percent of the value of a project when it is built in Asia. Why did we say that these incentives are also very important? Because I cannot build a global facility to build a global supply and then be uncompetitive from 25 to 40 percent. So, in both the U.S. and Europe, we've been very candid and shared data with governments about what it means to be a competitive location because we want to reestablish the presence of both the U.S. and Europe in the semiconductor market. [19]



#### POMERANIA ON THE SEMICONDUCTOR MANUFACTURING MAP?

In the context of further announced investments, a fundamental question arises whether Pomerania can be a potential location for a semiconductor factory.

Undoubtedly, the key factor is the availability of suitable investment land. Semiconductor factories, together with the accompanying infrastructure, occupy an area of up to several hundred hectares, have a huge demand for electricity, gas, water, and must be easily accessible while, at the same time, located away from potential sources of vibration (e.g. railroads). These are also projects that generate significant amounts of industrial waste and wastewater.

On the other hand, there is the issue of availability of appropriate personnel. For example, Intel's manufacturing campus in Leixlip, Ireland, once the expansion is finalised, will employ more than 6,000 people, including electronics, automation, and chemical engineers. Therefore, despite the high degree of automation in production, access to appropriate staff is still very important, and the Tricity agglomeration can provide it.

It is also worth noting that in its ongoing analysis for Invest in Pomerania, the World Bank points to manufacturing related to the semiconductor sector as one of the industries that Pomerania has a chance to develop in the future. 5 (

Undoubtedly, the most important challenge for the region, if investment in the semiconductor sector were to occur, will certainly be competence development.

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says Andrzej Mrozik (Lacroix Electronics)

## SIMULATION OF EMPLOYMENT IN A SEMICONDUCTORS FACTORY IN POMERANIA 4000 EMPLOYEES

Below is a simulation of employment in a new semiconductor manufacturing investment that was prepared for the needs of this report by recruitment firm Randstad.



Our partner's analysis used the following assumptions about the employment structure of the simulated investment, assuming the most common distribution of positions in organisations:



basic jobs unskilled employees



basic jobs qualified employees



basic jobs qualified employees

## **AVAILABILITY OF CANDIDATES**

#### **INFLOW AREAS**

Locations that fall within sourcing areas for entry-level positions:

- TCZEW (Starogard Gdański, Pruszcz, Elbląg, Malbork)
- TRICITY (Tczew, Kościerzyna, Wejherowo, Pruszcz, Chwaszczyno, Rumia, Lębork)
- KWIDZYN (Grudziądz, Malbork, Sztum, Starogard Gdański, Tczew, Toruń)\*

\*locations 100 km away require support in arranging transportation for employees, especially blue collar workers

high availability	average availability		low availability
STANOWISKA SPECJALISTYCZNE INŻYNIERIA	Gdańsk	Tczew	Kwidzyn
Constructor			
Process Engineer			
Automation Engineer			
Electrical Engineer			
Production Planner			
Lean Engineer			
Maintenance Engineer			
Application Engineer			
Tool Engineer			
R&D Engineer			
Device Design Engineer			
ASIC Design Engineer			
Process Integration Engineer			
Protocol Test Engineer			
Modeling Engineer			
Firmware Engineer			
Staff Engineer			
Field Application Engineer			
Embedded Systems Programmer			
Production Leader			

Quality Specialist				
Category Manager				
Purchasing Specialist				
Logistics Specialist				
Financial Controller				
Accountant				
BASIC JOBS - GDAŃSK				
	up to 50 vacancies	51 - 100 vacancies	101 - 200 vacancies	more than 200 vacancies
Assembly operative (with technical background)				
Assembly operative (no experience)				
Welder				
Packer				
Electrician (with qualifications)				
Production worker (no qualifications)				
Machine operator				
BASIC POSITIONS - TCZEW				
	up to 50 vacancies	50 - 100 vacancies	100 - 200 vacancies	more than 200 vacancies
Assembly operative (with technical background)				
Assembly operative (no experience)				



#### **BASIC JOBS - KWIDZYN**

	up to 50 vacancies	50 - 100 vacancies	100 - 200 vacancies	more than 200 vacancies
Assembly operative (with technical background)		٠		
Assembly operative (no experience)				
Welder				
Packer				
Electrician (with qualifications)				
Production worker (no qualifications)				
Machine operator				



#### TIME SIMULATION OF RECRUITMENT CAPACITY

#### FOR A PLANT OF 4000 EMPLOYEES

## Number of positions recruited quarterly, optimum salary level and transportation provided

#### **UNSKILLED AND SKILLED WORKERS**



#### TIME SIMULATION OF RECRUITMENT CAPACITY

#### FOR A PLANT OF 4000 EMPLOYEES

## Number of positions recruited quarterly, optimum salary level and transportation provided

#### **SPECIALISTS AND MANAGERS**



On the next page, we show the monthly salaries for each position (min-max salary range). These are gross figures and do not include additional employer contributions.

Category	Position	monthly salary (min - max)
	Managing Director	23 000 - 35 000
	Production Manager	14 000 - 20 000
Management	Quality Manager	13 000 - 20 000
	Logistics Manager	13 000 - 18 000
	Supply Chain Manager	18 000 - 25 000
	Finance Manager	15 000 - 25 000
	HR Manager	14 000 - 18 000
	Technical Manager	13 000 - 18 000
	Constructor	5 000 - 9 000
	Process Engineer	5 000 - 9 000
	Automation Engineer	5 000 - 9 000
	Electrical Engineer	6 000 - 10 000
	Production Planner	5 500 - 7 500
	Lean Engineer	5 500 - 9 000
	Maintenance engineer	5 500 - 8 000
	Application Engineer	6 000 - 11 000
Engineering	Tool Engineer	7 500 - 12 000
Linghieering	R&D Engineer	6 000 - 12 000
	Device Design Engineer	8 000 - 15 000
	ASIC Design Engineer	7 000 - 13 000
	Process Integration Engineer	7 000 - 10 000
	Protocol Test Engineer	8 000 - 15 000
	Modeling Engineer	8 000 - 14 000
	Firmware Engineer	8 000 - 14 000
	Field Application Engineer	8 000 - 12 000
	Embedded Systems Programmer	6 000 - 10 000
	Production Leader	7 000 - 11 000
Quality	Quality Specialist	6 000 - 9 000
	Cotogon : Maraara	10,000, 15,000
Currenting	Category Manager	T 000 - 15 000
Supply chain	Purchasing Specialist	5 000 - 8 000
	Logistics Specialist	5 000 - 7 500
Financia	Einancial Controller	8 500 - 12 000
Finance and		5 500 - 12 000
Accounting	Accountant	5 500 - 6 500

Basic jobs	monthly salary (min - max)
Assembly worker (with technical facilities)	3 400 – 4 400
Assembly operative (no experience)	3 200 – 3 800
Welder	4 600 – 6 600
Packer	3 100 – 3 400
Electrician (with qualifications)	3 800 – 5 600
Production worker (unqualified)	3 200 – 3 700
Warehouse employee (with authorisations)	3 800 – 4 600
Warehouse employee	3 500 - 3 800
Machine operator	3 400 - 4 800

### BENEFITS FOR SPECIALIST AND MANAGERIAL POSITIONS

#### STANDARD BENEFITS:

medical package sports card or reimbursement for sports card, holiday gifts (vouchers, packages) social benefits packages - tickets to the cinema, gym, swimming pool etc. additional life insurance

ADDITIONAL: covering the cost of transfer or reimbursement of travel expenses team-building events vacation allowance on-site doctor's surgery funding for language courses or studies, etc. school starter kit tax advisor

#### BENEFITS FOR BASIC JOBS

#### STANDARD BENEFITS:

medical package sports card social benefits packages - tickets to the cinema, gym, swimming pool, etc.

#### ADDITIONAL:

covering the cost of transfer or reimbursement of travel expenses free transport vacation allowance free meals or discounts on meals in the company canteen financing of courses or qualification/professional qualifications life insurance

## **INVEST IN POMERANIA**

## a decade of FDI attraction



## "WE CARE MORE"

Invest in Pomerania is a regional non-profit investment promotion agency that has been winning FDI to Pomerania for the last 11 years. The initiative offers a full scope of support to foreign investors willing to start operations in the region. Invest in Pomerania has been awarded multiple times in different rankings carried out by Financial Times, FDi Intelligence, Milken Institute, Polish Investment and Trade Agency, ABSL.

Invest in Pomerania is also a member of the Pomeranian Wind Offshore Platform another regional initative coordinated by the Pomeranian Marshal's Office. The platform aims at bringing all the Polish wind offshore stakeholders together. Currently the Platform comprises of 88 members including the key devlopers and suppliers.



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# **BIBLIOGRAPHY**

## Methotology

[1] Kategoria 85: Maszyny i urządzenia elektryczne oraz ich części; rejestratory i odtwarzacze dźwięku, rejestratory i odtwarzacze obrazu i dźwięku oraz ich części i akcesoria"

## Economic Outlook

[1] FTSE Russell Index 2018; FTSE Russell

[2] Trading Economics; www.tradingeconomics.com/poland/ease-of-doing-business

[3] Business Insider; Polski PKB w 2021 r. Wzrost najwyższy od 14 lat

(businessinsider.com.pl)

[4] Foreign Direct Investment Report 2022; www.report.fdiintelligence.com

[5] Bankier.pl; PMI Polska (Polska) - Wskaźniki makroekonomiczne - Gospodarka -Bankier.pl

[6] Trade Map; www.trademap.org

#### **Polish Electronics Sector**

[1] Trade Map ; www.trademap.org

[2] Trade Map ; www.trademap.org

[3] Trade Map ; www.trademap.org

[4] System Wspomagania Analiz i Decyzji (SWAiD) ; www.swaid.gov.pl

[5] Rzeczpospolita ; Nie ma mocnych na polskie fabryki AGD i RTV - rp.pl

[6] System Wspomagania Analiz i Decyzji (SWAiD) ; www.swaid.gov.pl

[7] System Wspomagania Analiz i Decyzji (SWAiD) ; www.swaid.gov.pl

[8] Rzeczpospolita ; Nie ma mocnych na polskie fabryki AGD i RTV - rp.pl

[9] System Wspomagania Analiz i Decyzji (SWAiD) ; www.swaid.gov.pl

[10] Trade Map ; www.trademap.org

[11] Inwestycje.pl ; Wartość sprzedaży na rynku RTV/AGD przekroczy 40 mld zł w 2022 – Inwestycje.pl

[12] Polska Agencja Inwestycji i Handlu ; www.paih.gov.pl

[13] Samsung mocno inwestuje w Polsce. Powstanie nowy zakład; Rzeczpospolita;

(https://www.rp.pl/biznes/art35641621-samsung-mocno-inwestuje-w-polsce-powstanie-nowy-zaklad)

[14] Amerykańska firma Kimball Electronics rozbuduje fabrykę pod Poznaniem; investmap.pl

[15] Zakład produkcyjny GARMIN (investmap.pl)

[16] Sharp wrócił do Ostaszewa! Odkupił fabrykę UMC Poland. Za kilka dni zmiana nazwy! | Nowości Dziennik Toruński (nowosci.com.pl)

[17] LG inwestuje 320 mln zł w fabrykę separatorów baterii Li-ion - Elektrosystemy

[18] Najnowoczesniejsza fabryka w portfolio BSH w Polsce (https://www.bsh-

group.com/pl/media/komunikaty-prasowe/najnowoczesniejsza-fabryka-w-portfolio-bsh-w-polsce)

[19] TCL: skąd pochodzi silnie zakorzeniony w Polsce producent TV QLED i MiniLED? Analizujemy historię marki, produkty i pozycję na rynku (hdtvpolska.com)

[20] Northvolt inwestuje w Trójmieście; Invest in Pomerania

(https://investinpomerania.pl/aktualnosci/northvolt-inwestuje-w-trojmiescie/)

# FOCUS ON ELECTRONICS SECTOR IN POMERANIA 2022

## Education and Labour market

[1] Gdańskie uczelnie łączą siły; (https://faru.edu.pl/pl/aktualnosci/gdanskie-uczelnie-laczasily)

[2] System Informacji Oświatowej; stan na 2020 rok. Liczba bez szkół policealnych oraz artystycznych.

[3] Informator o zawodach szkolnictwa branżowego, https://www.ore.edu.pl/wpcontent/plugins/download-attachments/includes/download.php?id=29892

[4] Kompetencje 4.0. Część 1. Cyfrowa transformacja rynku pracy i przemysłu w perspektywie roku 2030,

https://arp.pl/documents/41/Kompetencje\_cyfrowe\_ARP\_part\_I.pdf

[5] https://www.gdansk.pl/wiadomosci/gryf-gospodarczy-2020-kto-zostal-tegorocznym-laureatem-tej-pomorskiej-nagrody,a,185251

[6] Lacroix łączy naukę i zabawę. Gimnazjaliści wzięli udział w warsztatach robotyki (https://kwidzyn.naszemiasto.pl/lacroix-laczy-nauke-i-zabawe-gimnazjalisci-wzieli-udzialw/ar/c10-4080290)

[7] Raport społeczny Intel Technology Poland. 2020-2021, Raport niepublikowany

## Trends in the sector

[1] The 7 Biggest Artificial Intelligence (AI) Trends In 2022 (forbes.com)

[2]Artificial Intelligence Market (https://www.marketsandmarkets.com/Market-Reports/artificial-intelligence-market-74851580.html?gclid=CjwKCAiAvaGRBhBlEiwAiYyMDKQBkH7E9wmxPVmqiF3vOd5XEVddp70rT05Br6P0I3JDbELmqrIRBoCcasQAvD\_BwE)

[3] The 7 Biggest Artificial Intelligence (AI) Trends In 2022 (forbes.com)

[4]Top Strategic Technology Trends for 2022; Gartner

https://emtemp.gcom.cloud/ngw/globalassets/en/publications/documents/2022-gartner-top-strategic-technology-trends-ebook.pdf

[5] https://www.intel.com/content/www/us/en/internet-of-things/overview.html

[6] 4 of the Most Promising 5G Stocks Available in 2022 (defianceetfs.com)

[7] *Czy Edge Computing to nowa chmura;* (https://www.computerworld.pl/news/Czy-Edge-Computing-to-nowa-chmura,423355.html)

[8] *Automation and Control in Electronic Industries*; https://www.eolss.net/samplechapters/C18/E6-43-35-03.pdf

[9] Executive Summary World Robotics 2021 Industrial Robots

https://ifr.org/img/worldrobotics/Executive\_Summary\_WR\_Industrial\_Robots\_2021.pdf [10] *Tracking Industry 2021* (https://www.iea.org/reports/tracking-industry-2021)

[11] Corporate Clean Energy Buying Grew 18% in 2020, Despite Mountain of Adversity https://about.bnef.com/blog/corporate-clean-energy-buying-grew-18-in-2020-despite-mountain-of-adversity/

[12] The end of just-in-time for electronics manufacturing

https://www.electronicsonline.net.au/content/business/article/the-end-of-just-in-time-for-electronics-manufacturing-277372036

[13] How COVID-19 is reshaping supply chains

https://www.mckinsey.com/business-functions/operations/our-insights/how-covid-19-is-reshaping-supply-chains

## FOCUS ON ELECTRONICS SECTOR IN POMERANIA 2022

#### Semiconductors

[1] SIA State of the US Semiconductor Industry Report 2021

https://www.semiconductors.org/state-of-the-u-s-semiconductor-industry/ [2] Precedence Research, Recently Announced Report on "Semiconductor Market - Global Industry Analysis, Size, Share, Growth, Trends, Regional Outlook, and Forecast 2021 to 2030".

https://www.globenewswire.com/news-release/2021/11/24/2340848/0/en/Semiconductors-Market-Size-to-Hit-USD-808-5-Billion-by-2030.html

[4] https://semiengineering.com/knowledge\_centers/manufacturing/integrated-devicemanufacturer-idm/

[5] Trendforce.com https://www.trendforce.com/presscenter/news/20210305-10693.html[6] SIA State of the US Semiconductor Industry Report 2021

[7] "Strengthening the Global Semiconductor Supply Chain in an Uncertain Era" SIA
[8] https://www.rp.pl/biznes/art18914931-fabryka-intela-polska-walczy-o-najwiekszainwestycje-w-historii

[9] https://www.reuters.com/technology/intel-breaks-ground-20-bln-arizona-plants-us-chip-factory-race-heats-up-2021-09-24/

[10] https://news.samsung.com/global/samsung-electronics-announces-new-advanced-semiconductor-fab-site-in-taylor-texas

[11] https://www.reuters.com/technology/sony-invest-500-mln-tsmcs-new-chip-unitjapan-2021-11-09/

[12] https://www.bloomberg.com/news/articles/2021-12-11/tsmc-in-early-stage-contactwith-germany-about-potential-plant

[13] https://www.industryweek.com/supply-chain/article/21214871/intels-20b-fab-investment-combats-the-chip-drought

[14] https://www.ft.com/content/3f7e4a87-f0c4-469a-b0cf-7bb3570e31f4

[15]https://www.bloomberg.com/press-releases/2021-10-25/semiconductor-

manufacturing-equipment-market-to-hit-90-bn-by-2027-says-global-market-insights-inc [16] https://www.kdevelopedia.org/Development-Topics/themes/--39

[17] https://www.cnbc.com/2021/11/29/commerce-secretary-says-us-house-needs-to-pass-chips-act-immediately-to-ease-semiconductor-shortage.html

[18] https://www.cnbc.com/2022/02/11/eu-chips-act-europe-will-need-help-from-us-asia-to-achieve-goals.html

[19] https://www.rp.pl/biznes/art18914971-prezes-intela-europa-musi-wrocic-do-produkcji-procesorow