

REPORT

Agro conference 2018

AGRO RING

scenario-based costs

agri-food sector: perspective until 2023



BGZ BNP PARIBAS

Publication accompanying the 2018 Agro conference
AGRO RING - COST CONFRONTATION

AGRO RING scenario-based costs agrifood sector: perspective until 2023

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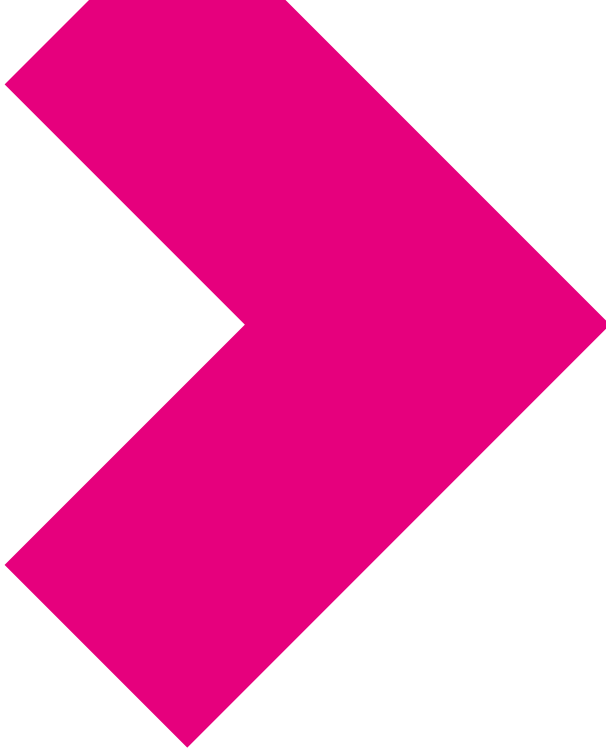
in cooperation with Macroeconomics Analyses Department of the Bank BGŻ BNP Paribas

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Preface

Bank BGŻ BNP Paribas constantly supports the development of the agri-food sector. For several years now, we have had even greater opportunities thanks to the strong shareholder, i.e. BNP Paribas Group. It has an extensive international experience in servicing this sector. Recently, we have established the BNP Paribas Group Agro Hub, based in Warsaw, whose aim is to create a food&agro competency centre for banks and companies from the BNP Paribas Group in Central and Eastern Europe and Africa.

We are the bank for a changing world. We actively respond to changes and challenges posed by the world development. Today's biggest challenge is the growing food requirements in most developing countries. These needs are growing faster than production capacity in the current economic status quo. The changes are necessary.

We can do a lot in this area, along with our Bank and Group experts and analysts. We want to be a source of inspiration for our customers, entrepreneurs, partners and competitors. We are willing to stimulate responsible development, expand production and gain new opportunities, as well as to discover markets for the agri-food industry.

We constantly share our knowledge and experience with customers and partners. We are also happy to receive the feedback. We try to focus our dialogue on important and topical issues. Issues that are close to our common daily challenges.

For the thirteenth time already, we have prepared a professional report. This year's edition is the result of cooperation between the Bank's experts and Capful Poland, a research company that, on our behalf, carried out detailed surveys among food companies and leaders of trade associations. Our goal was to analyse the most important phenomena in the food production environment in Poland. Therefore, although at first glance it may



seem trivial, we decided to explore the issue of widely understood costs. In the face of rapid changes such as globalisation, digital revolution, system competition, transformation of business models and sharing economy, the word „costs” takes on a new meaning. Entrepreneurs who want to remain competitive should keep abreast of trends and update their knowledge of cost policy management and optimisation. We all know that in a rapidly changing environment, low price is no longer a competitive advantage. Also, we are aware that even the largest companies fall out of the market due to too high costs. So how to adjust the cost policy to the situation of our company? I think that in our report you will find some inspiring hints.

As Bank BGŻ BNP Paribas, we continue the tradition of Agricultural Bank of Poland established in 1919. Our institution has been gathering and sharing knowledge about the national agri-food industry for almost a hundred years. Thanks to this exchange of experience, we built up our competence and leadership in the food and agri sector.

We cordially invite you to familiarize yourself with this report.

Bartosz Urbaniak
*Head of BNP Paribas Agro Banking
for Central and Eastern Europe and Africa*

Introduction

Economic calculation is an integral part of operating a business. In the second decade of the 21st century, in the face of rapid changes such as globalisation, digital revolution, system competition, business models transformation and sharing economy, the costs, in their broadest sense, are becoming more and more significant. Managing them according to the previous rules does not work anymore, and entrepreneurs face a huge challenge of verifying their approach. **The winners are those who offer a higher value rather than a lower price on the market. For them, increasing the revenues will be more important than cutting the costs.**

The team from Capful Poland consulting company, in cooperation with Macroeconomic Analyses Department of BGŻ BNP Paribas Agro Bank carried out a study which aimed at analysing the most important phenomena in the food production environment in Poland.

It was conducted from July to September 2018. It included, among others, 24 IDI's (Individual In Depth Interviews) based on open-ended questions. Respondents were selected from among food manufacturers and trade associations leaders. In addition, a study was carried out using an online questionnaire - CAWI (Computer Assisted Web Interview), in which 67 respondents - companies' representatives took part.

The starting point for conducting all analyses was a separation in the agri-food sector the most common business models (Chapter 1). A cost analysis was carried out in each of them. Simultaneously, during these works, the factors having greatest impact on the business activity in particular industries and those that may have the strongest impact on them within five years were searched for.

Generally, the costs play an increasingly important role and impact strongly on the competitiveness of the agri-food sector functioning. The research team undertook to verify this thesis. As a result of the survey, the labour, energy, raw materials and technology implementation costs were identified as the most important from the point of view of the functioning of the above mentioned sector. Their in-depth analysis was presented in chapters 2-5.

Collected research material made it possible to identify the strongest trends and uncertainties among the change factors. They were the basis for building future scenarios. Capful, as the European leader in scenario planning, has used a deductive method in this case, which results are four independent, equally likely options for the future of the agri-food sector with a perspective until 2023. (Chapter 6). This is one of the few studies in which this method was applied for a specific sector in Poland. This is a good starting point for a broad debate on the future of Polish agriculture and the food industry.



01

**Business models
in the agri food
sector**



The logic of building the company value

Every entrepreneur and manager is focused on creating value and improving business. Today, when rapid changes are taking place in the market environment, the existing methods of operation are often either insufficient or, worse still, no longer working. The analysis and improvement of the organization using the so-called business model can help. This is not a new concept. It has been working in management since the 1950s, but only recently has it is successful in small, medium and large companies.

The business model describes how to create and provide values to specific customers who are willing to pay for it. The summing up element is an analysis of the costs of the conducted business activity. Working using this tool makes it a teamwork character. It integrates employees and managers, triggers internal discussions on the rationale of earning money by the company and provokes the search for sources of competitive advantage.

At this moment, usually a question arises as to the relationship between business model and strategy. There are two different concepts, although many people do not differentiate them. Business models describe systematically how individual elements of an enterprise fit together, but do not take into account one of the key factors that contributes to success, namely the analysis of a competitive position. Sooner or later - usually sooner - each company starts fighting its market competitor. The manner of dealing with this problem is to apply

the strategy. It is facilitated if the company has a well-defined business model.

According to Peter Drucker, in order to identify a business model, three questions have to be answered:

- 01** Who are our customers?
- 02** What do our customers value?
- 03** How to provide value to customers without incurring unnecessary costs?

The business model should be simple and synthetic. It contains only the most important data, so that it should fill only one sheet of paper (yes!). If it is created in the form of a graphic visualisation of the company's mutually dependent areas, it allows for a very clear presentation of the operation and rationale of earning money. The most popular visualisation is the canvas of Aleksander Osterwalder, co-author of the world's bestseller "Business Model Generation". It is a simple and logical template consisting of nine rectangles - key areas of each company, which, when filled with the content, determine its uniqueness, profitability and innovation.

01 Customers or their segments

Questions: *For whom do we create value? Which people or companies will potentially buy our product/service? Who will make a profit and make us surviving in the market? Who are our most important customers? We need to realise their needs. What are their characteristics? Usually, customers with common features are grouped into larger groups - segments. Each segment requires the formulation of a different offer or message (e.g. a premium customer segment is able to pay more for more valuable elements of the offer than the mass customer segment). At this stage, we also wonder whether our product or service is targeted at end customers, consumers such as seniors, mothers with children aged 1-3, etc.? Are they business customers, e.g. chain stores, wholesale intermediaries? We do not enter here all customer segments that we have in our database. We should identify which segments we choose as key to our business.*

02 Value Proposition¹

Questions: *What services and products create value for a specific customer segment? What is a sufficient reason to make customers reject a competitor's offer and buy from us? For the customer, the value is something that satisfies his/her needs or solves a problem. The value proposition can be ground breaking and new (not occurred before) or simply better than the competition's value (e.g. more efficient, healthier, faster, more tailored to the demands, cheaper, more accessible, comfortable, based on the brand promise).*

03 Channels

Questions: *How do we reach customers with the value we offer? How do we transfer it, whether in a physical or virtual manner? What communication channels do we use to communicate with them? They are not limited to sales channels only. These are also direct meetings, tenders and auctions, promotions and advertisements, websites, social media, trend-setters, etc. That is, each point at which the customer contacts with the company or product and at which the customer's purchase decision, company evaluation or offer is shaped.*

¹ What is value? According to Philip Kotler it is: "the customer's assessment of the overall ability of a product or service to meet his/her needs".

04 Customer Relations

Questions: *What relationships do we want to build with each segment and how do we want to do it: personally, automatically, through community building or by co-creating „content“ or the value itself with customers? Experience the customer gains from contacts with the company and how long he/she remains loyal to the company depends on the relations we are able to build.*

05 Revenue Streams

Questions: *How much and for what will customer segments pay and how much money will finally be transferred to the company? Will customers pay for goods/services, subscription or use or licence?*

06 Key Resources

Questions: *What is necessary to create the values and reach the customers with them? Maybe it is people with special qualifications, or maybe automated production lines, recipes, point of sale networks, brand, patents, digital data? Resources can not only be purchased, but also leased or acquired from a partner.*

07 Key Actions

Questions: *What is the essence of actions without which the company could not work efficiently and the business model could not function properly? Are these projects of a unique character or processes of high repeatability? Contracting, processing, design and production of food, packaging, logistics, distribution?*

08 Key Partners

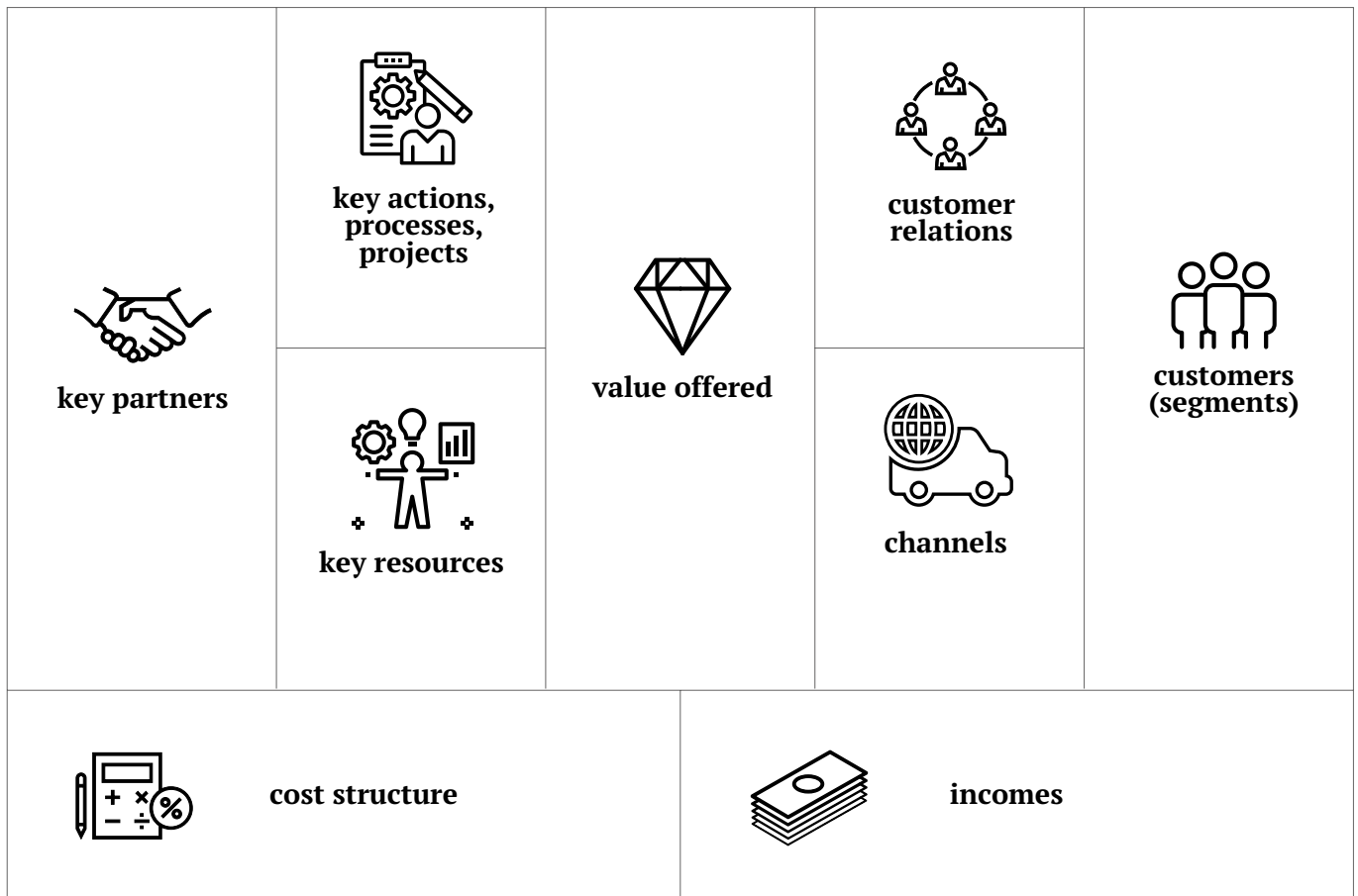
Questions: *Who are key suppliers and partners? Cooperation is now becoming one of the foundations of the company's efficient operation and development. As mentioned above, not all need to be own resources. Thanks to our partners, we can grow faster or reduce costs. There are also partners without whom it may be difficult or even impossible to carry out key activities, e.g. banks, suppliers of raw materials, energy, technology, etc.*


09 Cost Structure

Questions: *What are the key costs incurred in producing the value offered and the implementation of the business model? Which costs are fixed and which are variable and what does it depend on? At this point, one should review each model area and consider what costs does it generate.*

Graphic presentation of the business model is the canvas template, which makes easier to gather the information mentioned above (see: Figure 1.1). It allows to describe current and testing new models. The great advantage of working with the canvas is that one has more valuable discussions within the company, which often aim to improve one of the nine areas or to discover previously invisible opportunities for development.

Once the final business model has been created, it can be presented in a coherent, logical, understandable and brief manner (even in 3 minutes). The authors of the report participated in hundreds of sessions of creating and presenting business models, which led, among others, to unexpected conclusions of the participants: "at last we have a synthetic presentation of what we do and why we have/have no profits". There is no need to write a business plan, to use strategic analyses, matrices, market reports and similar tools. Yet, this does not mean that creating a model or describing it is so simple and easy. Firstly, it requires a change of thinking and giving up the existing opinions- which is sometimes the most difficult aspect. After all, we do it in order to identify something. This forces us to go beyond the company's and our own comfort zone, beyond being accustomed to our own ideas, beyond the fear that our negligence or managerial imperfections will be revealed.




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Fig. 1.1. Alexander Osterwalder's business model canvas (own study based on the Strategyzer)

Next step after model development is to determine the profit or innovation centres within the model. They can be found in a unique offer of values, e.g. of the packaging adapted to the Millennials, characterized by mobility, sense of their uniqueness, care for health and sensitivity to ecology. In the figure below, the arrows indicate the profit or innovation centre and their impact on other areas:

01 Competent selection of partners, key resources and designs for value creation and delivery

02 Model-based on offering unique value: novelty or new way or excellence

03 Selection of customers (segments) whose potential has not been seen or appreciated by competitors

04 Reducing costs and maximizing revenues

05 A unique configuration of all components of the business model (the most difficult model to copy)

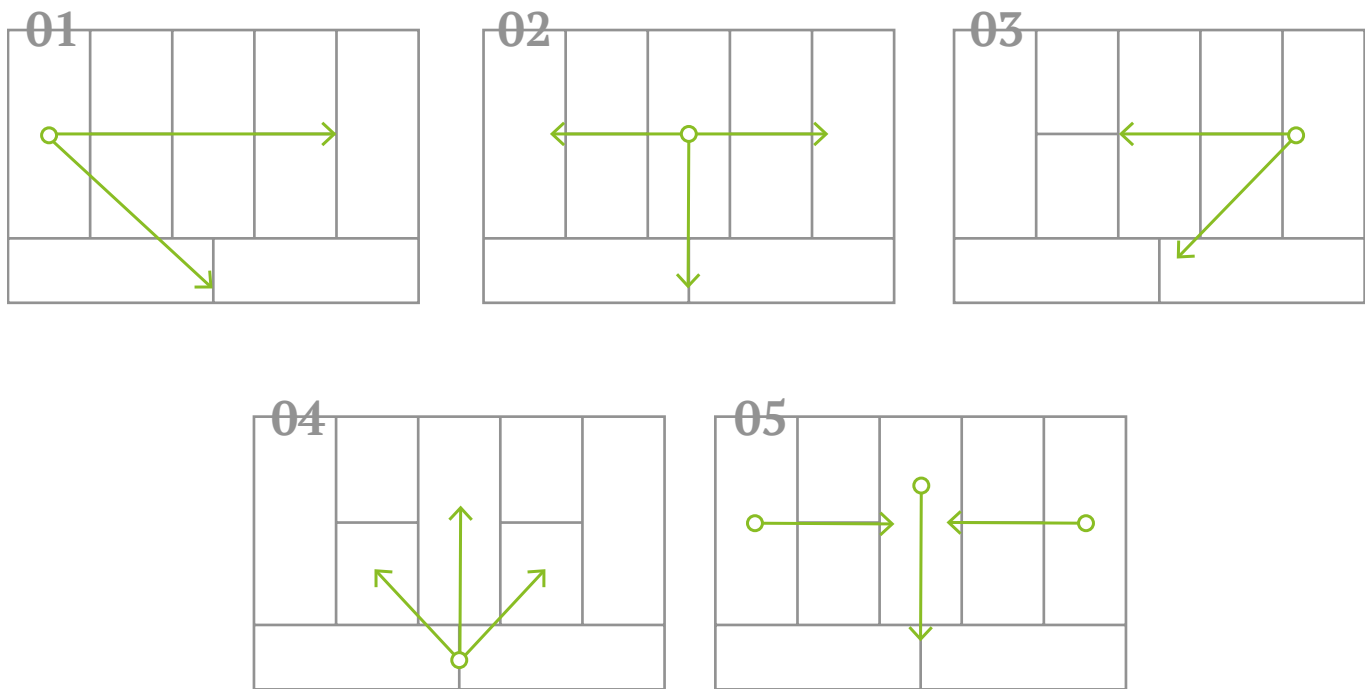


Fig. 1.2 Profit or innovation centres in the business model (own study)

It should be noted that a good business model is also becoming a powerful tool for increasing the company's effectiveness. Not least because it identifies the key areas and thus defines which areas to focus on (the Pareto principle) - even though by monitoring.

The canvas covers only nine business building blocks, yet those most important for the company's success. Trying to make the model realistic by adding other factors may make it more complex, but its value will not increase. The saying: *less is more* works perfectly well in this case.

Business models in the agri-food sector

In the food and agricultural sectors, business models depend on the location in the supply and value chain, as shown in Figure 1.3. It can be divided into **13 models, which differ in terms of value offered, its recipients and customers** (see Figure 1.4.).

• **Legislative and executive authorities** •

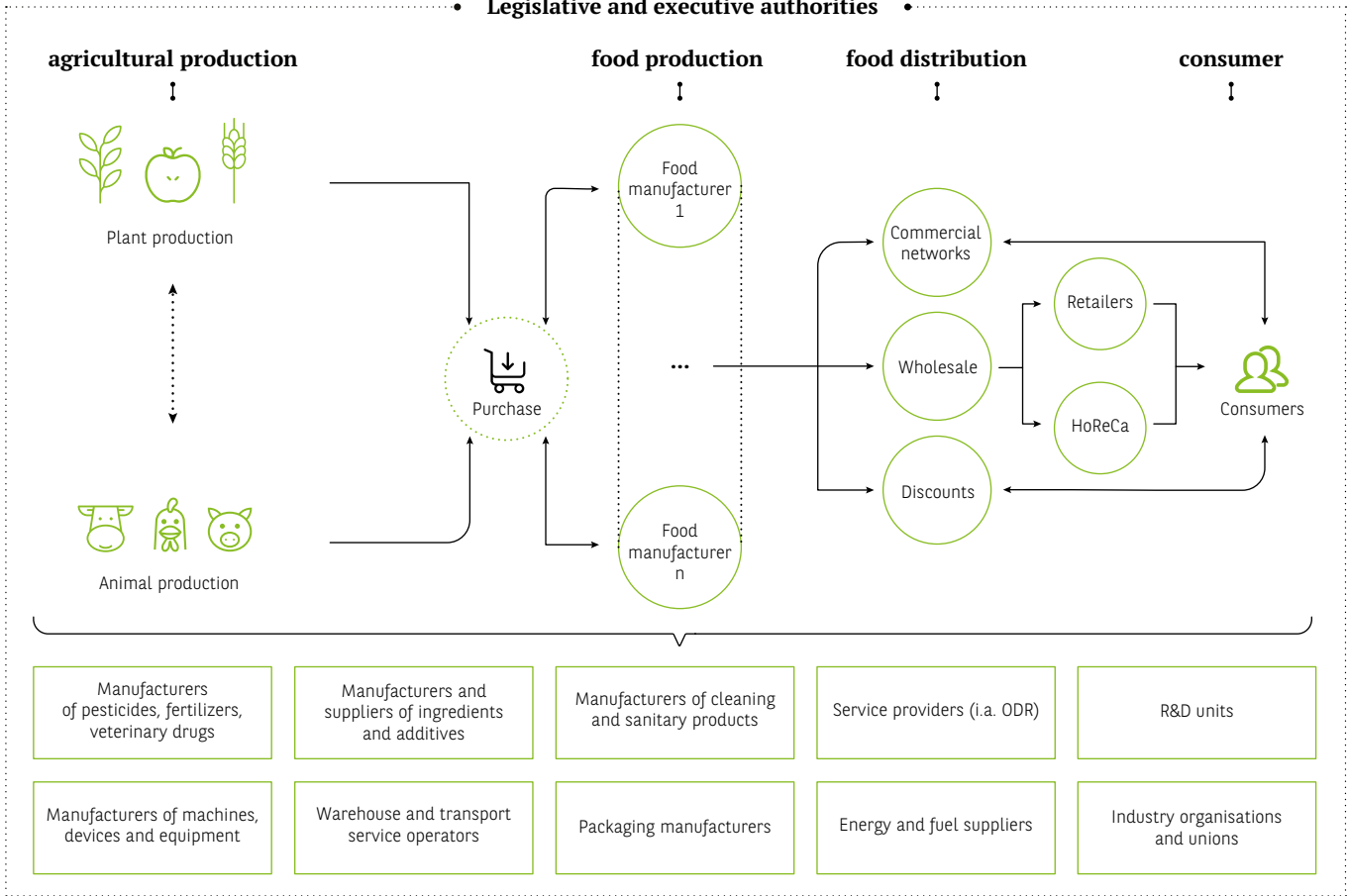


Figure 1.3 Value chain diagram in the food and agricultural sectors (own study)

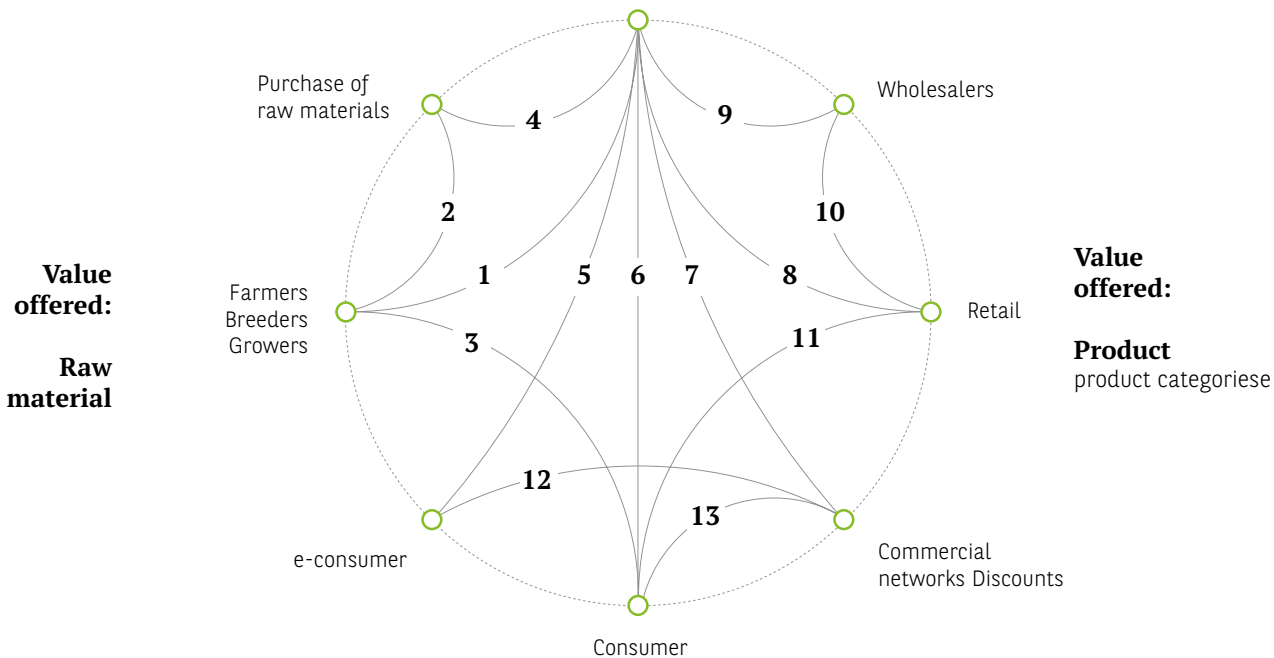


Fig. 1.4. Business models in the agri-food sector (own study)

Below, using the Osterwalder's canvas, **the 7 most common business models in the food sector are presented, due to the profit centre.** As already mentioned, generally, the model should be transparent and contain only the key elements that distinguish it in the market. When analysing own business model, one should use a large format canvas and self-adhesive cards. This work should be carried out by a small team. This simple tool promotes strategic conversations and fast prototyping.

01 Food manufacturer- retail chains and discount stores: model capacity

Profit and innovation centres are located in the offered value, resources and processes. The essence of the model is the ability to produce custom-made goods under own brand. When cooperating with such large partners, the most important from their point of view are the quality, brand, and ensuring the required production level. Formats of retail chains provide for a quick modification of the size and type of product assortments. This means

that the manufacturer must be able to carry out such changes with ease. **Costs** in the capacity model are generated by: raw material (purchase, processing and storage), new products creation, machinery and equipment (technology), logistics. Profits are generated thanks to whole activity costs optimisation.

02 Food manufacturer- retail chains and discount stores: private label model

It is a model similar to the first one. Also here, what counts, and thus what costs, is primarily the production capacity. The company is subject to the rigours of manufacturing the product, which is to be of no lesser quality than branded goods, yet offered at much lower prices. **Costs** in the private label model are generated by: raw material (purchase, processing and storage), technology, machinery and equipment and logistics. Profitability is determined by economies of scale and the associated risks.

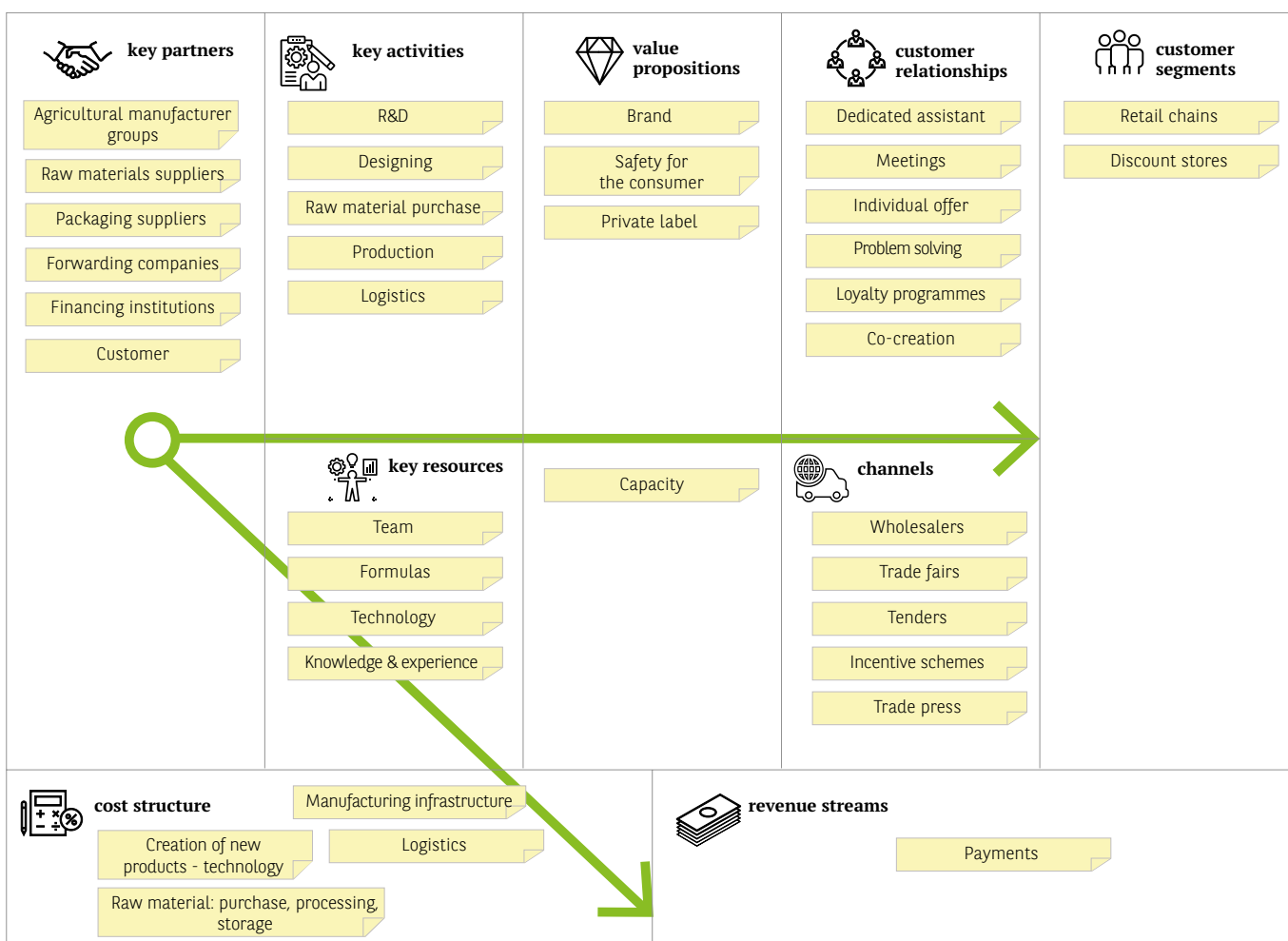


Fig. 1.5. Business model: food manufacturer - retail chains and discount stores 01 model capacity and 02 private label (own study)

03 Food manufacturer- retail chains and discount stores: product co-management model

More and more manufacturers switch the profit centre from resources and processes to offering value that can greatly support the sales channel. This does not reduce operating costs, but increases revenues and strengthens the position of the company. The condition is to develop partnership by convincing the stores that one has the capacity to cooperate on the basis of co-creation of

the final value. This includes the product itself and additionally its management (or management of the entire category) - from placing it on the shelf to taking it off the shelf and replacing it with another product. Including promotional service and logistics of the whole process. It is a big challenge, but it fits into the logic of 21st-century business, which requires the forming partnerships.

Costs in the product co-management model include product development and its management in the sales channel.

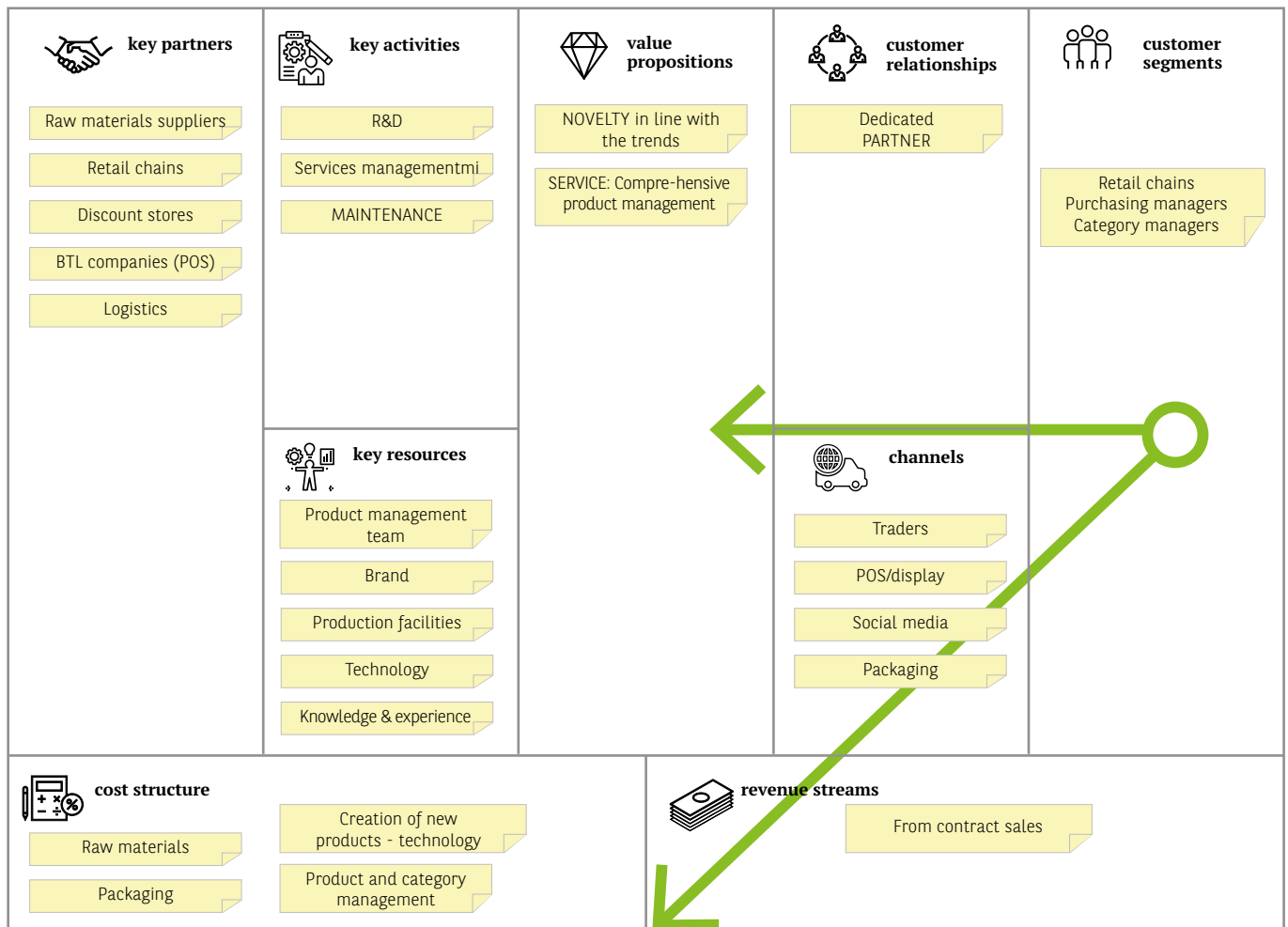


Fig. 1.6. Business model: food manufacturers - retail chains and discount stores 03 co-management - commoditisation model (own study)

04 Food manufacturer – consumer: brand and experience model

For consumers, most important is the product and its promise in the form of history. Thus, the profit centre is located in the offered value, i.e. the product. The stronger the brand, the stronger it is. As a result, the company has to incur high costs for product development and enrichment (R&D) and branding. In the case of Polish companies, it is difficult, as they have to fight against strong global brands, mainly through promotions, usually reducing the prices. This is reflected in their image. Today, especially for the younger Millennials and Z generations, more and more important is the

experience accompanying decision making and buying, but above all, using the product. Therefore, the emphasis in the value creation chain should switch from product design to consumer experience design. All manufacturers conduct market research and focus groups. These provide opportunities to co-create the products. This requires the development of an effective and implementable algorithm for designing food user experience (UX).

Costs in the brand and experience model are: consistent brand management, marketing and market research, UX experiments, creating a loyal community, manufacturing and sales support.

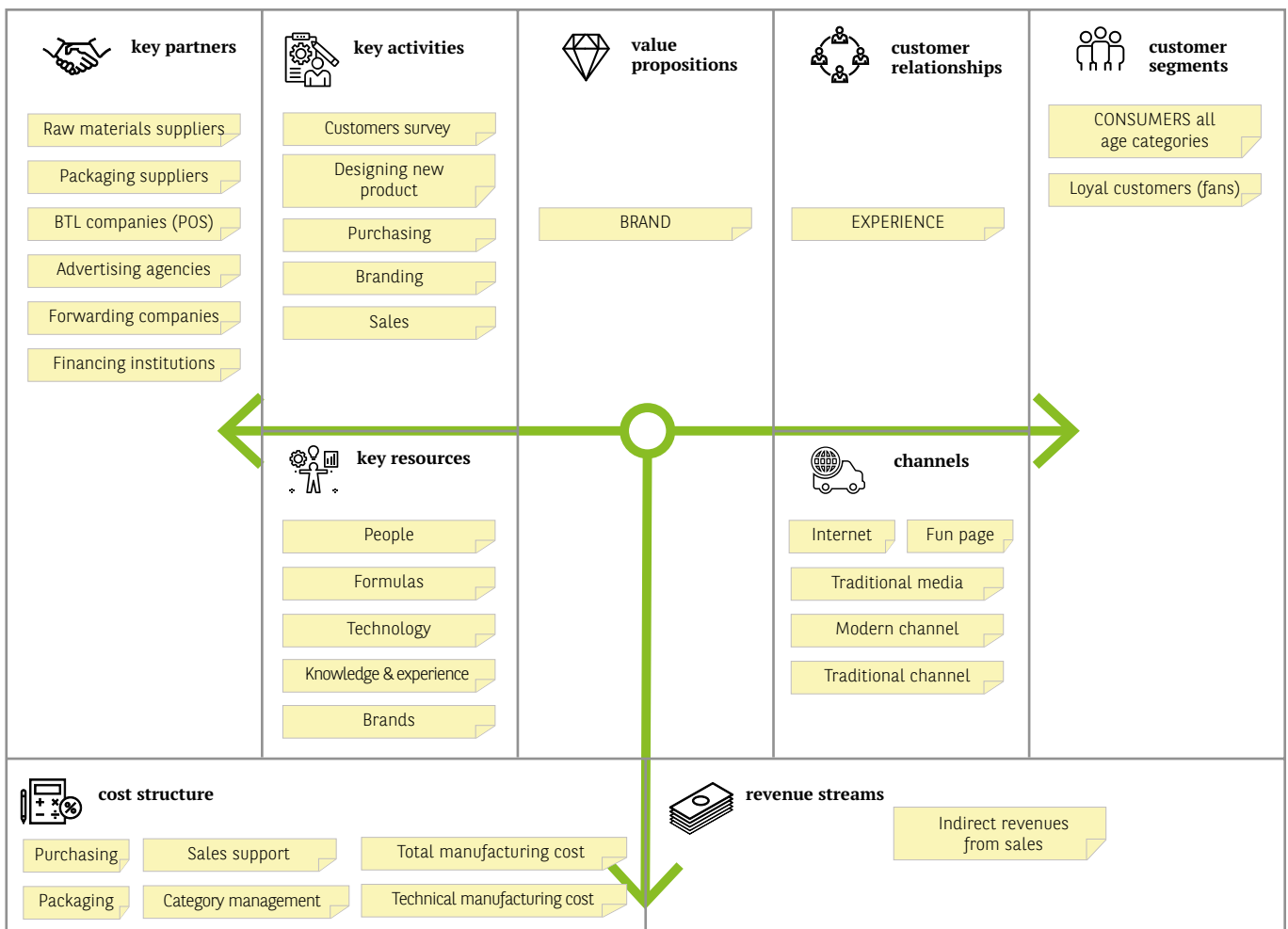


Fig. 1.7. Business model: food manufacturer – consumer 04 brand and experience model (own study)

05 Food manufacturers – consumer: niche model

The niche model, in this case, related to the customer segment, consists in recognizing, investigating and exploiting the potential of a solution, product, service or recipients or sales methods - the potential that is not widespread yet. Thanks to this it is possible to occupy the free of competition part of the market. In case of food, an interesting niche in Poland are 60+ Seniors. Contrary to stereotypes, this group often has a good and stable income, unburdened by the expenses associated with starting a family or educating children. Nutritional habits shaped throughout life face many limitations, mainly in terms of health: less appetite, cardiovascular

diseases, diabetes, etc. Nutrition starts to look more like a diet, and in addition, many of these people are already living alone. When buying products in standard packaging, they are often unable to use them before the end of their best-before date. Trade business tries to face this challenge, yet the vast majority of market players are just observing this target group. Possible promotions and special actions for the 60+ group are those of the manufacturers of dietary supplements. Everything seems to indicate that a model based on this niche could become very profitable.

The main **costs** in the niche model include marketing research and analysis, creation of new solutions (R&D), branding. In the example including the 60+ Seniors niche, the margin can be reduced by packaging costs.

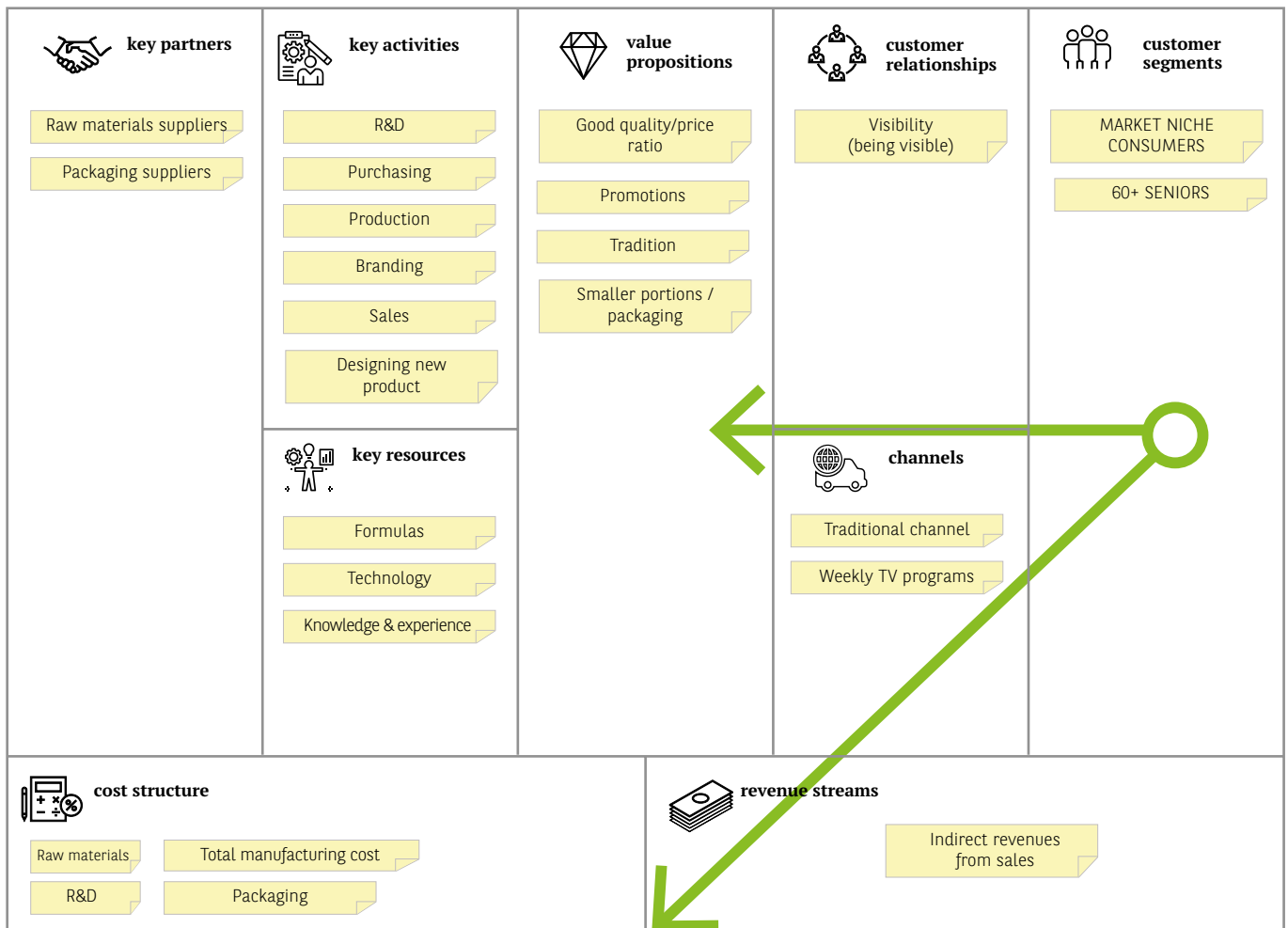


Fig. 1.8. Business model: food manufacturer- consumer 05 niche model, example for Seniors (own study)

06 Joint action- bundling offer model (horizontal integration)

In the case of primary manufacturers on the agricultural market, the bundling offer model is a proven way of achieving benefits by strengthening economies of scale and bargaining power. Today, as production costs rise and the production is exposed to weather anomalies, it is becoming increasingly important to offer added value. Groups build it based on the trust resulting from volume and management professionalism. This is particularly important in the case of exports. Long-distance freight forwarding is expensive and can be

compensated only by increasing the quantity. There are few manufacturers who can alone satisfy the needs of the Chinese, Indian or South African markets.

Poland has an interesting and admired tradition of merging into cooperatives. It is estimated that before World War II the share of cooperatives in the purchase of agricultural products amounted to as much as 12%. Today it is worth to use these approach.

In the cooperation model, there are three types of key **costs**: administration and management, common infrastructure, marketing.

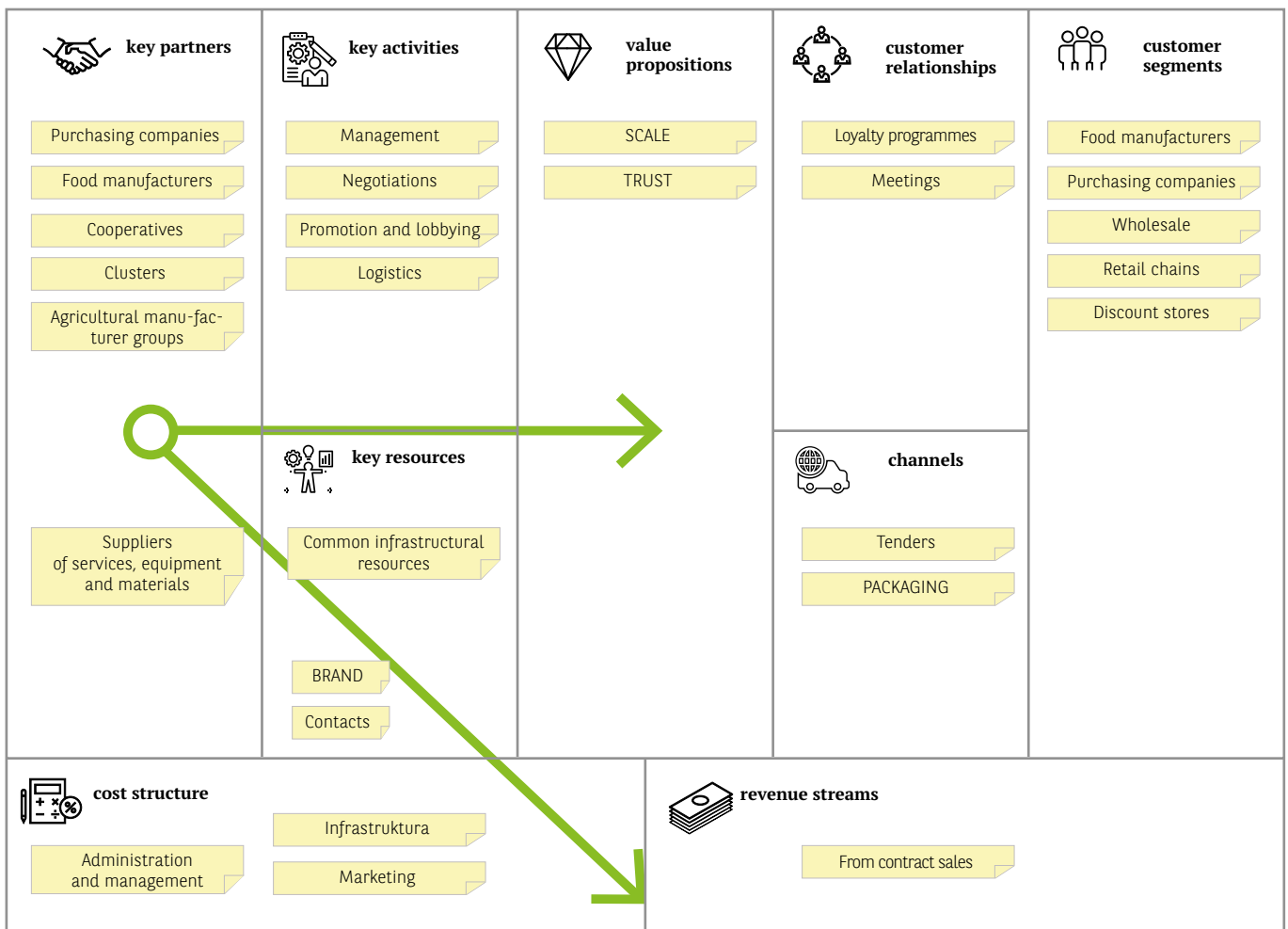


Fig. 1.9. Business model: joint action 06 bundling offer model - horizontal integration (own study)

Another model may play an important role in the next few years in reconstructing the entire agri-food sector in Poland:

07 Vertical integration

The Polish food sector is characterised by considerable fragmentation, as is the agriculture. It is a good situation for consumers. They have a very wide range of product. On

the other hand, the individual entities still have too little potential to compete effectively with global companies on the domestic market, and even less on foreign markets. The time is needed to consolidate the market by merging smaller companies, as well as to take over local players in foreign markets. This means the need to build very efficient, strategically oriented and operationally perfect companies. This entails a need for substantial investments. Management is also a high cost. They can and must be optimized through the use of digital solutions: data analytics, predictive systems or blockchain.

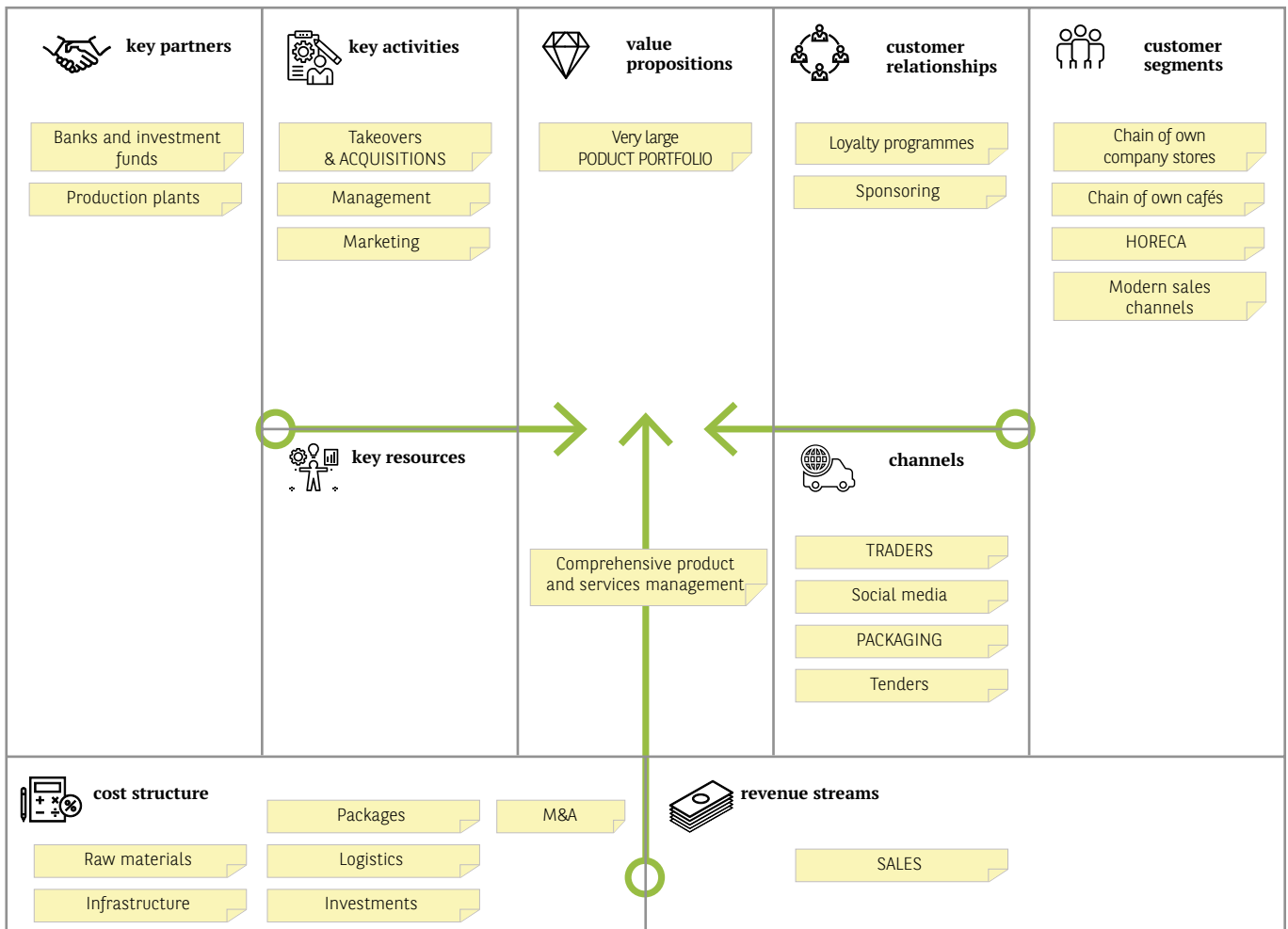


Fig. 1.10. Business model: 07 vertical integration (own study)

Each company operates on the basis of a business model. Each company needs and has a huge benefit from the conscious analysis and improvement of its own business model.

The presented business models have been selected since they are the most common in the Polish food sector. They can be modified and expanded according to the individual needs of each company. We hope that they will become a starting point for companies to conduct internal training concerning the business model; that they will become, as in many companies already, an important source of continuous improvement.

i.e. massification of the business model. In short, it is selling not a product but services: developing standards, speed and repeatability of operation on the market by the food manufacturer. Acquiring and segmenting as many customers as possible - retail and modern sales channels, offering them short delivery terms, a given standard of cooperation, a high number of transactions, etc. By its repeatability and predictability, the manufacturer becomes a real trading partner. Action scale and repeatability allow to reduce costs.

Piotr Zboiński, Sales Director of Stovit Group sp. z o.o.

According to experts and practitioners

Polish enterprises have so far beaten competition with low labour, raw materials and energy costs rather than with innovation. The need to create added value is growing. Businesses need to mobilise more in order to compete with something more than price.

Marcin Czarnecki, expert, long-term president of food industry companies

Once, a supplier of machinery and fertilizers was the leader of the agri-food sector. Then it was the food industry, and today it is the retail trade. Large networks decide what we consume. (...) Trade demands an appropriate price from the industry and the quality is put aside. In the most drastic cases, lowering the price significantly reduces the quality of the final product. This applies, among others, to meat products, because in Poland there are practically no norms and standards concerning this raw material

Stanisław Kowalczyk, professor, PhD, SGH Warsaw School of Economics, Institute of Markets and Competition

The food market in Poland is heavily stocked. In popular marketing theories, it can be described as the „red ocean”, where there are many similar offers, substitutes are present and which mainly fights with price promotions. The way to stand out is to continue to take care of the highest quality product, but above all, commoditization,

Practical use of the business model canvas

Each company operates in a specific environment that is changing. What will it look like in 3, 5 or 10 years? Will there still be a place for our business model? It is highly probable that.... no.

What can we do today to prepare for change? It is worth starting with identification of our current business model - its individual components. The next step is to think about what we can perfect, improve. Perhaps we will see a completely new logic of making money?

We certainly need to prepare for the changes in agriculture and the food sector. Many of them will be triggered by increasing labour productivity, the spread of advanced technologies, digitisation and the collection of large datasets through intelligent sensors of huge data collections. The automation of processing and production and the Internet of Things will increase capacity and allow to react quickly to signals from the market. Artificial intelligence will support farmers, breeders, growers, manufacturers, traders and consumers in their decision-making.

However, we will have little or no influence on many factors - even on weather anomalies caused by climate change, which have a significant impact on energy consumption. However, we are learning to anticipate and protect against these components of the system more and more effectively, and even to use them.

This has always been the case, and future generations are better prepared to cope with the challenges.

In the following chapters, we will take a closer look at the main cost items in enterprises in the agri-food sector. Labour, technology, energy, raw materials and resources are associated with costs, but without them, it is impossible to talk about value creation. Nowadays, intelligent cost management crucially contributes to the profitability of any business. This means a more flexible, comprehensive and long-term approach. Combined

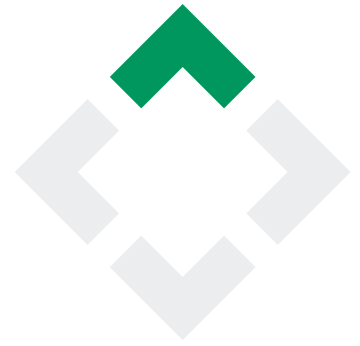
with a unique value, this will open up the possibility of competing not only with the lowest price and production exclusively on behalf of large concerns. Costs as part of the business model - they can have an impact on branding that will thrill the world.

The last part of the Report contains the results of the survey of change factors and the resulting scenarios for the future of the agri-food sector in Poland in 2023. Each of them contains also anticipation of future costs.





02 Labour



In the coming 3-5 years, the same factors will affect labour costs in all sectors of the Polish economy. The agricultural and food sectors will not be the exception in this case, but the effects will be felt more strongly due to the seasonal nature of many works. Ways of responding to and dealing with challenges may differ greatly, depending on the sector or the specific circumstances of individual companies.

Current situation

Today's labour market in Poland is shaped by five main phenomena:

- 01 decline in birth rates after 1990
- 02 ageing of the society
- 03 low professional activity of a part of the society
- 04 economic immigration to Poland
- 05 economic emigration from Poland after 2004
- 06 the presence of different generations on the labour market

Decline in birth rates

In contrast to other parts of the world, many European countries are experiencing a sharp **decline in birth rates**. This pertains particularly to Poland. Demographic data are inevitable: in our country, the fertility rate fell from 1.99 in 1990 to 1.29 in 2015 ², thus being one of the lowest in Europe and giving us the 215th place in 224 countries in the world. With slight fluctuations the decrease in birth rates, it deepened from 1990 to 2015. This state was caused mainly by a change in the value system, lifestyle and the spread of the 2+1 or 2+2 family model. After 1990, there was also a lack of institutional the state in the area of child and family care. **The po-**

² Central Statistical Office, Birthday and Fertility 2018

population of Poles will decrease. At the moment, there are no factors that could change this direction, on the contrary - this trend will deepen in the following years. According to the Central Statistical Office (GUS) over 38.4 million people live in Poland today, and by 2050 this number will decrease to 34 million. The decrease will be observed in all voivodships. Only in the case of four of them, a periodic increase in the population³ is expected: Wielkopolska Region until 2023, Małopolska Region until 2026, Pomerania until 2027, Mazovia until 2028. These data are often undermined and there are numerous forecasts stating that in 2050 there will be only about 30 million of us.

Ageing of the population

Life expectancy increases every year in all European Union countries. This is due to an overall improvement in prosperity compared to previous generations: improved medical care, hygiene, nutrition or a healthy lifestyle. In Poland, life expectancy increased from 1990 to 2017 for men: from 66.2 to 74 years and for women from 74.2 to 81.8 years⁴. **Polish society is one of the fastest ageing population in Europe.** The demographic forecast leaves no illusions: in 2020, the percentage of Poland's population aged 65 and over will reach

³ Central Statistical Office, Population. 2017

⁴ Central Statistical Office, Life Expectancy in 2017

the level of 20%. Every sixth person belongs to this group already. The increase in the number of seniors will be accompanied by a significant decline in the population aged 15-64. In the near future until 2025, - this group will be reduced by about 2 million people. Ageing of the society is accompanied by the low economic activity of Poles over the age of 55. For this age group in 2016 Poland was ranked 30th among 35 OECD countries, with the result of 46.2% (the average for the OECD is 61%, and for New Zealand - 76.1%). **The average effective age of going into retirement in Poland is 61 years⁵.**

Professional activity

In recent years in Poland, despite the decrease of unemployment, **the professional activity rate has declined**. In the first quarter of 2018, it amounted to 56%⁶. The problem concerns mainly people having the education below higher degree. The employment rate for people aged 25-74 with higher education is 82.9% and is one of the highest in Europe. On the other hand, the employment rate for people aged between 25-74 with general secondary education, basic vocational and post-secondary education is 59.9%. Only Greece (54.1%) has worse result in the whole EU. For comparison: in Sweden it is 74.2%, in Germany - 71.1%, in the Czech Republic - 69.3%⁷.

Emigration

Within the framework of economic emigration in the years 2004-2016 over 2.5 million people left Poland⁸, while in 2017 the number of Poles in economic emigration increased by another 100 thousand people. The main directions are Germany, the Netherlands, Great Britain and Ireland. Another 11.8% of the working population (i.e. 2.6 million) are considering going to work abroad. Poles working in the EU earn much more than in their country, and the rate of growth of their salaries is almost twice as high. Accordingly, in 2017 in the European Union they earned on average PLN 7.705 gross and nearly 10% more than in 2016. At that time, the average salary in Poland amounted to PLN 4.272 and increased by 5.5% compared to the previous year. Moreover, what is characteristic, in 2016 there were 3.3 children per

5 Goleđ Age Index, Pwc Report, 2018

6 Central Statistical Office, Economy Activity of the Polish Population, 1st quarter of 2018

7 Eurostat: Statistical Data on Employment

8 Central Statistical Office, Information on the scope and directions of emigration from Poland in the years 2004-2016

one Polish woman living in the United Kingdom. At that time in Poland, the fertility rate of women was below 1.3. The decrease in birth rate does not seem to affect Polish emigrants. We should be aware of the fact that many Poles emigrated permanently and we cannot expect their return.

Generation succession

Currently, there are several generations on the labor market, who have a completely different approach to life and work. **The baby boomers (BB)** generation, also known as ‚silver generation‘, born between 1946 and 1964, is now starting to retire. They are people who value independence, stability and health. Their strengths in the area of professional activity include involvement, optimism and a global view of the problems. They can misbear conflict situations and feedback as they perceive it as criticism. They are more process-oriented than result-oriented. They do not like to change jobs or positions - they can do the same activity for many years.

The X-generation - described in France as Bof g n ration, that is, the „whatever“ generation - born in 1965-1979 are now mature workers. Important values for them are personal development, independence and hard work. However, they have difficulties with multitasking. People of this generation can be sceptics and pessimists, as well as showing distrust towards their superiors. They use new technologies such as a computer or smartphone without any problems, but they definitely prefer direct meetings and paper documents. In the workplace, loyalty is very important to them.

Y generation, the so-called Millennials, is divided into two groups - younger (born between 1990 and 2000) and older (born between 1980 and 1990). They are born explorers and experimenters, but do not seek authority. They are children of the technological revolution - they cannot imagine the world without the Internet and a smartphone. They are eager to study, explore the world and travel. The self-confidence and life experience are more important to them than possession, therefore they expect a lot of freedom and flexible working time in their professional life - it cannot be a limitation in the fulfilling personal aspirations. They expect a clear delimitation of objectives, controls, but also incentives. They prefer more virtual ways of solving problems than face-to-face meetings. They have difficulties in organizing their own work - they start many tasks at the same time and have problems with completing them. They solve standard tasks well, but are less able to cope with new situations.

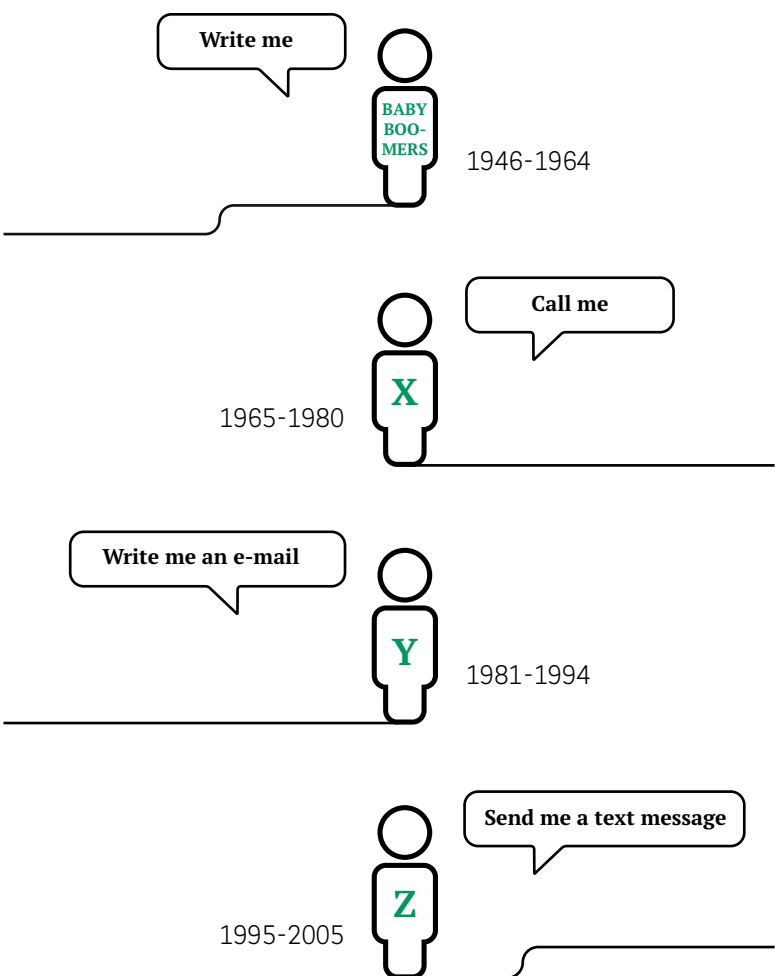
Today, the Z generation, born after 2000 and, according to some researchers, after 1995, enters the market. The Z generation expects from work to be interesting and ensure constant development. On the other hand, its representatives are open to continuous learning as well as ambitious and ready to take responsibility. They expect training and individual development paths from their employers. They are hardworking, but also demanding. They can be quickly discouraged by repetitive tasks - they expect interesting and varied work. The challenge for the employer is to motivate the employee. The representatives of the Z generation are definitely more multifunctional than the previous Y generation. At the same time, they are more socially oriented and interested in the problems of corporate social responsibility. It is the most technologically oriented generation in history, born in the digital world. They do not remember the times without the Internet. They are looking for answers to their questions there and, as a result, geographical barriers no longer exist for them. All the more so because most of them speak English well. They can easily work with robots, artificial intelligence or virtual reality.

Labour costs in specific industries

Based on Institute of Agricultural and Food Economics (IERIGŻ) **data on costs in the food industry in 2017 and 2018 (Annex 1), we can see an increase in labour costs by 6.5% in the first semester of 2018 compared to the same period of 2017 in the whole sector.** Two industries show the highest labour costs: production of meat products (excluding poultry meat products) and milk processing and cheese production - labour costs of each of them represent over **10% of labour costs in the entire food industry.**

Eight industries recorded an increase in labour costs of over 10%. The highest percentage increase in costs in the first half of 2018 compared to 2017 can be observed in the following industries: production of spices 17%, production of ready-made pet food 24% and production of ready meals and dishes - as much as 26%. In addition, it should be noted that 5 branches recorded an increase in labour costs despite a decrease in total business costs. This is particularly evident in sugar production, where total operating costs decreased by more than 15%, with labour costs rising by 4%, and in fruit and vegetable juice production - total operating costs decreased by more than 7%, while labour costs increased by nearly 8% in the compared periods. **Three industries recorded a decrease in labour costs:** production of vegetable and animal oils and fats - decrease by more than 15% - production of ice cream and production bakery wares.

All in all, labour costs in the food industry as a whole account for around 9% of operating costs. It is likely that pressure on wages may only intensify over time as resources diminishing in the labour market.



6,5% average labour cost increase in the food sector I term 2017 to the 1st half of 2018

Fig. 2.1. Polish society generational structure

Results

The phenomena and factors described above result mainly in a shortage of labour force in Poland and, consequently, in a change in the balance of labour market forces. This can be described as a transition from an 'employer's market' to an 'employee's market'. This will also involve a gradual increase in labour costs. Demographic decline, low professional activity and economic emigration caused a sharp shortage of employees in Poland.

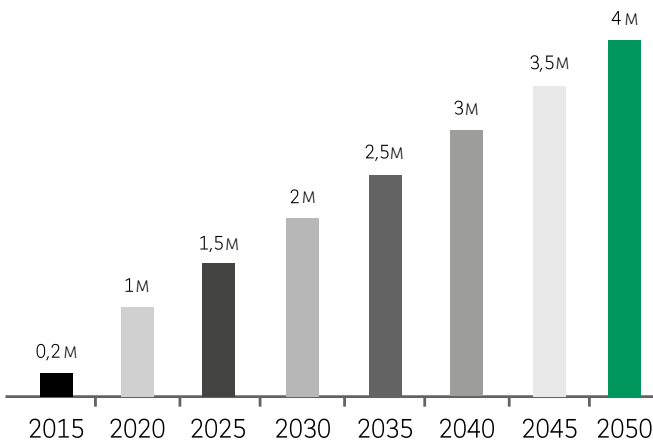


Fig. 2.2 Scale of employees shortage in Poland in subsequent years (own study based on ZPiP data from 2016)

At present, the labour market is being entered by the generation born after 1995, i.e. in a period of deepening demographic decline. This means that with each year the number of people starting work will decrease and at the same time more and more people will join the retired group. Fewer people of working age will provide for the growing population of pensioners. Economic emigration will also contribute to the reduction of labour resources. Poland may lack even 1 million workers in 2020, and in 2030. - 2 million, and by 2050. - 4 million⁹.

Already today almost half of the employers (49.7%) cannot find suitable employees, and over 16% of companies limit new investments due to deficiencies in human resources¹⁰. More than 62% of large companies have problems with recruitment, while in the manufacturing sector as many as three-quarters of companies have problems with the lack of human resources.

The period of low-paid Polish workers and the resulting competitive advantage based on low labour costs is ending. For the first time after 1990, there was a shortage of employees. The era of the „employee market“ has begun - the employer will now dictate the conditions increasingly less. There is no doubt that the situation will result in wage pressures. In addition, due to the ageing of the population, social security will have to increase, which will increase the costs of enterprises. Thus, the labour market may be the most important factor of changes for the entire Polish economy in the coming years.

The majority of employers and superiors are BB and X generations. Collaboration with employees from the Y and Z generations may prove to be a considerable challenge. This necessitates changes in efforts and personnel management, as well as the transformation of organizational culture. Conflict between generations and values is inevitable - after all, in almost every company we deal with people from different generations.

The appearance of the **Z** generation on the labour market, with its attitude and expectations, may be a big surprise for employers, not fully aware of the changes taking place, but still struggling with the problems of managing the older generation of Millennials. Generation **Z** representatives are only just beginning their professional career and are a mystery. It is difficult today to assess what kind of employees they will become, how to motivate them to work, how to train and evaluate them. Undoubtedly, these are people who openly communicate their needs and expectations related to work - there is nothing else but to listen to them. It would certainly be a mistake to assume that the **Z** generation can be managed in the same way as previous generations.

⁹ Union of Entrepreneurs and Employers (ZPiP), 2016

¹⁰ Labour Market Barometer X, 3r quarter of 2018, Work Service

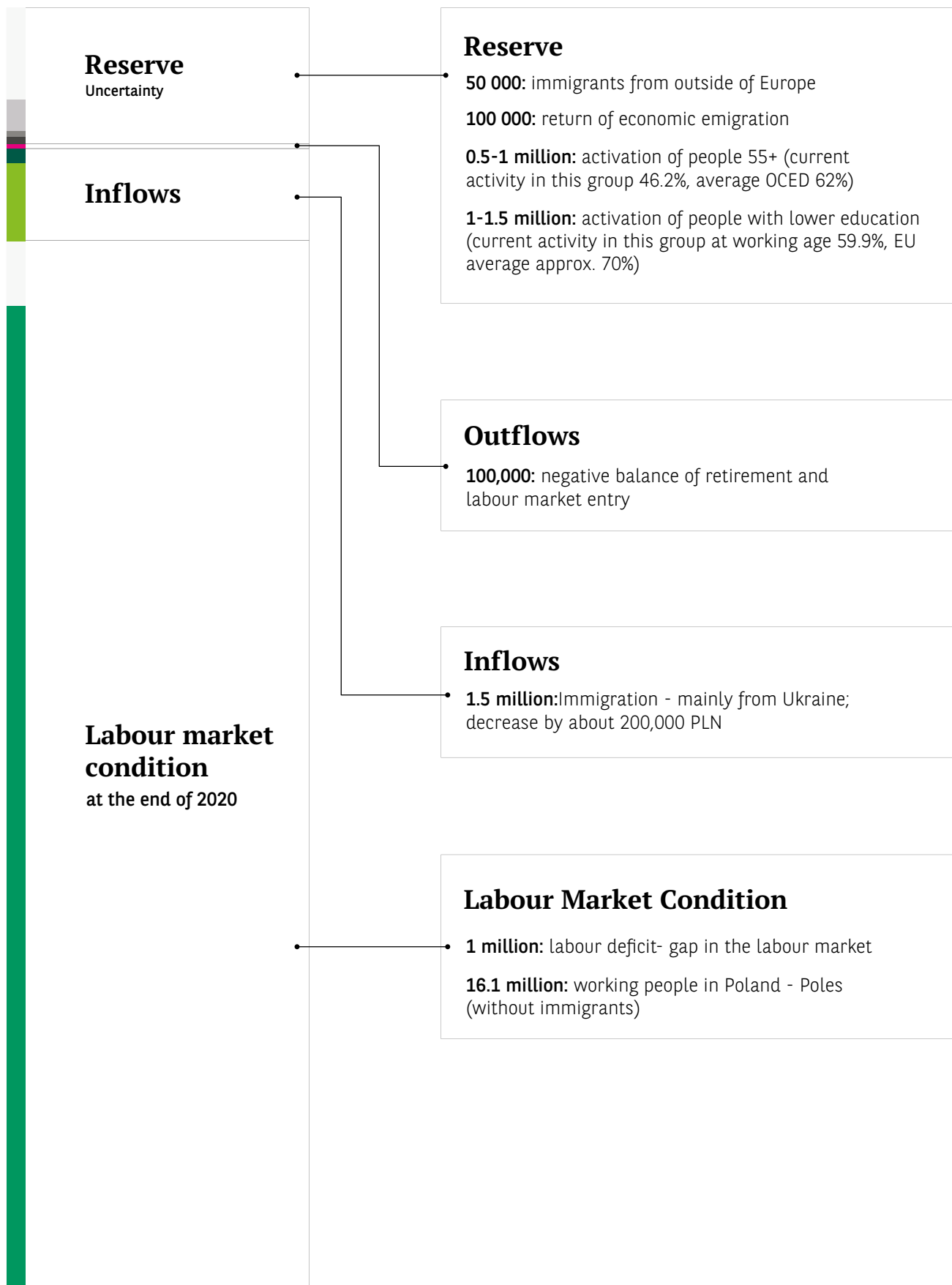


Fig. 2.3. Labour market balance at the end of 2020 (own study based on GUS, ZPiP data)

Solutions

In the search for solutions to problems on the labour market, the companies will first of all rely on themselves. They will have to change their approach to employment, move from employer to employee, prepare for the employment of the new generation and immigrants, and introduce more automation and robotisation to their plants.

It will be difficult to expect support from the administration. It is not known how it will solve problems related to economic activation of people with lower education and people 55+. The issue of Poland's openness to immigration remains considerable uncertainty.

Increase in wages and employee benefits

Employers will feel growing to increase wages and salaries. Currently, their growth is about 6% per year (taking into account the period 2016-2018)¹¹ and this trend is expected to continue in the years to come. Employees, especially those of Y and Z generations, increasingly expect that work will be a friendly place where they will be offered **personalized individual and professional paths**. The key may be to gradually give them more and more challenges and problems to solve. At the same time, young employees are not willing to devote more time to work than they think is necessary - their priority is private life. These are directions that employers will have to take into account in order to keep employees.

In this context, cooperation between businesses and universities can be very important. Enterprises should establish contacts with students, offering them favourable internships or apprenticeship, which may lead to the acquisition of a valuable employee in the future.

Employers can encourage its employees to take up or continue their studies, offering them personalised employment plans. Universities, on the other hand, thanks to contacts with enterprises, are able to quickly adapt their curricula to the current needs of the industry. Capful participated in the IdeAgora Project in 2014-2015, which was devoted to adapting university education programmes to the needs of the labour market and cooperation with graduates in the area of enriching their qualifications. One of the still valid conclusions of this project and the research carried out at that time is the fact that the matching of education with market needs is still delayed. Sometimes approving the programmes takes so long that during it a subsequent change takes place. The solution is individual training for a specific company or other entity with a guarantee of employment.

Professional activity growth

Low professional activity of Poles concerns mainly people with lower education and amounts to 59.9% for this group. The increase of labour force participation in this group to the European average - by about 10 percentage points - would result in an additional 1 million people entering the labour market. Activation of these people is, however, a long-term process and requires many systemic changes, first of all, enabling them to improve their qualifications. Increasing the activity of people 55+ remains a major challenge as well. This also requires systemic solutions from the government. These include, among others, a nationwide information and promotion campaign organised by the Ministry of Labour and Social Policy and the Centre for Human Resources Development „Equalising Opportunities on the Labour Market for 50+ People“. Since 2008, a number of activities have also been carried out under the „Solidarity of Generations“ Programme, designed to increase employment rates in the 50+ age group. In 2020, the programme aims to achieve the employment rate of people of 55-64 years

¹¹ Central Statistical Office (GUS), Statement on average remuneration in the 2nd quarter of 2018

old at a level of 50%. Realistically, however, no major changes in labour force participation in these groups in the coming years and their impact on labour costs should be expected. Employers, as in other cases, will have to take greater responsibility for activating the 55+ group. They must prepare a suitable offer for them in terms of both financial and working conditions - providing a flexible working system and appropriate training that will allow them to work in industry 4.0.

Employees from the Ukraine

For several years now, Poland has been increasingly becoming a target for economic emigration. First of all, Ukrainian citizens come. According to some sources, there are already about 1.5 of them in Poland¹². Unlike Poles who left the country, most Ukrainians treat Poland as a temporary stopover. Although 22% of them would like to move to Poland permanently, and 26% would like to stay for few years¹³, so far no appropriate mechanisms have been created that would enable Ukrainians to take up a permanent job and the possibility of permanent residence, and to settle down in the future. Offering work permits for 9 months does not provide wider prospects for either employees or employers. For example, it is difficult to find employment in positions requiring appropriate qualifications and training. Employers do not pay to invest in such employees, while employees do not think about the development path, but about quick earnings. It can even be said that the opportunity has already been missed. Poland's advantages in terms of linguistic and cultural proximity are becoming less and less important. More than half of the Ukrainians working for us are already thinking about moving to another country. The main directions are Germany, Czech Republic and Italy. Most of them intend to leave to Germany after changing migration policy in this country. This is a serious risk for the Polish labour market, which would deepen the HR gap from 150,000 to 500,000 people. Ukraine is already heavily deserted and there is no need to expect further waves of the labour force from this country. Everything indicates that the number of Ukrainians in Poland will decline regularly and thus they will not support our labour market.

In 2017, over 683,000 residence permits were issued in Poland to persons from outside the EU, which constitutes over 20% of this year permits issued throughout the EU.

¹² NBP Statistics Department, Warsaw, 2018

¹³ EWL report

We are the first in Europe in this respect. The attention is drawn to the fact that as many as 87% of the permits were issued in Poland because of taking up a job (with the EU average of 59%). The vast majority of persons obtaining a residence permit in Poland are the Ukrainians - over 585,000 people, which constitutes 85.7% of all permits. Then there are Belarusians (about 43,000 people) and Moldovans (about 8,000 people)¹⁴.

Non-European employees

Completely new opportunities are emerging for non-European employees. After Ukrainians and Belarusians, the largest groups come from Nepal, India and Bangladesh. However, there are still relatively few of them - a total of around 16,000. They also face administrative and organisational barriers, mainly in obtaining work permits and work visas. They are dependent on agents - they do not know the language, often even English, they are not able to deal with all the formalities on their own. This leads to waves of abuse by agents. Entrepreneurs employing such workers most often use the services of work service companies, which organize the entire stay of foreigners. These are hired employees who rotate quite quickly and it is not worth investing in them (e.g. in training). Alternatively, companies themselves have to deal with bringing in employees and dealing with everything from administration to housing or children's school. There is no indication that a sufficient number of non-European workers will come to Poland in the coming years.

Immigration policy

One way out of the collapse of the labour market can be immigrants. **With regard to the image of European and non-European immigration, there is still no adequate migration policy (and practice).** New policy priorities were announced in March 2018 at immigration priority¹⁵. They include: scholarship programmes for foreign students, a package of incentives for Poles who would like to return from emigration, facilitation of foreigners employment. The procedures for issuing work permits are to be further simplified. On the government side, there are assurances that „issues of foreign employees“ are being worked on and that „a privileged position will be given to those of them who decide to stay longer in our country and who will

¹⁴ Eurostat

¹⁵ Ministry of Investment and Development

work in professions desired for the development of the Polish economy". The aim is to „make it easier for these people to settle here permanently in order to fill the demographic gap in the future". Simultaneously, there is a large reserve towards immigrants from countries with different cultures and religions. Thus, **the size and sources of economic immigration to Poland are the greatest uncertainty for the labour market.**

Automation and robotisation

Professional activation and immigration are factors that are largely outside the direct influence of the companies. They require structural changes and belong to the activities of the state. In addition to changes in employment policy, companies can look for solutions related to the lack of employees in automation and robotisation, regardless of the administration's actions. In the face of a shortage of employees, companies will be forced to implement more advanced production technologies with less human intervention. Automatics can effectively replace labour shortages and increase productivity. In addition, automation makes it possible to offer higher wages and better working conditions. The automation potential in Poland is very high. Analyses show that in Poland as much as 49% of the working time (the equivalent of 7.3 million jobs) is occupied by employees, which can be automated by 2030 thanks to the use of the existing technologies¹⁶ The main problems related to automation are high costs and long waiting time for ordered devices. A full description of automation and industry 4.0 can be found in Chapter 3 of this Report.

According to experts/practitioners

Employees outflow in the poultry industry is noticeable, but this does not yet significantly affect the increase in labour costs.

Łukasz Dominiak, Director of the National Council for Poultry - Chamber of Commerce

Major role in the beef industry is played by meat cutting. Qualified workers are needed for this. However, there are fewer and fewer people willing to work in the cutting process, not only in Poland, but also in the European Union, Australia and the USA. Cutting robots, in this case, may be helpful, but for the time being, they will not replace humans. They need to be extremely precise and therefore costly. Otherwise, they generate a lot of losses of raw material, which is too valuable. R&D works on automation of meat cutting are becoming more and more advanced.

Jerzy Wierzbicki, President of the Polish Association of Beef Cattle Manufacturers

Study Results

On the basis of the conducted study: direct interviews, internet surveys and analysis of the collected data, general conclusions can be drawn:

- 01 Over the last few decades, the agri-food sector in Poland gained a competitive advantage in relation to Western countries, i.a., due to lower labour costs.
- 02 The growing shortage of workers is increasingly affecting agri food sector.
- 03 The increase in labour costs has an impact on the reduction of operations' profitability and ceases to be the source of competitive advantage of the food industry.
- 04 Employees with unique skills work abroad where they can gain several times higher remuneration.
- 05 Lack of labour forces evolves the agri-food sector towards a higher automation level and mass production.
- 06 Industries or companies which are not impacted by the outflow of employees and wage increases are characterised by a significant level of automation of production and work efficiency.

¹⁶ Shoulder to shoulder with robots. Tapping the potential of automation in Poland, McKinsey & Company, 2018, p. 5





03

Technology.

Food

industry 3.0/4.0

Imagine a yoghurt factory, which informs about the consumption of a crucial element of the production line and warns against a possible failure in 17 hours, or alerts about too small stock of raw material. At last, we have radical control over production and we can prevent stoppages. This is just one example of Industry 4.0 functioning, which creates smarter solutions for food and beverage processing thanks to combining devices, machine learning, cloud computing and industrial Internet of Things.



Current situation

Agri-food sector and its various industries are today facing totally new challenges. On the one hand, they concern ensuring the continuity and quality of production and its economic viability, on the other hand, they have to meet growing legal requirements and the needs of increasingly mature and conscious consumers. These conditions are changing more and more often. Flexibility and the ability to see opportunities quickly becomes a key power of companies. The Polish food industry is a part of the global market, which makes it subject to increasing competitive pressure. Existing sources of advantage: low labour, energy or raw materials costs are becoming exhausted. Meanwhile, the market and consumers are still looking for the lowest product price and at the same time quality expectations are rising. This is rarely reconciled.

The vector of the entire agri-food chain changes direction. It now runs from the consumer to the manufacturer. It is an irreversible process. It will result in an increasing scale of individualised production, for which a new approach of manufacturers and updating of technology is needed. Existing and expandable processing and manufacturing capacities, including increased productivity through advanced technologies would enable a significant increase in exports, both in terms of volume and value. In terms of volume - through increased sales and the acquisition of new markets; in terms of value - through the sale of more processed but healthy products. Winning on the global market is ensured more and more often not by a raw material or semi-finished product, but an advanced product, sold under a well-known brand. This requires increased efforts at the design, processing and production, packaging

and food distribution stages. This can be achieved by focusing on digitisation and development of food industry 4.0 in Poland, that is connected with investments that not all can afford. Especially in the small and medium-sized food enterprises segment, where many of them generate profits amounting to 1-2% of turnover. But is this not the last moment to look for such solutions anyway? All the more so as these investments may not turn out to be as high as it would seem, and the market is increasingly short of the labour force. Advanced technologies require fewer employees. If the right steps are not taken, we will start to lose markets, including internal markets, as competitive economies have been developing Industry 4.0 for almost four years.

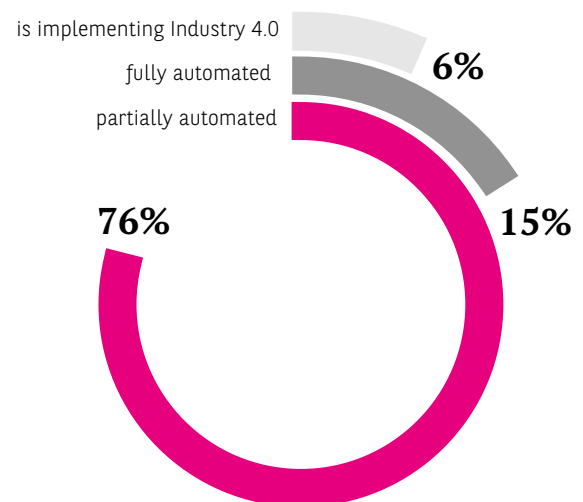


Fig. 3.1. Scale of enterprise automation in Poland according to Astor (own study based on Astor S.A. 2016 research)

Results

Food industry 4.0: innovations and technologies

The dynamics of the agri-food sector requires observing and responding quickly to trends and fashions in nutrition. Different customer segments expect different products: from snacks and effortless, easy to prepare meals, through traditional food to organic and functional food. In each of these categories, there are products with a significant degree of differentiation. Simultaneously to being part of global supply chains and exporting the same products to other markets, they need to be more or less adapted. This means that the product range needs to be constantly expanded. The size of individual production batches is also variable.

In order to cope with this diversity and variability in production, a new approach to processing and manufacturing is essential. The current paradigm of the industry based on machines and automation as autonomous parts of the manufacturing system is no longer sufficient. The main objectives of Industry 4.0 are communication between machines (machine-to-machine) and human being with machines (men-to-machine). But the biggest advantage here is the machine-business communication, which enables treating machine-as-a-service. This allows preparation and production lines of modular design to be integrated with each other and to develop the rapid adaptation capacity of the processes. Thanks to the Industrial Internet of Things (IIoT), plants become hybrids of devices and production lines connected in automated modules. The added value is the simplification of work processes, increase in productivity and reliability of production. As a result, its scope is often widened and services are diversified. Food safety and strict hygiene standards throughout the process, from the purchase of raw materials to packaging, storage and logistics, play an increasingly important role in processing, production and distribution. This area can

also be controlled today thanks to technology. A crucial aspect of technology implementation and development is the human factor. In several places in this report, it has been pointed out that one of the strongest factors influencing the future of the agri-food sector and the economy as a whole is the deepening labour force shortage. Automation and the food Industry 4.0 can be the antidote to this phenomenon. There is also the „other side of the coin“ - the degree of complexity and technological advancement of machines and the tasks performed by them based on data processing, requires fewer, but better educated and more experienced employees. Machine and technology creators focus on simplifying the operation, configuration and servicing of the devices, but highly qualified specialists for this work will be sought after for a long time. As technology continues to evolve, employees will need to be trained on a continuous basis. The challenge for companies is to find employees - automation engineers and technicians. They are already lacking on the market, because often after graduation they go abroad, where they receive higher salaries in their profession. **The Industry 4.0 ecosystem consists of four pillars:**

01 Industrial Internet of Things (IIoT)

Provides communication with distributed, intelligent sensors and other elements of the system, intelligent production line modules. Production processes can be controlled through diagnostic data obtained from the system (e.g. quality control of food products).

02 Data analytics¹⁷ i and optimisation

Real-time collection, analysis, aggregation, processing and synthesis of data. Managers, through their own cockpits, have access to current production parameters. This enables an advanced optimisation of production

¹⁷ According to an Intel study from 2015, only one in five Polish companies uses analytics.

and implementation of predictive maintenance methodology.

03 Cyber-physical systems (Physical-Systems CPS)

CPS integrate mechanical, electronic, communication protocols and software. It is a combination of production systems with the IT area and business (decision making and management).

04 Cyber-safety

Implementation of protection against rapidly growing external and internal threats.

The above four areas are filled with dynamically developing technologies, which include:

- ⊙ Big Data
- ⊙ Artificial Intelligence

- ⊙ Digital twin and digitalisation
- ⊙ Cloud computing
- ⊙ Production line simulations
- ⊙ Mobile interfaces (cockpits)
- ⊙ Predictive maintenance and service systems
- ⊙ Machine-as-a-service
- ⊙ Intelligent supply chains
- ⊙ Cooperating robots
- ⊙ Mobile robots
- ⊙ Additive manufacturing technologies, eg. 3D printing
- ⊙ Augmented and virtual reality
- ⊙ Blockchain

In the following part of this chapter, we describe selected technologies, which are economically most beneficial for the agri-food sector.

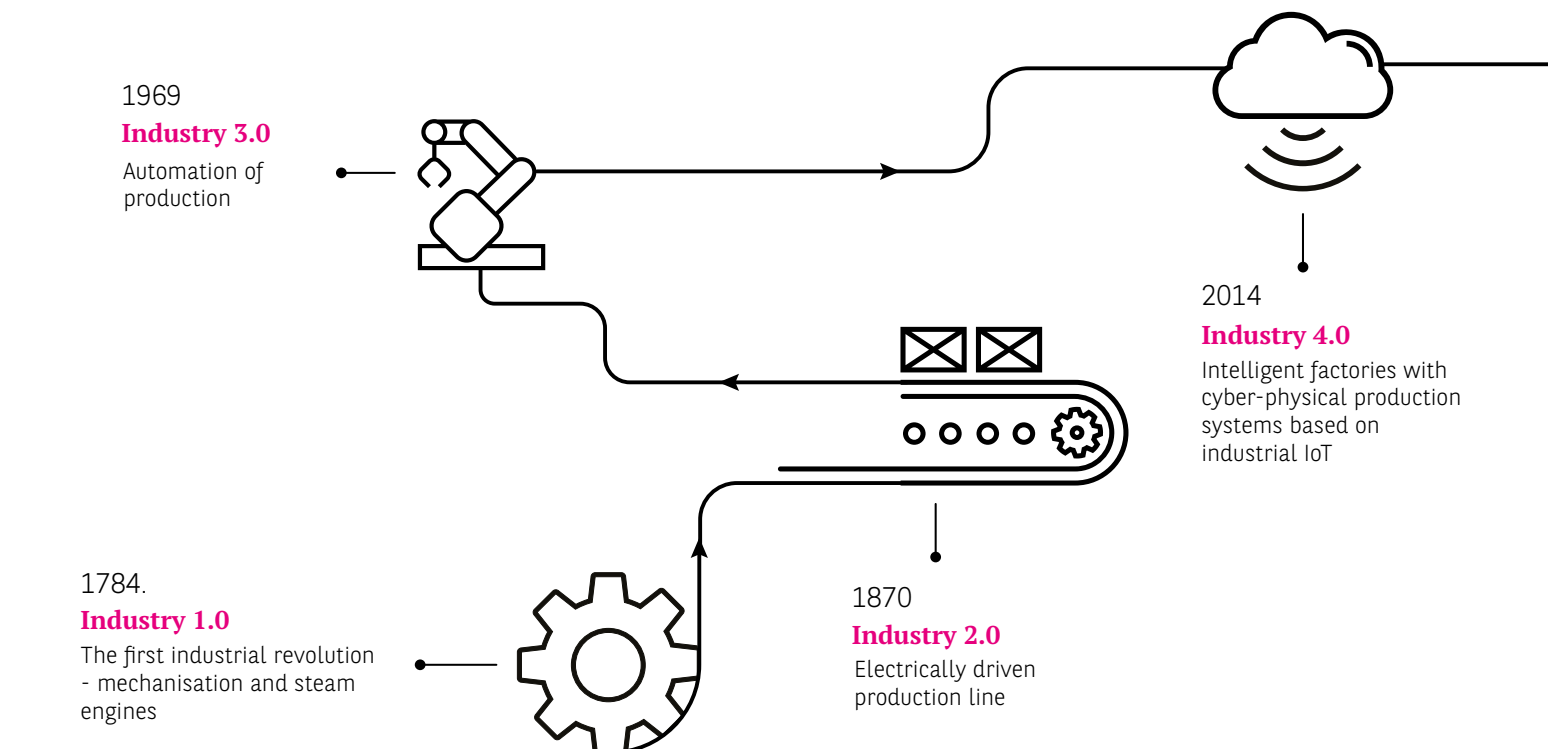


Fig. 3.2. Evolution from the first to the fourth industrial revolution (own study)

Solutions - future that has already become

Industry 4.0 is a platform that integrates many technologies (see: 'Results in this chapter and Figure 3.3). Most of them are becoming more and more widely available, but combining them takes time. This must not be omitted when deciding when we want to start the digital revolution in our business.

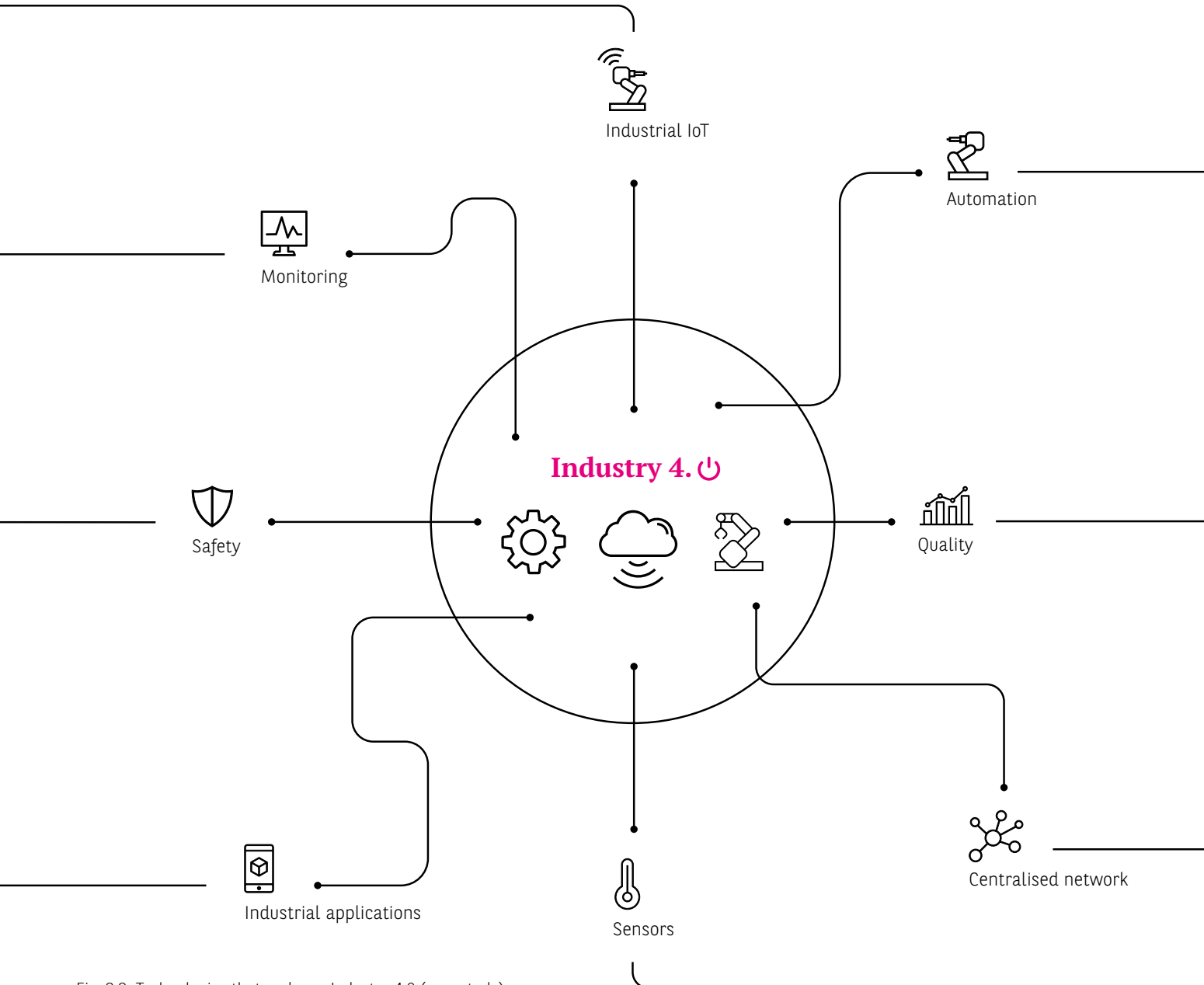


Fig. 3.3. Technologies that make up Industry 4.0 (own study)

Automation, i.a. MES and SCADA

A key element of the Food Industry 4.0 is the automation of production (the main feature of the Industrial Revolution 3.0) combined with the support of MES production management (Manufacturing Execution Systems) as well as data acquisition and under SCADA (Supervisory Control and Data Acquisition). Designed and built on the basis of these components, production lines allow for faster change of production parameters, ensure safety and increase of productivity. Experts estimate that the level of automation in the food industry is high and grows faster than the average for the whole market. The standards are set by large companies with significant automation and digitalization intensity. But also here, there is still a long way to full automation. In both larger and smaller plants, many production sub-processes are already optimised, but in both cases often they are not interlinked.

Currently, the main tasks performed by the robots are related to pre-packaging, collective packaging and palletisation. According to data from the Institute for Market Economics, in Europe there are **85 robots** per 10 thousand employees, in Poland, there are only **28**.

Automation, the connection of subprocesses and the processes themselves require online status, so that individual elements of the entire production ecosystem can communicate with each other and with other systems. There are two levels of data circulation: Fog Computing in the immediate vicinity of devices and Cloud Computing, i.e. storing and exchanging data on external servers. This creates obvious threats from cyber hackers and malware. Intelligent devices used in food production must be protected against the attacks, because of the sensitive nature of this sector. Ensuring cybersecurity is becoming as important a cost item as production automation.

As for effective implementation of production automation based on the Industrial Internet of Things, in the food industry, it is often claimed that such solutions are best built from scratch, i.e. by replacing the existing machine park. Experts point out that this can also be done effectively in existing systems.

Predictive maintenance is a concept of organization of maintenance activities in production plants. It successively replaces run to failure, i.e. an immediate reaction after a fault or failure, as well as the classic preventive approach, based on a predetermined inspection and maintenance schedule. The basic aspect of the idea of predictive maintenance is the precise adjustment of conducted activities to the individual, current needs of machines.

Virtual Reality and Augmented Reality (VR and AR)

Thanks to comfortable flat screens, or slightly less comfortable use of googles, AR technology allows... to see „something“ more. The operator of a machine or production line has access, in real time, to data concerning the entire production and its critical elements or performance indicators. If problems arise, he or she can receive visual advice on where the place in which anomaly has occurred and suggestions on how to deal with it. In this case, the benefit is inestimable, as any possible downtime is shortened - moreover, it can be predicted and counteracted by service actions.

This function is performed by preventive services using visualization of the location of worn-out machine parts. Thanks to the possibility of an online exchange of data with internal or external specialists, it becomes possible to solve difficult problems by people who are not experts in a given field. Thanks to AR, service technicians can carry out repairs practically without the need for prior training. They use real time consultations and a tutorial containing step-by-step instructions on how to replace worn parts. VR and AR in the industry are still new, evolving technologies. In the coming years, intensive development and expansion of current functionalities are expected.

What are the components of the cost of implementing this technology? The technology requires designing and implementing so-called „digital loop“ in the company.

It is a complete system enabling real-time data exchange. This includes appropriate equipment - mobile devices for industrial use - e.g. environmental resistant tablets or glasses/goggles. They must be comfortable enough not to hinder the employee's everyday work. In addition, there is a CAD or ERP IT environment, which is and is to be a source of data for engineers and technicians using the devices discussed above. After designing the system, the staff must be trained and there is a need to make sure they get used to wearing the AR goggles and looking at the image, on which information is constantly layered. Over time, there may be a need to better adapt the application and interface.

Big Data

Collection, analysis, aggregation, processing and synthesis of data, drawing the conclusions and creation of predictions affect the food industry today more than ever before. This is, for example, due to the need to observe consumer behaviour and anticipate future trends in nutrition. It is not yet limited to this - for example, in global raw materials supply chains, data on raw material prices play a key role in achieving business objectives. In the production, these sensors provide a huge amount of data.

The world is moving towards comprehensive data management. Processes that take place in large datasets provide specific conclusions in real time, e.g. on sales volumes by geography. The Gartner Institute predicts that by 2020 as much as 80% of business processes in companies will be based on Big Data. The collected data is an "input" for Artificial Intelligence. The larger sets, the more accurate is machine learning.

Artificial Intelligence (AI)

When did the breakthrough occur? It is hard to determine the exact moment. For many, it was a lost chess match between Garry Kasparov and Deep Blue IBM computer (May 1997). It was then that the world began to discuss the end of man's domination of the machine. Increasingly fast, exponential development of technology - unprecedented in the entire history of mankind - provo-

kes a question today, not about whether, but when could a computer replace the human mind?

Artificial Intelligence is the strongest factor that is already beginning to revolutionize many branches of industry and human life. Analysts predict that the AI market will grow at a rate of 55.1% each year to reach 72 billion dollars by 2021¹⁸. Currently, the industry in the agri-food sector that uses AI most intensively is e-commerce.

In order to develop this technology, Big Data is necessary, as machine learning is based on the analysis of huge amounts of data sets. Only on this basis do new algorithms arise, which are used in predictive systems to facilitate decision making.

Blockchain

The food supply chain based on blockchain technology is characterised by safety, food traceability and reduced waste.

The Subjects - actors in the supply chain reap many benefits:

- 01 lower costs
- 02 better access to information on prices, markets and products
- 03 helping to identify new opportunities in local or global scale and enabling the adaptation of supply chains
- 04 better responding to consumer needs
- 05 greater transparency of more reliable data, resulting in developing better financing options

While the Polish food industry is becoming more and more automated, the digital transformation is much slower. ASD Consulting's survey, published on 28 June 2018, shows that most companies have not yet started

¹⁸ Deloitte University Press and Singularity University Report: Exponential manufacturing. A collection of perspectives exploring the frontiers of manufacturing and technology. 2018

the digital transformation process. 84% of production managers admitted that their companies record production information manually. 47% consider this to be sufficient, and 23 and 4% consider it to be good and very good, respectively. In the second part of the survey, production managers were asked to identify the area in their company with the greatest potential for improvement, as much as 76% indicated the flow of information. The second place was taken by the production process efficiency, where 65% of the respondents noticed the need for improvement. Large gaps also exist in the areas: quality (38%), timeliness of deliveries (30%), machinery availability (28%) and stock levels reduction (25%). Plans to implement advanced data analytics in the production area over the next two years were declared by 58% of respondents, while 43% of them want to use it for better quality control in this time frame. The same percentage of production managers forecasts the implementation of data analytics in the area of maintenance, 39% want to apply it soon in order to improve production planning, and 17% to manage distribution in a better way.

According to the 2017 Capgemini global report: „Smart Factories: How can manufacturers realize the potential of the digital industrial revolution“, intelligent factories can increase productivity by more than 25% over the next five years. At the same time, out of 43% of the Industrial 4.0 initiatives implemented by companies, only 6% of undertakings are fully digital.

Technology implementation costs

Each project in the scope of Industry 4.0 has an individual character. At the stage of auditing needs and simulating solutions, it is necessary to focus on the calculation of return on investment. **Depending on the specific industry and plant as well as specific goal and scope of the digitisation project, the observed returns on investment take place as early as 6 months after the launch of the system¹⁹.**

As automation in the food industry is high compared to many other industries, the transition costs from the current 3.0 to 4.0 do not have to be as great a barrier as it is commonly believed. This is an investment in the design and connection of individual elements of a production line.

¹⁹ Source: ASTOR sp. z o.o.

Calculation of investment return in the fourth industrial revolution may be easier if the Total Cost of Ownership (TCO) approach is used. The costs associated with the investment itself (CAPEX) and operating costs (OPEX) should be taken into account here. Total amounts include, i.a.:

- ⊙ training and constant employee development
- ⊙ modernisations, replacements, updates
- ⊙ waste
- ⊙ safety (including cyber-security)
- ⊙ service costs
- ⊙ inspections
- ⊙ warranties
- ⊙ environment protection
- ⊙ customer response costs

To sum up, it is worth treating planning and implementation of intelligent production solutions as a long-term investment and choose a contractor who will be a Partner during this process.

Innovation in the agri-food sector. Current situation and perspective

The agri-food sector is one of the least innovative industry in Poland - much less frequently than in other sectors, completely new or significantly improved products are introduced. In the years 2014-2016 only 8.1% of enterprises from the food sector launched novelties on the market, and 10.6% changed their production processes. In other industries, it was two or three times more. In this period, almost 19% of companies in the industry received subsidies for innovative activity. This means that research and development work was carried out almost exclusively in the case of receiving the subsidy. At the same time, sales of new products (i.e. those introduced in the last three years) in 2016 accounted for only 3.1% of revenues in the industry²⁰.

²⁰ GUS, Innovative activity of enterprises in 2014-2016, 2017

In international corporations, it accounts for 10-20% of revenues and is one of the most important sources of competitive advantage. Each business concern has extensive R&D departments, but they are located outside Poland. The majority of Polish companies from the agri-food sector do not carry out R&D works and do not intend to do so in the coming years. Innovation is understood primarily as the purchase of modern equipment and not the introduction of new products. Polish companies choose to compete with the price or quality of traditional, low-processed products.

Increasing demand for highly processed foods and new nutritional trends (e.g. „easy to use”, healthy, functional, age-appropriate food, etc.) are leading to a demand for innovation and research and development work in the agri-food sector. In order to keep pace with the more developed EU countries, it is necessary to carry out R&D works and incur appropriate expenditure. The lack of such expenditure will widen the gap between the Polish and Western agri-food sectors and Poland will remain a supplier of cheap raw materials and semi-finished products.

Financing of research and development work. Agri-food sector

The financing of research and development work for the agri-food sector is possible under the EU subsidies for the years 2014-2020. Subsidies can be obtained for R&D works and for implementation of R&D works results, as well as for the creation of R&D centres in companies.

Research and development lead to the development of an innovative product or service (product innovation) or a change in the manufacturing process (process innovation). It consists of two stages: industrial research, the aim of which is to acquire new knowledge that can be used to develop new products, and development work, where new products (or services or processes) are being developed. The subsidy is intended to cover, among others, partial costs related to salaries, research equipment, external services or operating costs.

The subsidies have basically two sources: these are national funds under the Intelligent Development Operational Programme (PO IR), and regional (voivodship) funds under the Regional Operational Programmes existing in each voivodship.

National subsidy for R&D works is available within the framework of the PO IR 1.1.1, the so-called fast path, which is intended for enterprises conducting R&D projects. Enterprises may also carry out R&D works in consortia with scientific entities under PO IR 4.1.4.

It is also possible to carry out R&D works by a research unit at the request of the enterprise, for which the PO IR 2.3.2, the so-called innovation voucher, is intended. Additionally, innovations in the agri-food sector are financed under the Rural Development Plan (PROW) action 16 „Cooperation”.

Co-financing for the implementation of R&D works results and for the creation of research and development centres are intended for investments, i.e. for the purchase of fixed assets, intangible assets (e.g. software) and construction works. In the case of creating research and development centres, it is the purchase of research equipment which will be used for R&D works, and in the case of implementing R&D works results, it is the purchase of means of production.

Subsidies for implementation R&D works results are available in the PO IR 3.2.1 - „Research on the market”, whereas funds for research and development centres can be obtained in the OP IE 2.1.

In each voivodship there are subsidies analogous to the national ones, i.e. addressed to R&D projects, creation of R&D centres and implementation of the results of R&D works (within the Regional Operational Programmes).

Subsidies can be obtained, both from national and regional funds, for activities related to innovation. These are activities such as: preparation for implementation, consulting, patenting and industrial property protection, or certification of innovative products.

According to experts/ practitioners:

Produkcja serów dojrzewających wymaga wielu manual works. Today, it is hard to imagine, that they will be replaced by machines. However, over time, this will result in increasing labour shortages and higher labour costs. Investments in further production automation must be well thought out, as they have an impact on the final financial result. The future of the industry is production digitalization, i.e. maximum integration of machines, devices, networks and information systems. This will enable smooth and reliable operation of the devices. The downside is the risk of cyber-attacks, as each line is connected to the network. In addition, we need to find workers with the right skills, which is not easy and entails higher costs. All these elements do not remain margin neutral. (...) In optimising water use in Ceko, automation and the internal program, which has the support of the employees, was helpful. The best in the industry invest in their own water treatment plants, close media consumption processes through control and monitoring, and recover biomass.

Dariusz Zieliński, prezes Ceko Sp. z o.o.

Automation is only a remedy for lack of hands. But to implement automation, you need to have a high margin. Commonly, in Polish companies, the investments in automation are made without extensive analysis, because of which they

turn out to be unsuccessful. Paradoxically, high technology may become a driving force for the consolidation of companies, as it will be easier to buy those who do not manage to modernise their plants.

Marcin Czarnecki, expert, long-time president of enterprises from the food industry

We will still have to wait for full automation in food production. For economic reasons, it will not yet be possible for a very long time to fully replace staff with robots.

Jarostaw Szczepaniak, President of ZPS Jamar Szczepaniak sp.j.

Study Results

- 01** The automation of production seems to be one of the best remedies for the deepening labour deficit.
- 02** The food industry 4.0 requires high qualifications from employees, which may make it even more difficult to obtain them than it currently is.
- 03** Full replacement of personnel in food industry by robots and machines connected in a network will not be possible for a long time.
- 04** Investments in automation significantly influence the final financial result.
- 05** Companies with a low level of automation will be an easy target for mergers during the consolidation of industries.



04 Energy



Current situation

Modern agriculture and farms consume 5.3% of Poland's total energy balance. The entire industry, including food sector and food distribution, consumes 23.4% of the energy balance²¹. Meanwhile, in discussions about the economy, development of companies and innovations, we devote very little attention to this issue.

The analysis of energy consumption in selected food sectors according to Institute of Agricultural and Food Economics/Central Statistical Office data between the first half of 2017 and the corresponding period of 2018 (Annex 1) shows a very low increase in energy consumption costs. In some industries, there has even been a slight decrease in costs, which can be the result of energy audits and more frequently introduced optimisation. In sum, in the food industry as a whole, energy costs account for approximately 1.3-1.5% of operating costs. It has to be noted that the analysed period does not include increases in energy prices for industry, which started in August 2018 and reached between 50 and 70% of the current rates per MWh. Information was obtained from respondents' in-depth interviews.

50-70% the average amount of electricity price increases in September and October 2018

Increase in electricity generation costs

In Poland, 80% of electricity is produced from hard coal and lignite - the energy sector is dependent on them. Prices of this raw material for power plants in 2018 reached a level not recorded for six years - due to its increased demand in China. In addition, the by-product of combustion is the emission of greenhouse gases, mainly CO₂, which contributes to a significant disturbance of the natural environment. The postulate of economy decarbonisation resulted in sanctions - the charges for carbon dioxide emissions. This is due to the planned 40% reduction in European emission rights auctions in 2019. The water, or more specifically, its scarcity, has also contributed to the increase in energy generation costs. Coal-fired power plants need it to cool down the water vapour. In summer 2018, severe water shortages occurred due to heat and drought.

The decreasing competition on the Polish energy market is also a pivotal factor contributing to the cost increase. It was left by corporations such as Corrente, Suez and EDF. ZE PAK remained the only independent manufacturer. This is not beneficial for the customers.

²¹ Data of the Central Statistical Office for 2016

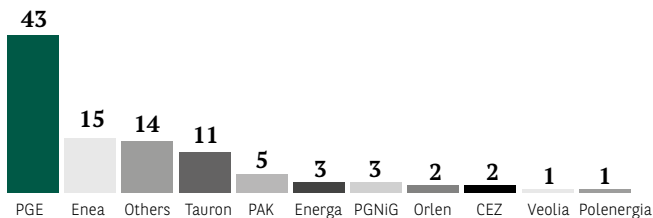


Fig. 4.1. Companies providing electricity to the grid and their market shares in percent (own study based on Energy Regulatory Office, JSW and CoalGlobal data)

Transmission networks

Over 77% of medium voltage overhead lines are more than 25 years old and 36% are over 40. Transmission networks are very sensitive and failure-prone component of the entire plant, which has been constantly deteriorating over the years. Breakdowns lead to power cuts, which are characterised by two SAIDI and SAIFI indices. In Poland they are decreasing, but they are still among the highest in Europe. Weather conditions (e.g. strong winds and hurricanes, freezing rainfall) have a major impact on failures and blackouts. Any production processes stoppage caused by shutdowns, with lack of emergency power supply, results in losses.

Renewable Energy Sources

Awareness of dwindling mineral resources, negative impact on the environment, high costs and long construction time make us think about energy sources using local, mainly renewable resources. In Poland, the obligation to purchase energy from renewable energy sources was imposed, as stated in the Ordinance of the Minister of Economy of 19 December 2005. The Ordinance specifies the increase in the share of energy from renewable sources to 9% in 2010. In 2006, an amendment to the Act was adopted, setting a new level of 10.4% in 2010. The Act of 20 February 2015 on Renewable Energy Sources (RES) was to allow to obtain a 15% share of renewable energy in total energy consumption by 2020.

In the last three years the development of renewable energy has been halted. The mandatory share of „green” electricity sold to consumers in Poland is to reach 19% in 2019 and 20% in 2020 (of which 0.5 p.p. will be exclusively given to

electricity from agricultural biogas plants) – as results from the Act of 7 June 2018 amending the Act on Renewable Energy Sources and certain other acts²².

Such a decision was expected on the market. As a result, prices of green certificates, i.e. the main source supporting renewable energy sources (RES), were increasing. However, shortly after the draft regulation was announced, their price rose to 133 PLN/MWh - a value unquoted for over three years.

This is good news for „green” energy manufacturers- inter alia, hydroelectric power plants, biomass-fired power plants or wind turbines. A year ago, the prices of certificates were around 20-30 PLN/MWh; which was below the profitability level of most installations. Their owners decreased the costs extremely, reducing even the number of inspections or postponing the replacement of worn parts.

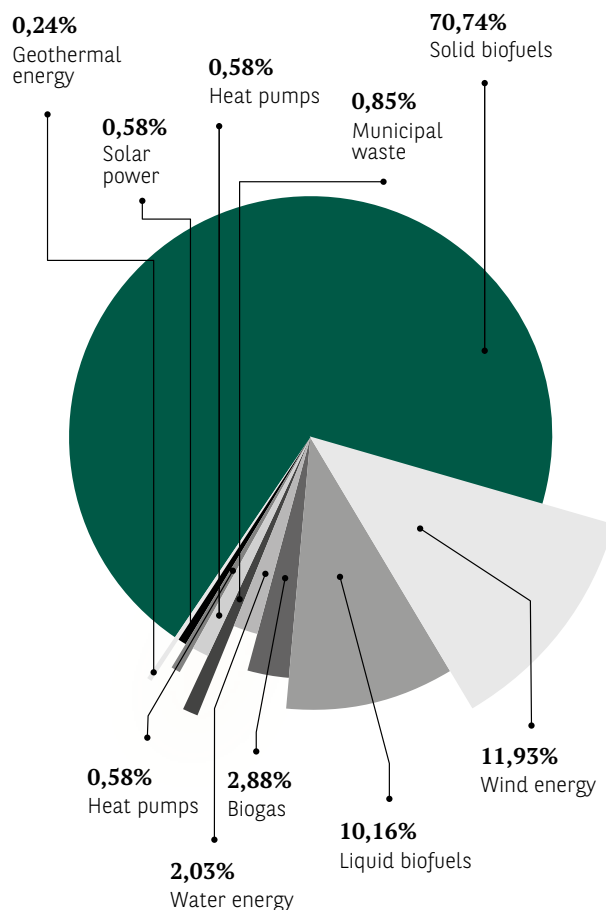


Fig. 4.2. Structure of obtaining energy from renewable sources by carriers in 2016 (own study based on the ERO data)

²² Journal of Laws of 2018, item 1276

Diesel, biofuels, natural gas

Liquid fuels are required for the development of each branch of industry - including the agri-food sector, which consumes significant amount of fuels, especially diesel (ON). It is estimated that 14% of diesel available on the Polish market is used by agriculture. This is due to the high level of mechanisation of the works in the field. For comparison, the food industry uses 2% of diesel. It should be noted, **however, that transport, which consumes as much as 75% of this fuel, is to a large extent used by the food production sector**, e.g.: purchase and transport of raw materials and supply of finished goods to distributors.

Crude oil prices depend on many global factors, including the international situation, growing global demand, regulated production, political situation. It is highly possible that oil will be more expensive in the coming years. Such a high fuel consumption in agriculture causes that changes in diesel prices have a great impact on agricultural production costs.

Natural gas is a very good alternative to other fuels for farms. It is particularly appreciated by gardeners and animal breeders. Heating greenhouses with natural gas allows for a significant reduction of crop cultivation costs, especially in combination with an exhaust heat recovery system.

Increasing number of companies uses natural gas stoves directly in food production. With the use of suitable equipment, a constant temperature and convenience of use are achieved. It is crucial that the gas meets even the strictest hygiene standards. In addition to the use of natural gas for technological purposes, larger food industry plants also use this raw material for heating and air-conditioning the rooms and for heating domestic water. Until recently, only electrically powered heat pumps were used in air-conditioning units. Currently, it is possible to use heat pumps powered by natural gas: compressor or absorption heat pumps. Heat pumps, based on the heat exchange cycle between the evaporator and the absorber, called GAX pumps (generator-absorber heat exchange), **are considered to be a future-proof technological solution due to their very high energy efficiency, 40% higher than in the existing designs.**

Results

The increase in generation costs of the manufacturers entails an increase in electricity prices for consumers. This particularly affects energy-intensive businesses. The price increase in wholesale purchases exceeded even 50%. The study made for the purpose of this report has shown that the average scale of increases in September 2018 in the food sector is between 50 and 70%. Electricity prices for the following year on the Polish Power Exchange dated 19 July 2018 were higher even by 100% as compared to 2017 and reached 224 PLN/MWh.

The same happened on the spot market (costs of energy ordered for the next day). In mid-July they reached 230 PLN/MWh, and in peak hours even 260 PLN/MWh. In previous year the average monthly price was 150 PLN/MWh. The record was set on 23 August, when

prices rose up to 350 PLN/MWh²³. Small and medium-sized enterprises receive written notice of termination of electricity supply contracts or letters informing about the application of the so-called modification clause, changing the current price to a higher one. In some cases it is an increase of even 90 PLN per MWh.

During the period August-October 2018 **natural gas prices increased on average by 30%.**

The logical consequence of the increase in energy prices is an increase in the prices of products and services. It is also one of the inflation sources, higher interest rates and decrease of the competitiveness of Polish agri-food sector.

²³ Source: Polish Power Exchange

Solutions

The traditional energy industry is turning into a much larger-scale energy industry, primarily since it enables interdisciplinary solutions thanks to digital tools. There are several clear future trends: smart grids using large data sets (Big Data), real-time smart measurement and auditing, virtual power plants and the merger of companies generating energy as a by-product of their business into a new type of distribution system operators. The most essential aspect is network security, energy storage and balancing the fluctuations in the production and circulation process. These phenomena change the rules of the game also in agriculture, food industry, distribution and trade. The study allowed to determine specific solutions that the sector and its individual industries are already use or plan to implement.

Energy audits and energy use optimisation projects

Every industrial facility can have optimised energy efficiency: electricity and heat. This significantly reduces costs through intelligent media savings. The representatives of the food value chain point out the possibility of reducing bills by up to 50%. Importantly, the investment is carried out in cooperation with the solution provider, who participates to a certain extent in the savings achieved by the customer.

Mergers into purchasing groups

The purchasing group allows to negotiate the most favourable conditions of energy supply. Its power depends on the total volume of energy demand. Three factors have the greatest impact on success:

- 01** Purchasing groups must be organised on the basis of entities partnership.
- 02** Groups should be formed according to a similar characteristics of energy consumption by their constituent entities. Thanks to this, each participant will receive an optimal and adjusted offer.
- 03** The negotiating team must include individuals with experience in tendering procedures and knowledge of the energy market.

Possibility of purchasing energy from foreign manufacturers - energy bridges

It is worth checking the possibility of purchasing energy directly from foreign suppliers in term contracts, e.g. from Germany, Austria or Scandinavian countries, where prices are lower than in Poland. However, it should be noted that Poland is one of the countries with the smallest number of cross-border interconnections. Total interconnection capacity exceeds 12% of domestic demand, but only about 5% is used. This is mainly due to technical problems with power transmission and the lack of a coordinated market coupling strategy. There is a large overcapacity on the European market. Market coupling will reduce energy system costs, reduce energy prices (which have fallen by 30% in recent years) and support supply security. However, will Polish manufacturers cope with foreign competition?

After full integration with the European market, the Polish energy market may be reduced by maximum 15%. Industry and consumers in Poland would benefit from combining energy markets, but this means higher competition for manufacturers.

The ERO quality tariff

Breakdowns of electric transmission lines, resulting in lack of power supply, are regulated by the quality tariff introduced by the President of the Energy Regulatory Office. The aim of its implementation is mainly to improve the distribution services quality, inter alia, by improving the quality and reliability of energy supply. This would shorten the time of breakdowns and network connections. By 2020, breakdown time is expected to be improved by 50%. The average duration of SAIDI breakdowns in 2013 was 360 minutes, 272 minutes in 2015 and is expected to fall to 130-140 minutes in 2020. These indicators can only be achieved if further investments are made in upgrading and optimising networks and creating smart distribution solutions.

Renewable Energy Sources Prosumer Market Development - energy at your hand?

An alternative to system solutions is the search for energy from renewable sources. This would allow for an almost 100% self-supply of energy. The most popular is the use of solar energy. A properly selected photovoltaic micro-installation can reduce electricity costs by up to 95% per year. It is also a buffer against constant increases in energy prices. When electricity is produced by own micro-installation, the produced energy can be consumed on an ongoing basis. Moreover, at any time during the accounting year, the user may collect each kilowatt-hour from the power distribution company that was produced from surpluses and provided to the network. In 2018, owners of installations up to 10 kW benefit from a reduction of 1 to 0.8 ratio, while those with 10 to 40 kW benefit from a reduction of 1 to 0.7 ratio. In this settlement no distribution fee occurs. Only the so-called fixed fees of approx. PLN 160 per year remain in the account (e.g. subscription, quality, transitional and trade fee). It is a beneficial solution for the owners of agricultural holdings. The scale of the investment is a disadvantage. The purchase and installation of a photovoltaic micro-installation for single-family house brings return only after 10 years. Therefore, for many country dwellers the benefits of such an investment are too unrealistic.

Supplementary supply and self-supply in energy using photovoltaic system is also possible within industrial area. One of the extraordinary examples is a 1 MW solar farm which was made of approximately 4,000 panels on nearly 2 ha at Tymbark plant by the Maspex group in 2015. It has to be highlighted that biogas (for the trigeneration process) is also used for generating electricity, thermal and cooling energy; and the plant works on the basis of low emission economy, production lines are energy- and water-saving²⁴.

Carrefour Polska, owner and manager of Galeria Słowińska in Zgorzelec, has installed a hybrid installation using photovoltaic and wind technology on the roof of its facility. The total power of the system is almost 40 kW, which makes it possible to cover about 3% of the total electricity demand. The photovoltaic installation includes 86 panels with a total power of 23.7 kW. It complies with 16 wind turbines with a total power of 16 kW. This is a test solution.

Energy storage

What if the future belongs to the prosumers? The world will be a hybrid of micro-networks and... electricity storage facilities.

Even today, full-generation energy storage makes it possible to stabilise the system and thus strengthen energy security. This is particularly important for the use of less stable renewable sources, which are difficult to control, since they depend on weather variations. The main goal here is to balance the network on a daily basis - to alleviate the load on the power network during the peaks and to collect the energy when its overproduction occurs. Unequal operation of the network causes frequency jumps and system malfunctions.

Experts agree that the development of RES and new generation energy are linked to energy storage technologies. According to data from the International Energy Agency („World Energy Outlook 2016“), current energy storage capacity is slightly under 3% of the world's electricity production capacity and is dominated by a single technology - pumped storage power plants (ESP). In Poland, the capacity of pumped storage power plants is estimated at nearly 1800 MW.

²⁴ Source: Maspex

However, energy can be stored using several other technologies. These include, inter alia, lithium-ion batteries, chemical, mechanical and thermal technologies and compressed air storage facilities built at the level of distribution networks.

Energy storage costs decrease by at least 20% per year and it is expected that the level will fall so low that in 2020 they will commercially equate with the production of energy by using photovoltaic panels. This forecast was published by the China Energy Storage Alliance (CNESA).

Periodic, high fluctuations in electricity prices on the Polish Power Exchange encourage to use the electricity storage facilities. Loading during the time when prices are minimal and unloading at demand peak is becoming more and more profitable. Perhaps at many transformer stations dispersed energy storage facilities will be built to stabilize the network and allow for island operation (cutting off from the not working power network) in the so-called micro-networks, e.g. in case of breakdown in many municipalities or districts.

Energy clusters

Energy cluster is a new form of distributed network, binding in the Act on Renewable Energy Sources. It is described as a civil-law agreement which may include natural persons, legal persons, scientific entities, research institutes or local government units. The agreement is concluded in order to generate and balance the demand, distribution or trading of energy from RES and other sources or fuels within a distribution network with a rated voltage of less than 110 kV. The statutory provision restricts the area of cluster activity to the borders of one district or 5 communes²⁵. Among the extensive number of benefits offered by the cluster, ensuring reliability of supply, low energy prices, better operating conditions for local entrepreneurs and attracting new investors can be mentioned.

²⁵ Source: Article 2 (15a) of the RES Act

Fuel surcharges

The government grants financial support to farmers to purchase agricultural fuel used in the cultivation of fields and cattle rearing, which reduces the costs of Polish agricultural holdings. From 2019, subsidies to ON used in cattle rearing are to be introduced - PLN 30 per head of cattle.

Closed Circle Economy (CCE)

Up to 8% annual savings can be made by European companies in the closed circle economy²⁶. As a reminder: this is a production and consumption model that involves sharing, lending, re-use, repair, renewing and recycling of existing materials and products for as long as possible. In this way, the life cycle of the products is extended. In practice, this means that waste is kept to a minimum. When a product's life cycle is over, raw materials and waste from it should remain in the economy. They can be reused, thus creating an additional value.

However, the benefits must be preceded by the necessary investments, including the search for and improvement of new technologies and business models. It is an area for cooperation between entrepreneurs and scientists within R&D projects. The benefit of new solutions is not insignificant: minimizing the consumption of raw materials and limiting losses and waste in food production. The added value can be the use of waste for other purposes, inter alia, energy production (biomass). This non-linear cycle of the economy also creates opportunities for accelerated development of a new industry based on the bio economy.

²⁶ Source: The European Parliament

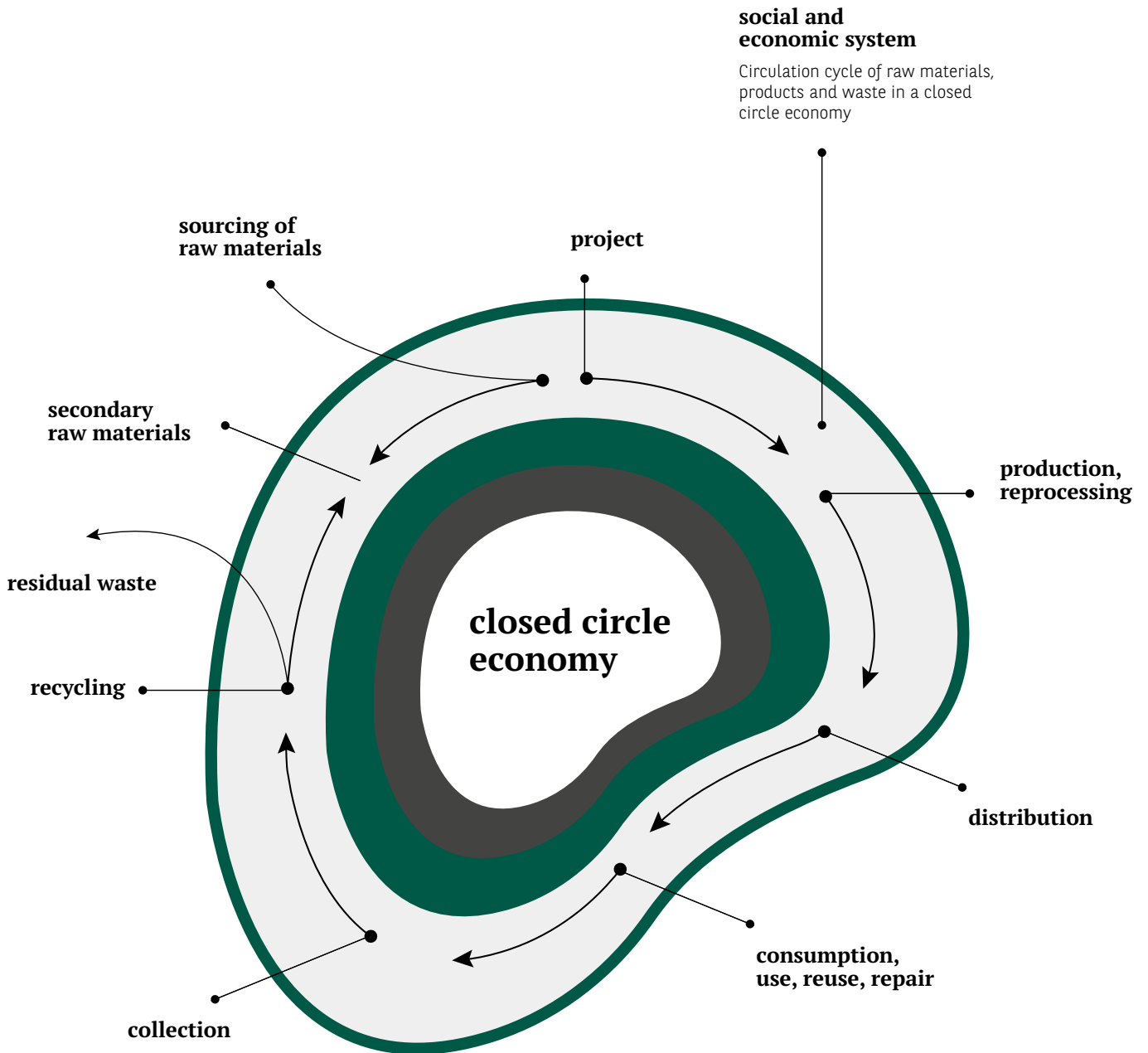


Fig. 4.3. Closed Circle Economy (own study)

According to experts / practitioners:

”Today, a modern approach to energy cost management in every company requires more activity rather than passive consumption. There are numerous actions, which farmers and companies may consider and implement. From energy audits, creation of own energy sources, investment in energy, heating/cooling warehouses, to Demand Side Response services (the energy supplier contracts power reduction services), or the creation of energy clusters. There is a lot of space for innovation here, both in business models, as well as specific technological solutions.

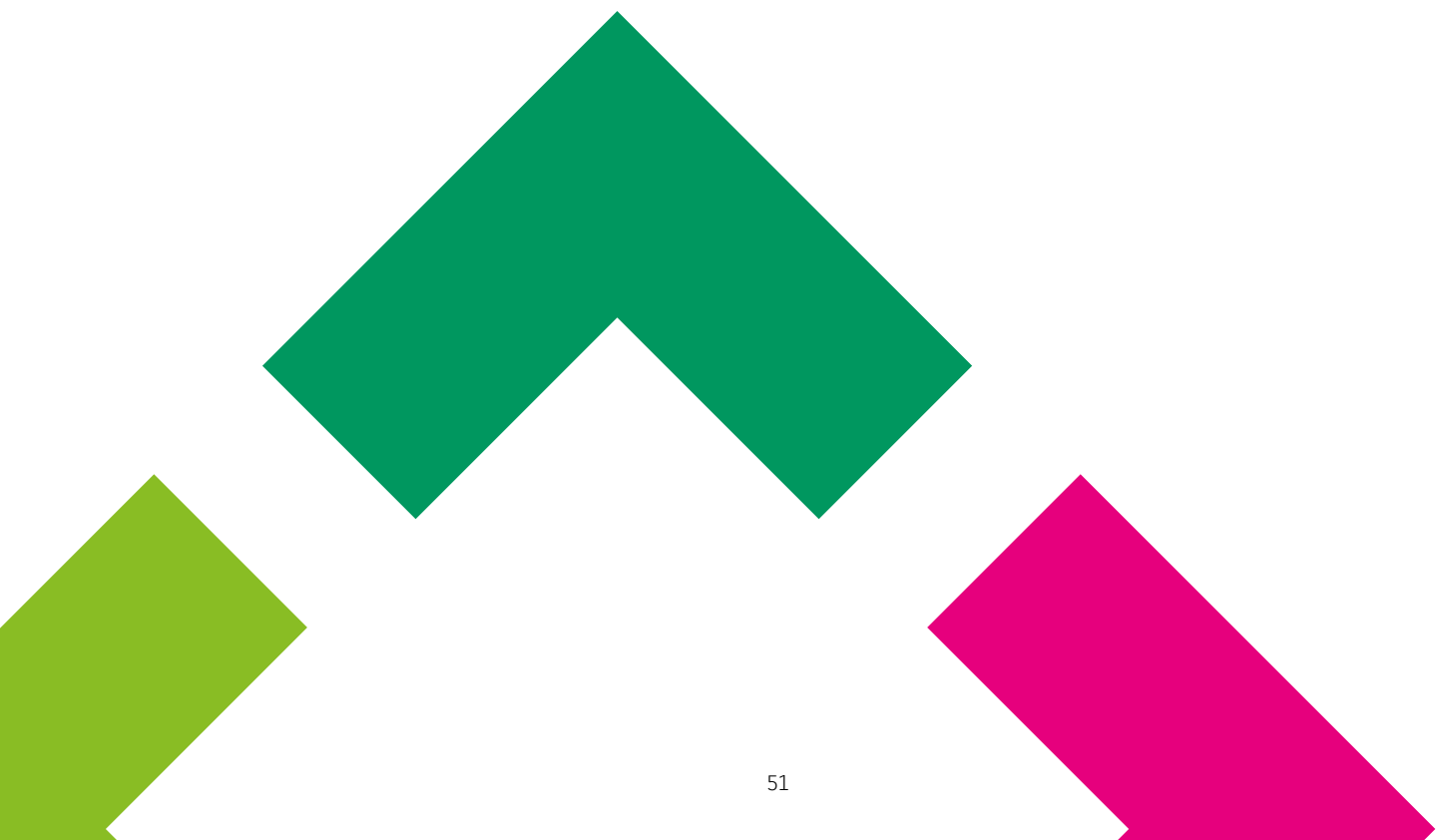
Arto Kaunonen, Partner Founder of Capful Oy Ltd, energy expert

”The level of water consumption in the food industry is very high. The largest occurs in meat and milk processing plants. With increasing number of shortages and rising prices, its consumption must be subjected to strict controls.

Dariusz Zieliński, President of Ceko Sp. z o.o. (limited liability company)

Conclusions:

- 01** The agri-food sector is one of the main energy-intensive sectors in economy.
- 02** Increase in electricity prices for industry in the second half of 2018 certainly surprised the customers.
- 03** In the following years we should expect further increases in energy prices, which will result in active implementation of optimisation and savings programmes.
- 04** Larger companies are looking for optimisation in directing their plants to circular economy.
- 05** Electro-mobility seems not to be the biggest challenge in the energy area today, as the energy storage. Developing solutions in this area requires cooperation of business with the most innovative Polish companies and research centres in this field.



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05

**Raw materials
and logistics**



Current situation






The competitive model of food production based on increasing the sales scale and low price of products is becoming exhausted. The reason of it are rising production, labour, raw materials, energy, transport costs. In addition, there is a number of other conditions: the need to ensure food safety (while improving quality), weather anomalies and climate change, the need to adapt the businesses to national and EU regulations, etc. Agricultural raw materials are increasingly treated as investment assets, so the risk of artificially raising their prices and speculation on local and global markets is increasing. These factors result in the price volatility and prosperity in whole food sector.

Polish agricultural raw materials are competitive both on the European market and, in many cases, on the world market. Also, we observe that currently Polish agricultural producers often lose their current cost and price advantage. It is reflected in the decreasing difference between domestic and foreign raw material prices. This is illustrated in Fig 5.1, which compares selected product categories in Poland and Germany over the last decade. In this case, in order to maintain competitive edges, the Polish food sector will have to redirect its offer towards creating added value.

The Institute of Agricultural and Food Economics data showing an operating costs summary in the food industry for the 1st half of 2017 and 2018 indicate (Annex 1) that the costs of materials consumption (mainly raw materials) constitute approx. 57% of the operating costs

within food industry. Based on this research, the amount of costs of fruit and vegetable raw material in the total costs of food production within this category, was estimated at 30 to 40%. Problems with access to some semi-finished products, including strawberries and tomatoes, and noticeable growth of the above mentioned costs in the first half of 2018 were also pointed out. Mostly, in the analysed period, the increase of material costs was observed in sugar production (increase by over 44%), starch products (increase by over 23%) and pet food (increase by over 21%). A significant decrease took place in case of ice cream (decrease by over 14%), biscuit and rusks production (by over 12%) or red meat processing (by over 8%).

Manufacturers in the agri-food sector jointly agree that the most substantial challenges they currently face are:

-  Security of raw material supply - contracting
-  Quality assurance
-  Food safety
-  Weather anomalies caused by climate change
-  Logistics

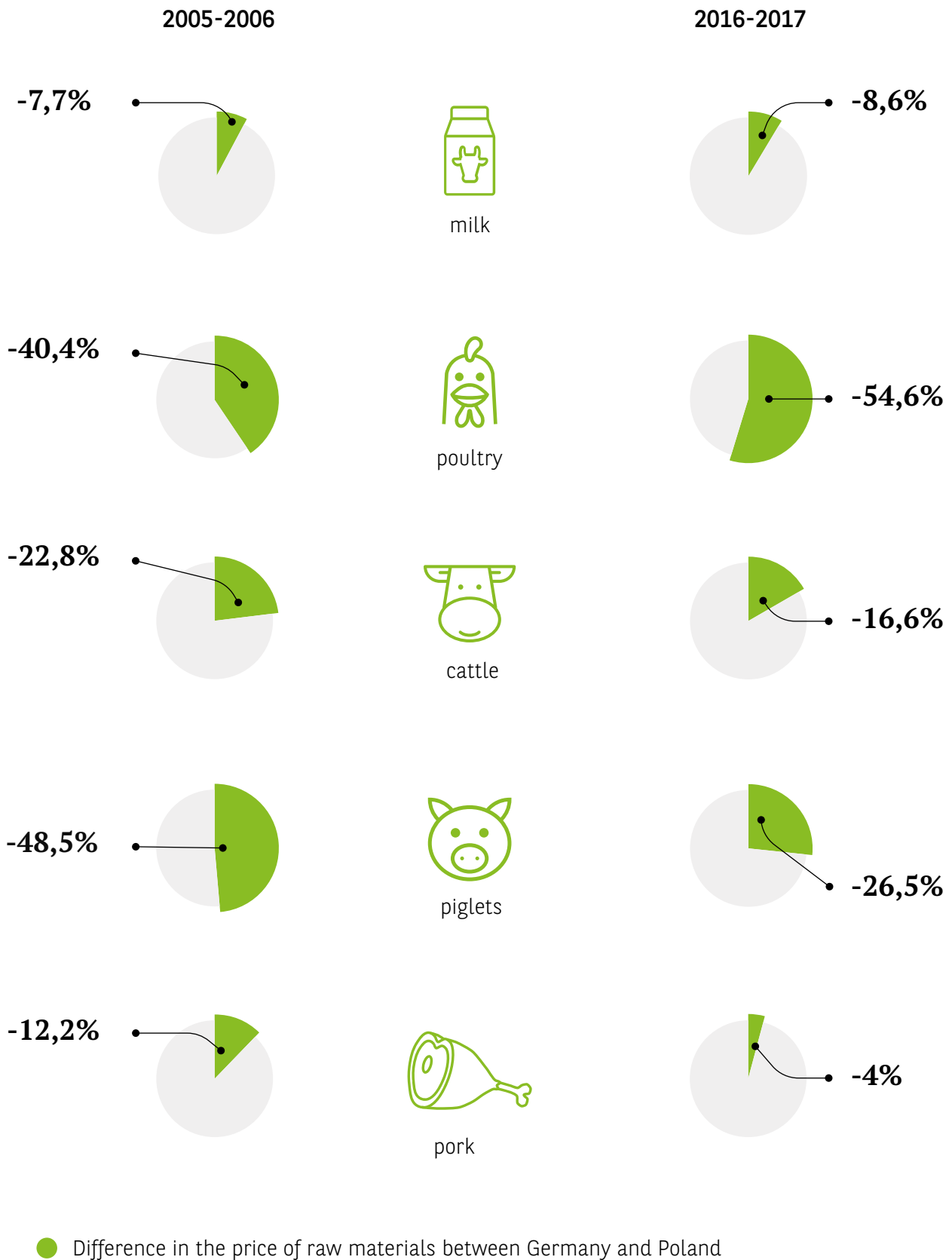


Fig. 5.1. Difference in prices of selected raw materials between Poland and Germany in 2005-2006 and 2016-2017 (own study based on European Commission data)

Supply security - contracting

Domestic raw materials are the primary base for food production in Poland. According to data from 2016, they constituted 63% of all raw material resources of the food industry used for food production. Import, mainly concerning categories that could not be produced domestically (even for climatic reasons), constituted the remaining part; and nowadays, it is increasingly stimulated by lower prices on world markets.

Good cooperation between raw material producers and processors is a guarantee of current supplies of raw materials with good quality parameters and their effective processing. Contracting plays a pivotal role in supplying system within agri-food industry with raw material.

According to set forth above provisions, the supply of agricultural products contract must primarily contain the following:

- © price to be paid for the delivery or a formula for calculating the price
- © quantity and quality characteristics of the supplied agricultural products, together with the time of delivery
- © duration of the contract
- © details of payment terms and procedures
- © arrangements for receipt or delivering agricultural products
- © provisions applicable in the event of force majeure

A contract is not required if the agricultural products are supplied by a manufacturer of a cooperative of which the manufacturer is a member, and the statutes of the cooperative or the rules and decisions contained therein or resulting therefrom contain provisions having similar effects as the requirements for the aforementioned contracts.

Regardless the above regulations, for many years, contracting has been well established in domestic production of vegetables, potatoes, sugar beet or recently poultry. The milk market, due to its specificity, is also based on regulations resulting from membership in a dairy cooperative or contracts for deliveries to other entities operating on the milk market. In plant production based on long-term relations of contracting, the cooperation between the agricultural producer and the contracting company is often extended to include the supply by the recipient crops, seed/planting material, plant protection products, fertilisers and agro technical consultancy. The responsibility of the farmer is to manage the proper plant growth. This model also works successfully in animal production (e.g. contract fattening), where the contracting company often delivers chickens/pigs, feed, veterinary care, advisory and technical support, and finally collection of pigs or chickens to the agricultural producer. Observing world trends in plant and animal production, the development and increase of contracting on vertical market integrators should be assumed.

Despite the existence of good practices, there are food production sectors where smaller entities within food delivery chain have no bargaining power and alternative access points to agri-food industry or consumers. They are prone to unfair commercial practices of larger and stronger entities. Meanwhile, a well-functioning food chain is the basis for sustainable agriculture. Therefore, the balance of bargaining power and a fair distribution of added value in the chain have become a priority for the European Union. In 2018, the European Commission, seeing the scale of the problem relations inequality between large and small entities, prepared a draft directive to protect farmers and small and medium-sized suppliers.

In a proposal, the Commission wants to give them a stronger position in the supply chain and reduce the need to manage risk which they have no, or have little, influence on. The draft directive recommends prohibiting unfair commercial practices, that is, payment delays for perishable food products, cancelling deliveries at the last minute, making amendments to contracts which are unilateral or with retroactive effect, forcing suppliers to pay for wasted products. At the same time, if both parties agree, the following practices shall be acceptable: returning food products, which were not sold by the purchaser, to the supplier, charging the supplier by the purchaser for providing or maintaining a contract for the food products supply, payment by the supplier for the promotion or marketing of food products sold by the purchaser.

Quality

The research has shown that the pivotal quality characteristics which raw materials for processing should meet, are:

- ⊙ homogeneity
- ⊙ productivity
- ⊙ regularity of supplies
- ⊙ capacity of the market
- ⊙ freshness
- ⊙ health

The dominant position of the sales network and strong competition on the food market mean that the issue of guaranteed quality of raw materials, so that which will fully meet the customer requirements, are nowadays „to be or not to be“ for the agri-food sector manufacturers.

Poland is one of the top EU countries in terms of the number of farms and areas used for agricultural purposes. In Poland there are about 14% of all farms located in the EU. For agricultural purposes, Poland uses 14.4 M ha (8% of the total in the EU), compared to Germany 15.2 M ha, Great Britain 16.7 M ha, Spain 23.2 M ha, France 27.8 M ha - the largest number of Member States²⁷. This proves how strong the fragmentation of agricultural holdings in Poland is. The farms belonging to the group of 1-10 ha of agricultural land, which constitute over 73%, are dominant. In 10-15 ha range there were slightly over 10% of farms, and from 15 to 20 ha over 5%. Farms with an area of over 20 ha constituted in total less than 10% of farms, of which only 270 of them had more than 1000 ha, while 790 farms were in the group of 500-1000 ha. And here, farms with an area of over 20 ha determine the productivity and competitiveness of Poland. In most EU Member States, the predominant agricultural area is situated in farms of 50 ha area or more.

In a situation of high fragmentation of farms, obtaining the necessary raw materials of the expected

quality from many suppliers becomes an expensive process, which involves a lot of time and agri-food industry resources. It requires the necessity to enter into many agreements with suppliers, to carry out more inspections and possible certifications, and to use production consultancy services if the manufacturer and processor are bound by terms of production. The number of necessary accounting and administrative operations is also increasing. With the fragmentation of suppliers, the importance and costs of logistic operations related to securing the raw material and delivery to, or collection by, the processing plant increases.

Food safety

Increasing turnover on international markets, combined with intensive farming performed without respect for the environment and with the use of plant protection products prohibited in the European Union and high levels of environmental pollution, cause that areas, so far, free from threats in other climates and geographical latitudes are exposed to the import of contaminated food. The main sources of contemporary threats to food safety are physical, chemical and microbiological factors. Other food impurities and threats are: pathogens, prions, parasites, food pests, food disasters, bio-terrorism.

Many identified food safety incidents on the market, e.g. eggs infected with filproniol, milk infected with melamine, or mechanical impurities found in „kabanosy“, make the safety of raw materials and food products more significant. Customers increasingly pay attention to the product and its place of purchase, ingredients, manufacturer, information about production and storage conditions.

A crucial tool is the **traceability** system, including control and measurement data, recording both the application of quality procedures and product safety supervision, as well as the physical environmental conditions of production and logistics processes (e.g. humidity, time, temperature, circulation and air components, pressure, etc.). The guarantee of safety and quality of a product and its tracking in the supply chain, starting from supply, through production, transport, storage, sales and distribution, is a very important element of the offered value and, as a result, building a competitive advantage.

²⁷ Eurostat, Farm structure survey 2016

Weather anomalies caused by climate change

As the main supplier of raw materials to the food sector, domestic agriculture, like no other sector of the economy, is sensitive to climatic and weather conditions. They are a fundamental element of the cultivation and breeding ecosystem. **Climate change and weather anomalies** in Poland contribute to an increase in the production conditions volatility. Component phenomena include: drought and soil desertification, frosts, floods. As a result, they have a significant impact on costs. The current condition, forecasts and the weather effects are well described in the document prepared by the Government "State Environmental Policy 2030"²⁸, which replaced the current strategy "Energy Security and Environment - perspective to 2020". Experts point out that agriculture is not prepared for the effects of weather changes, and their aftermaths financially impact farms, mainly. There is no strategy preventing weather anomalies in agriculture, which would promote the fields drainage and the maintenance of existing equipment, the construction of retention silos and retain water activities in the event of drought.

A crucial factor influencing the agri-food sector is the **availability of natural resources**, mainly arable area and water. In Poland, water resources are among the lowest in the EU. There is 3 times less water per Polish resident than the average in Europe, which is about 1600 m³. During drought, the rate falls even below 1000 m³ per person per year, while in the European Union it is over 4500 m³. Each manufacturer and processor is fully aware of these figures. The consumer is usually not aware of the fact that the production of a favourite hamburger needs 2400 l of water!

Logistics

The food industry in Poland creates complex and extensive cooperation and well-developed logistics chains. Especially in the fruit and vegetable, and dairy industries. It is due to the major fragmentation of raw material suppliers. Most food producers source

products for processing from a few sources at least. Collecting them requires proper transport and storage - often in cold conditions. Logistics costs consist of stocks, packaging and transport management.

In the agri-food sector, **logistics costs** depend mainly on the business model - own section, outsourcing, transfer to the ordering party. According to the respondents to the survey, it is from 4 to even 12% of operating costs.

Transport costs are nearly 80% of the logistics costs as for own section. It has to be underlined that currently there is a lack of drivers on Polish market in range of 100-140 K. Within a few years, the demand for professional drivers is to increase by 2.5-3% annually, as a result in 2025 it should be about 300 K more professional drivers in Poland than now.

Manufacturers have to choose between their own logistics base and outsourcing for logistics processes. The most important advantages of own logistics are effective process control, flexibility and the possibility of fast response to changes and all signals coming from the environment, and also direct contact with the final purchaser. However, this model requires appropriate infrastructure, equipment and staff. Logistics outsourcing allows you to focus on your core activity, which means less investment and decreased operating costs. The external partner offers knowledge and experience resulting from specialization in servicing within a given market area and opportunities related to optimization tools usage. In addition, it leads to significant economies resulting from the scale effect, which means lower unit costs. It also effectively deals with the negative effects of seasonality.

Market mechanisms constrain to a continuous increase of production scale. Agri-food processes need logistical support covering the organisation, planning, control and movement of agri-food goods implementation from the place production of agricultural raw materials (farms and agricultural entities) through their purchase, storage, production and distribution to the final customer (consumer). The goal is to satisfy the requirements of the consumers, while maintaining food safety, minimum costs and minimum capital usage.

²⁸ State Environmental Policy 2030 (PEP) will constitute a strategy within the Act on the principles of development policy. It will be one of the foundations of the environmental protection policy in Poland. Planned date of adopting by the Council of Ministers: Q1 2019..

Results

The aspects affecting the production, storage and transport of raw materials in the food sector are presented below. They represent a major challenge for the link of agricultural food chain.

Food Security costs

The globalisation of the economy is a crucial factor in increasing the number of food safety risks, and it is directly related to the availability and prices of raw materials. In the event of impurities or infection of raw materials, manufacturers cover the costs related to: the necessity to withdraw goods from the market and its disposal, culling of animals, carrying out laboratory research and tests, disinfection, production line cleaning. These also include costs of customer confidence re-establishment or loss of revenue due to changes in consumer shopping habits.

Weather anomalies costs

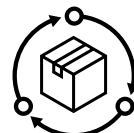
The weather conditions in recent years differ significantly from those considered as „normal“ for decades. An increase in average annual temperature of at least 1°C can result in the emergence of new diseases and pests. Increasingly frequent periods of drought in many

agricultural regions cause lower groundwater levels and a rapid loss of soil humus. This increases the vulnerability of crops to drought.

One of the most visible results of changes in our geographical latitude is the disappearance of the traditional four-season division. The consequence of changing climatic conditions is the risk related to crops loss and quality decrease, which as a result may lead to a reduction in production and increase of raw materials price. For processors, this means that they always have to use imported raw materials. Due to the ongoing and forecast climate changes, the process of planning long-term actions for manufacturers of agricultural raw materials in Poland is becoming much more complicated, time-consuming and there is more risk of adopting inappropriate assumptions.

Rising logistics costs

The costs of acquisition and storage of raw materials and food products, packaging (including recycling), transport and control of the logistics system are slightly increasing. The energy intensity of storage and transport costs are the reason of it.



Solutions

Outsourcing of logistics processes

With a high share of logistics costs within the total costs, it is reasonable and necessary to seek a source of competitive advantage for the company in this area. Outsourcing of logistics processes - entrusting the whole process or selected activities to an external service provider, or implementing IT systems supporting logistics, these are examples of activities enabling agri-food companies to focus on their own key tasks.

Food safety Bio insurance - system solutions

According to data from the Ministry of Agriculture and Rural Development, the costs of ASF combat in 2017 were PLN 140 M, and by 12.09.2018 there were 212 ASF outbreaks, half of which occurred in 2018. Revenues of pork and feed manufacturers are endangered. A virus attacking only pigs and wild boars threaten a collapse of the Polish pork production.

Strict biosecurity, supported by veterinarian inspectors, is the key tool to avoid the spreading of animal diseases. The Veterinary Inspection is underfinanced - this requires system solutions at the government level. Countrywide educational activities aimed at breeders and growers, as well as residents of bio-insurance areas, are necessary.

According to the opinion of the survey respondents, food and food products safety regarding primarily plant and animal production will become increasingly significant. The reason of it is the access to most of export markets (phytosanitary and veterinary requirements)

and growing consumer awareness, demanding not only tasty but also healthy products.

Bio-insurance is a quite irritable subject among Polish countryside. According to the definition, it is a collection of methodologies and practices within animal rearing, aimed at maintaining or improving the health status, at the same, protecting it against the entering of new pathogens. In fact, it means a series of actions (investments!) that a farmer-breeder should take in order to protect the herd against African swine fever.

Cooperation and horizontal integration within the supply chain

We live in a hybrid world in which we have to be able to combine local and global action. Individual activities are effective on a local area. We are producing more, the small market is quickly full and forces us to look for a larger scale market, where „big can do more“ and where the competition is also stronger. The decisive factor is a real production capacity and its reliability. Even the largest local primary or secondary or even national producer may have difficulties in meeting these requirements. Successful business models prefer partnership - joining forces. In Poland they can be built as: cooperatives, clusters, groups of agricultural manufacturers and industry organisations and associations. Each of these organisations has its own regulations and support areas. The values they offer are not overestimated - from decreasing the production costs to creating purchasing groups (media and raw materials for production and protection, insurance or financing conditions), influencing on the legislation, up to increasing the export possibilities.

Horizontal integration within the supply chain will enable faster and cheaper cooperation between its links. It will allow to control and reduce the entire production process costs - from obtaining the raw materials to distribution and delivery to the final customer.

According to practitioner/ expert:

”Fruit and vegetable manufacturers should notice new opportunities to use their products. This requires a search and development of innovative production and processing methods, but also final goods. A great potential lies, inter alia, in the eco-snacks production or the raw material usage within non-food industries, e.g. cosmetics, pharmacy, etc.

dr Witold Boguta, President of the Polish Association of Fruit and Vegetable „Producers Groups

”Quite low fruit and vegetables prices are, inter alia, the result of notable crops fragmentation for their producers. This requires the next link in the supply chain to provide more extensive service: pre-seasonal contracting, crop control, supply tracking, transport and storage system.

dr. Andrzej Maria Faliński, President of the Forum „Dialogu” Association

”30-40% of fruit and vegetable industry costs are raw materials. Currently, the source of the raw material origin is becoming less crucial and the economic factor becomes a decisive one. Polish consumers’ preferences are exactly the same: for most of them, the price is more important, than the country of origin of raw materials used in the product.

Jarosław Szczepaniak, President of Jamar sp.j.

”As for high quality beef there is about 20% price difference between the raw material from Poland and other European countries. The profitability of production for each participant in the beef industry means the need to raise prices and in the same, reduce costs, which is possible by using reserves, including better marketing, innovation and knowledge transfer.

Jerzy Wierzbicki, President of the Association of Polish Beef Cattle Manufacturers

Conclusions:

- 01 Prices of certain Polish agricultural products stop to be competitive, which affects on the final costs of food that was produced of them.
- 02 Prices are and will be increasingly influenced by global factors.
- 03 Primary producers are the weakest link of the value chain within the agri-food sectors. A new approach to cooperatives creation and agricultural producer groups should be the solution.
- 04 Globalisation leads to the increase of food safety importance. It is one of the most significant factors of competitive advantage within the most demanding and valuable export markets.
- 05 Logistics within all the supply chain has a chance for a significant improvement through the use of advanced technologies of the Food Industry 4.0.



06

**Change factors
influencing the costs
of agri-food sector.
Future scenarios
until 2023.**



We live in a world that changes rapidly and expands its borders. It happens much faster than ever before. This is mainly due to globalisation, the 'new economy', the Internet, digital and mobile technologies. Existing business models are no longer working. Companies are forced to look for new sources of competitive advantage based on innovation, brand building, access to markets and efficient cost management. This also applies to the agri-food sector. **What influences and inhibits business development today?** The causes lie both in the companies themselves and in their environment. We present below the factors that are particularly important for food producers, processors and distributors. These were illuminated and evaluated during 24 in-depth IDI interviews conducted with leaders of various companies from the agri-food sector, from July till September 2018 and in the CAWI study (online questionnaire).

Change factors

Costs in the agri-food sector are shaped by a number of factors, with varying degrees of impact on entities existing within all the value chain. These phenomena are included in the so-called change factors.

Drivers of change are events, facts, phenomena, attitudes, behaviours, players, elements of larger systems that occur in the environment of each enterprise/organisation and affect them to a different extend. Some of them are radical as they lead to fundamental changes in market rules throughout the sector or industry. Others are incremental - they gradually and in a sustainable way affect a sector or industry. Factors of change may be favourable, unfavourable or neutral for the entity. Their influence depends on the strength of the impact.

Companies operate in a specific, definable market, sector and industry environment. This is their natural **business ecosystem**. Its members form interlinked value chains. A closer circle is defined as a **relational environment**. Factors that occur in it affect the business- but it

can also influence and shape it itself. Enterprises are also affected by an extensive number of factors on which they have little or no influence. The factors mentioned above create the so-called **system environment**. These are macro phenomena which can be divided into six groups: politics, economics, society, technology, environment, law. They are general, but contain components specific to each sector of the economy.

Relational and systemic factors can be studied and analysed by us, leading to the understanding of their nature and identifying cause-and-effect relationships with other phenomena or facts. The data obtained in this way provide a basis for forecasting the changes at an early stage, when they are still barely discernible. The set of identified drivers of change is the starting point for building alternative scenarios for the future.

The extracted factors are either **trends** or **uncertainties**. The operation and impact of trends on the whole sector or industry is predictable, but in case of uncertainty we are not able to determine the direction in which they will develop and how strongly they will affect the other elements of the system. They may cause many surprises, so as that they should be monitored. Unfortunately, many companies focus more on trends, assuming that they have to adapt to them.

Uncertainty - a factor whose nature, size and extent are unknown to the present knowledge or information. It is also impossible to jointly and reliably predict what its effects will be in the future. Uncertainty can be evaluated for the quantity or quality of the associated uncertainties. Awareness of uncertainties allows for limited management, inter alia, by building alternative scenarios for the future.

The starting point for scenario planning is uncertainty. Thanks to them, the scenarios of the future are different. Each of these factors can have two opposite values. This results in a 2x2 matrix of end states. Trends will be present in each of them. Building a scenario ma-

kes it easier to see business opportunities, risks, and it also **enables the development of strategic options on their basis**. As a result, it is possible to create strategies that are more flexible and resilient to change.

Forty-six drivers of change in the agri-food sector's environment, which will have a significant impact on costs over a 3-5 year horizon, were identified through face-to-face interviews and an on-line questionnaire (see Table 6.1. and Figure 6.1.).

In the next stage of the study, Capful and Bank BGŻ BNP Paribas team assessed the selected factors and, as a result, identified thirteen factors that will have the most crucial impact on the agri-food ecosystem and they divided them into trends and uncertainties (see Table 6.2). These will be illuminated later in this chapter.

Owners	Industry organisations
Investors	Labour costs
Employees	Raw material costs
Labour unions	Market regulators
Business partners	Negative natural growth
Competitors	Organic food trend
Suppliers	Convenient food trend
Logistics	Functional food trend
Trade and distribution	Demand for differentiated products
e-commerce	Baby Boomers generation
Food industry 3.0	Generations X, Y, Z
Food industry 4.0	Resources: land and water
Innovation	Weather anomalies
Grants	The European Union
Animal and plant diseases	Common Agricultural Policy
GMOs	Globalisation
Food safety	Polexit
Tax on retail sales	Economy condition
Fiscal policy	Energy
Repressiveness of offices	Closed circle economy
Food quality controls	Protectionism
Supplements market controls	International trade
Labour migrations	Food wastage

Table 6.1. Factors of change in the agri-food sector (own study based on the research)

Trends-T

- T.1 Generation succession
- T.2 Food types (three main trends)
- T.3 Food industry 3.0
- T.4 Closed Circle Economy (CCE)

Uncertainty-U

- U.1 Employees
- U.2 Energy
- U.3 Animal and plant diseases
- U.4 Degree of food processing
- U.5 Food industry 4.0
- U.6 Economy condition
- U.7 Future of the European Union
- U.8 Weather anomalies
- U.9 Natural resources

Table 6.2. Main trends and uncertainties identified in the environment of the agri-food sector in Poland (own study based on research)



Fig. 6.1. Relational and systemic environment of the agri-food sector

Characteristics of change factors

TRENDS – T

T.1 Generation succession - labour market presence

There are currently several generations on the labour market:

	Birth	Quantity
Baby Boomers	1946-1964	11,8 million
Generation X	1965-1979	7,6 million
Generation Y	1980-1990 1991-2000	9,1 million
Generation Z	from 2000 ²⁹	6,9 million

Table 6.3. The number of individual generations in Poland (own study based on CSO data)

Each of these generations has its own values, lifestyle and a different approach to professional duties. Meeting at the same workplace can create tension and it requires mutual adaptation. In Poland, the working-age population involves a part of BB and X, Y and part of Z generations (from the age of eighteen to 59 and 64), which together constitute 62% of the total population.

²⁹ According to some demographers, the Generation Z appeared in 1995

It is also worth mentioning here that 7 M Polish people over 25 years old live alone. As consumers, they buy less food and often do not eat lunches at home. They buy less during single purchase and may prefer convenient food in smaller portions. This group can be an immense challenge for manufacturers.

T.2 Food types: three prevailing trends

Food trends are increasingly affecting the consumer choices, and consequently the agri-food sector. In terms of scale and power of influence, three dominant ones may be pointed out today:

T.2.1 convenient food, has a long shelf life and allows the rapid preparation of a dish (reheating, cooking, baking); this is usually medium and highly processed or snack food, which is considered to have lower health value, less valuable and nutritious;

T.2.2 organic food, for which there is growing demand, which is largely a reaction to highly processed food; must be produced, stored and processed without synthetic additives, fertilisers and chemical agents;

T.2.3 functional food, which has a positive impact on one or more body functions, and thanks to that, it causes the health and mood improvement or reduces the risk of certain diseases, in particular, civilisation diseases (diabetes, atherosclerosis, and cancer), nutrigenetic and the BFY food - 'Better for You'. It includes food that, inter alia, affects mental health (mood food), beauty food and

“drive-in” food - for people who spend a lot of time in vehicles, due to their profession or during the travel.

Consumers are not entirely coherent in making purchasing decisions. This is determined by a number of factors. It is becoming increasingly important that food is healthy and fresh on the one hand, and comfortable to store and prepare on the other. Here, it is worth mentioning that in Poland the basic criterion for selecting a product is still, in major part, its price.

T.3 Food industry 3.0 - advanced automation

The condition of technological advancement in food processing and production determines the production capacity, productivity and quality of the final goods. The simplest solution is a slightly automated production line using electric drive, which dominated within the whole industry until the 1970s (industry 2.0). A breakthrough was achieved thanks to the development of automation with the use of IT tools and the first industrial robots (industry 3.0). The Polish food sector is one of the best automated in Europe (see Chapter 3 of this Report, concerning the technologies).

T.4 Circular Economy - Reuse of raw materials and waste

At a time of rapid economic growth, which requires more and more raw materials and energy, a model of production and consumption based on recycling and re-use brings great savings. According to the European Commission, Circular economy, i.e. sustainable development economy, has five priority areas. The second is food waste.

In the future, energy costs will depend on the degree of implementation of a circular economy, which may be an important element in the creation of a low-carbon, resource-efficient, innovative and competitive economy in Poland. The basic element of the circular economy is the bioeconomy, which includes the production of renewable biological resources and converting those resources and wastes resulting from processing, into added value products, such as food,

feed, bio-based products and bioenergy.

UNCERTAINTIES - U

U.1 Employees - tackling the labour force deficit on the labour market

The greatest impact, not only on the agri-food sector in the coming years, will have the progressive deficit of workers. This leads directly to a labour costs increase. The reason of it is, among others, the declining for almost 30 years number of births, and thus the decrease of the Polish women and man population. As a result, the number of people of working age is decreasing. In addition, this is compounded by economic emigration from Poland, which is not offset to a sufficient degree by immigration to Poland (see chapter 2 of this report, related to work).

U.2 Energy - sources, availability, costs

In case of energy, the same as in labour, its availability and cost are crucial. This applies to all sources: electricity, heating fuels and vehicle fuels. The greatest uncertainties relate to the availability and future prices of electricity and natural gas. Energy shortages can lead to blackouts. In Poland, it should be assumed that regular shutdowns will occur in 2022.

U.3 Animal and plant diseases - food safety

Nowadays, raw materials, plants, animals and food products cross many national borders by the supply chain. This favours the transmission of animal and plant diseases. Nearly 200 diseases can spread from animals to humans via the food chain. „Every year around the world, plant diseases caused by fungi, bacteria and viruses destroy 30% of yields in the field or garden, and

another 30-40% after harvesting, so during storage (vegetables, fruits can be stored for a few months before they are sold)³⁰.

U.4. Degree of food processing

Poland is mainly a source of high-quality raw materials and semi-finished primary products for the food industry (inter alia, apples, blueberries, poultry, milk powder). They are the leading export products. The advantage on foreign markets is, in this case, made due to low price, with high quality maintenance. But soon it may be difficult to maintain one of these parameters: price levels. This is due to rising labour and energy costs.

In comparison to the Western countries, despite the potential in this area, we do not have commonly known and remarkable Polish brands of value-added products in the world (the exception is Polish vodka). This is connected with building brands and offering goods, which are highly processed - it is possible since Polish food manufacturers have equipped their plants with world-class technologies. Their extensive usage for export production may change the competitive position of the Polish food sector within next 5 years.

U.5 Food industry 4.0 - digital revolution

2011 is considered as a starting date of the fourth industrial revolution, when the German government launched the Industry 4.0 programme, the „Fourth Generation Industry“. It is a digital revolution. It has been caused by the widespread availability of the Internet, reduced data storage costs, mobility and intelligent sensors. Combining automation and robotisation, it becomes possible to build the idea of the so-called Smart Factory. In Western European countries this is treated as an antidote to rising labour costs and lack of workers, also within the food sector. In Poland we should not think whether Industry 4.0 will come to us, the question is rather, when

30 Source: Prof. Małgorzata Mańka, 11th Conference of European Foundation for Plant Pathology. „Healthy plants – healthy people“

and what will accelerate this process, in which sectors and on what scale it will dominate (see chapter 3 of this report) Uncertainty is related to the scale of this future factor until 2023, as it may turn out that Polish food businesses will react too late to the need for digital transformation.

U.6 Economy condition

The state of the Polish economy is closely connected with the European and global economy. The visions of development are still promising, but three factors may endanger continued growth in the medium term. They include:

- 01 increase in inflation
- 02 weakening of consumption and investment
- 03 increased protectionism on foreign markets

Poland and the EU agri-food sector are increasingly integrated into global market processes, which is a great - but not without risk - opportunity. The EU takes further initiatives and binds trade liberalisation agreements with large and often competitive partners³¹. The entry of the above mentioned agreements into force in the coming years means a potential increase in the opportunities for expansion into partners' markets

The EU, but also these agreements - especially between major producer and agricultural exporting partners - may extend competition in the internal market.

U.7 Future of the European Union

The future shape of the European Union is still questionable. The European Commission has five different scenarios in its White Paper: 1 **Carrying On**, 2. **Nothing but the Single Market**, 3. **Those Who Want More Do More (two-speed Europe)**, 4. **Doing Less More Efficiently**, or 5. **Doing Much More Together**.

31 The EU-Canada Comprehensive Economic and Trade Agreement (CETA) has been in force since September 2017; EU-Mercosur (Argentina, Brazil, Paraguay, Uruguay); EU with Mexico, Japan, Australia, New Zealand and also the United States (TTIP).

In particular, many uncertainties affecting the food and agricultural industries are related to the EU budget after 2020. These are mainly:

- © the possibility of changes in European cohesion policy regarding a possible reduction in its budget and the allocation of the resources currently given to the individual countries and regions, and the change of management principles,
- © the possibility of changes in the Common Agricultural Policy referring to greater link with environmental and climate objectives, at the expense of increase of the agri-food sector competitiveness actions,
- © the need for effective process management of leaving the Union by the United Kingdom (Brexit) and its consequences, which may include the new supply-demand balance on individual agri-food markets as a result of a possible deviation from the free trade with the United Kingdom.

U.8 Weather anomalies

Weather anomalies resulting from climate change can and do have a very large impact on costs. These two factors belong to chaotic systems. The fact that they cannot be precisely predicted in long-term determines them as very strong uncertainties. They change production conditions (droughts, frosts, floods, new diseases and pests, etc.) and, on a global scale, result in more frequent supply shocks and price volatility.

U.9 Natural resources

A crucial factor influencing the agri-food sector is the availability of natural resources, mainly arable area and water. In Poland, water resources are among the lowest in the EU. Increasingly frequent periods of drought in many agricultural regions cause a rapid loss of soil humus, intensifying vulnerability of crops to drought. The land availability as production input is declining, its prices and rental costs will increase, and consequently, also the prices of the raw materials produced thereon (see Chapter 5 of this report, related to raw materials).

Scenario exercise:

3 questions to the Prophet

Imagine that you meet a prophet who knows the future....

What three questions would you ask him about your industry development within next five years?

Write your questions:

- 01
- 02
- 03

Building scenarios for the future

2018-2023 - methodology

Scenario building broads the perspectives.

Scenarios usage is an extension of possibilities.

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The presented and briefly described change factors, which should have the greatest impact on the agri-food sector in Poland, were selected during a survey conducted in July-September 2018. They were completed by 24 in-depth interviews, which were conducted in the same period. The strength of influence of factors and their level of uncertainty were determined, which allowed to identify the status of the factor as a trend or uncertainty. The correctness of this analysis was additionally verified and confirmed by Capful experts who are among the leading representatives of scenario planning in Europe. The next step was to select two independent factors that could constitute a matrix of alternative future.

Scenarios (so-called scenario logic). The authors of the report accepted to the description, the perspective of 5 years, so until 2023. As a result of these discussions, the future prototype was chosen:

- ⊙ horizontal axis - the economy condition with two poles: slowdown/growth
- ⊙ horizontal axis - the economy condition with two poles: Industry 3.0 /industry 4.0

The combination of these two axes has allowed to identify four alternative equal scenarios for the future. The next stage in building the scripts was to formulate the main plot themes in each of them, and then to give them a title.

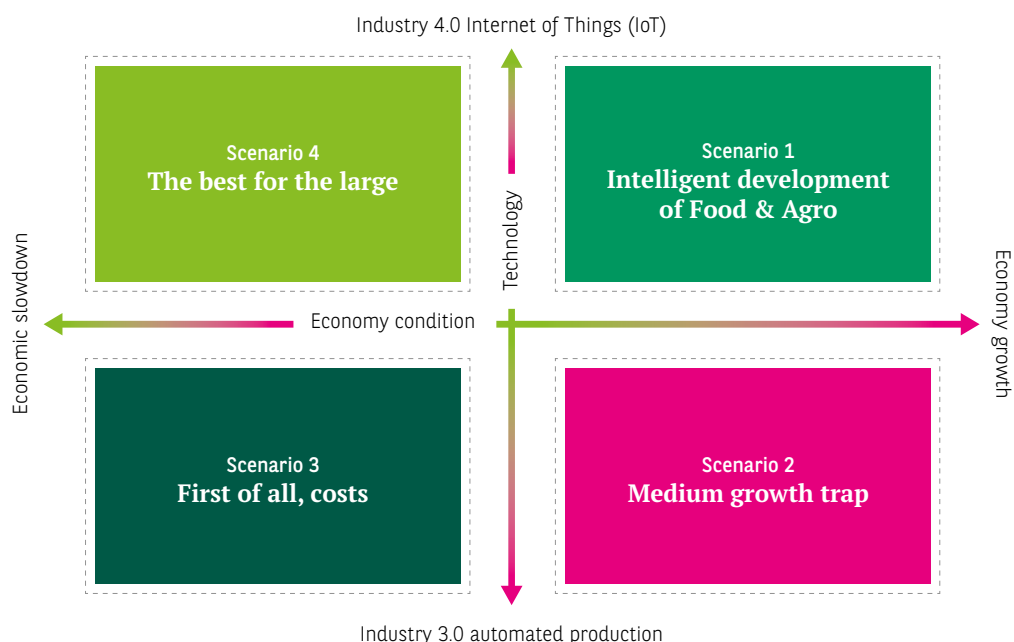


Fig. 6.2. Scenario matrix and titles

Main threads in scenarios

Scenario 1: economy growth and Industrial Development 4.0 „Intelligent development of Food & Agri”

Industry 4.0 development in the agri-food sector and Poland are experiencing economic growth. Harmonious development of the entire agri-food sector.

BUSINESS MODELS

- © DModels based on increased efficiency, reliability and quality, while decreasing production costs, dominate. The food industry 4.0 makes it possible to customise products and to develop the market niche models.
- © New food design methods are being developed, enabling the production of functional and personalised food adapted to different generational segments. Companies offering food design services are improving.
- © The profit centre is located in the value offered: healthier products made of better raw materials; better recognition through brand building.
- © Enterprises devote significant amounts to promoting private labels on global markets.
- © Due to the acceleration of urbanization trends, e-commerce is developing dynamically. The leaders are international retail chains looking for new formats and ways to reach the consumers.
- © Production capacity in agriculture, breeding and cultivation is increasing. Precision farming and genetics gains increasing importance. Good conditions are created for the creation and

development of producer groups that can operate together as economic consortia.

- © New cross-sector business models, changing the food industry, are appearing. Scientific centres, which are starting to be more and more business-oriented and able to commercialise research results, make a significant contribution to this process

LABOUR

As a result of adopting the Industry 4.0, the demand for manual workers is decreasing. The demand for highly qualified workers is growing dramatically. Companies train staff intensively at their own expense. There is an increase in salaries. The opening of visa-free travel from the USA means that despite the improvement of conditions on the domestic labour market, another wave of economic emigration is taking place.

TECHNOLOGY

- © A gradual transformation of the Automated Industry 3.0 into the Food Industry 4.0, leading to the creation of intelligent processing and manufacturing plants - SMART Factory.
- © Raising capital for investments is easier than in previous years, mainly due to favourable, innovative methods and products developed by banks. Financing relates not only to large companies, but also small and medium-sized enterprises.
- © Polish companies introducing competitive digital technologies are developing: Internet of Things, artificial intelligence, virtual and augmented reality, blockchain and digital security. It is due to good economic situation and the efficient innovation ecosystem in Poland created in those years through the Next Step Poland project. This also influences on the development

of agriculture, design and food production start-ups.

- © There is a significant increase in production efficiency within all agri-food sector. Mainly, the highly processed food production is increasing, which leads to the dynamic growth of exports to more mature markets

ENERGY

- © The increase in energy costs has a negative impact on final product prices.
- © A number of investments in smart grids are taking place, so that Poland avoids excessive shutdowns during peaks in energy demand. This is also possible due to the readiness for reduced consumption, so-called DSR (Demand Side Response) by larger or smaller companies, connected with aggregates.
- © Companies are intensively looking for security of energy supply - especially electricity, heat and gas. Energy storage and autonomous generation systems are developing
- © Innovations in the energy storage - batteries and completely new, yet unknown solutions: perovskites, methane clathrates, hydrogen generators, etc. - are appearing.

RAW MATERIALS

- © The high level of production makes companies start looking for raw material abroad, where it is cheaper.
- © Domestic agricultural producers, breeders and growers are forced to increase the productivity. Reducing costs ensures a scale growth. It is obtained individually or by combining offers in cooperatives, clusters or groups of agricultural manufacturers.
- © In order to defend raw material producers, the government is trying to introduce protectionism against outside the EU products, but this causes retaliatory measures and customs wars.
- © The government highly invests in complex plant and animal protection programmes against diseases.

Scenario 2:

economic growth and authorization 3.0 “Medium growth trap”

The Polish food industry, despite the local economy growth, remains at the production level of 3.0. The sector has an average growth rate.

BUSINESS MODELS

- © Leading business models are vertical integration models (industry consolidation takes place) and those focusing on maintaining capacity and productivity (capacity model).
- © Cooperation between the agri-food industry and scientists is becoming more effective, resulting in new products, improvements in food technology and organisational models.
- © A good economic situation is also positive for investing in brand building and extending the product portfolio. The development of a model of product or brand co-management is the result of it.

LABOUR

- © The labour deficit is increasing. New sources are being intensively sought, mainly from Ukraine, which are quickly becoming exhausted. In addition, after opening Germany to Ukrainian workers, they quickly leave the Polish market.
- © The economic growth in Poland also encourages young Italians, Spaniards and Portuguese to look for a job in our country.
- © The number of immigrants from East Asia is growing.

TECHNOLOGY

- © Many companies delayed in carrying out studies of advanced automation and digital transformation industry implementation. When they decided to do so, it turned out that the waiting list for the installation of new solutions is longer and reach even 3-4 years. It is a generous gift for

the competition.

- ⊙ Production capacity is growing at a steadily. An aging machine park is becoming a risk factor. The one which was modern 5-10 years ago, starts to be insufficient and it also breakdowns more frequently.
- ⊙ Medium-processed food as well as convenient and traditional food are produced. The latter is more appreciated and higher margins can be achieved on it, but the production determines too little scalability.

ENERGY

- ⊙ Energy costs have increased, which has a negative impact on final product prices.
- ⊙ A number of investments in smart grids are taking place, so that Poland avoids excessive shutdowns during peaks in energy demand. This is also possible due to the readiness for reduced consumption, so-called DSR (Demand Side Response) by larger or smaller companies, connected with aggregates.
- ⊙ Companies are intensively looking for security of energy supply - in particular electricity, heat and gas. Energy storage and own energy sources are developing.

RAW MATERIALS

- ⊙ Production for the domestic market and export markets acquired in previous years do not cause a significant increase in demand for raw materials. Food companies start looking for a raw material abroad more frequent, where it is cheaper and more available.
- ⊙ Domestic agricultural producers, breeders and growers face a dilemma: further price reductions or productivity growth and innovation in their business models. One of it is combining offers in cooperatives, clusters or groups of agricultural producers- however, despite the advantages, it is not quite popular.
- ⊙ The government highly invests in complex plant and animal protection programmes against diseases.

Scenario 3: economic slowdown and Industry 3.0 „First of all, costs”

Poland is affected by the economic recession, and automation is at its current level, which is production 3.0. Efforts are aimed at maintaining the „status quo” of both sectors.

BUSINESS MODELS

- ⊙ A scenario assuming even a small economic recession may reduce all business models to low-cost purchases and reduced-quality production. Best known and common model is the private label model commissioned by discount stores and retail chains. Also, it has be underlined that today, such branded products do not mean lower quality, anymore. The advantage is the very large scale of production - often to many countries.
- ⊙ In order to maintain the existing margin levels, complex cost management is introduced: from energy, raw materials, labour, to ordering the production to more developed plants, also abroad.
- ⊙ Mainly low processed food is produced, the demand for a healthy and fresh food is increasing. The recession favours dramatic shortening of supply chain. Consumers, with large-scale, start to supply agriculture products directly from the manufacturers (fruit and vegetable markets and exchange development).
- ⊙ In primary production, the horizontal integration model provides cost-effectiveness and lower costs.

LABOUR

- ⊙ All sectors and industries are affected by labour deficit, which can lead to a production capacity and investment reduction.
- ⊙ The trend of economic emigration stopped after 2012 is again developing. Mainly to North America.
- ⊙ Thanks to reduced wages and worse social conditions, Poland stops being the target country for economic emigration of workers the Ukraine,

Western Europe and Far East.

- © These factors have a strong impact mainly on the agricultural sector with seasonal work - there is a labour deficit on crops and harvests.

ECHNOLOGY

- © Production 3.0 is a standard level of automation and saturation with commonly used production technologies. It allows you to carry out production, but unfortunately, it does not give a chance for long-term development. The whole sectors effort is aimed at maintenance and protection of the 2018 production level.
- © The recession stops the machine park renewal.

ENERGY

- © Energy shortages and rising energy prices affect the whole economy.
- © High popularity of solutions related to optimisation of energy consumption and energy audits.
- © Many companies begin to think of and implement internal strategies for the closed circle economy.
- © The first blackouts appearing around 2022.

RAW MATERIALS

- © Raw material producers face the need to merge into cooperatives, clusters and groups of agricultural producers.
- © The government is trying to defend the food and agricultural sectors from the current situation with protectionism, but this causes retaliatory measures and customs wars regarding countries outside the EU.
- © More economical methods of storing and transporting the raw material are being sought.

Scenario 4: economic slowdown and Industry 4.0 “The best for the large”

In the food sector, Industry 4.0 is being introduced, which coincide with the beginning of the economic slowdown. Several market leaders with a capitalization over PLN 1 bn benefit from it.

BUSINESS MODELS

- © Large companies have no problems with financing the production automation and robotisation, based on digitisation and the Internet of Things. They had already ordered the right solutions earlier and are now receiving them on time. Smaller companies cannot afford to digitisation and have to wait several years for implementing it. The technological advantage between large and small entities increases until it becomes impossible to catch it.
- © Experiments with business models based on the individualization of food production begin. Retail chains are beginning to introduce intelligent solutions based on the Internet of Things.
- © The scale of production is increasing, also due to the corporation. The share of exports is growing, but not equally for the whole sector. Large companies produce highly processed food, mainly for the domestic market and for foreign customers. Smaller ones focus on low- and medium-processed food.
- © Smaller companies find it difficult to compete with large companies and groups. The market consolidates faster and large domestic or global companies take over the weaker ones.
- © All business models develop complex cost management, which is not, however, similar to the restructuring.

LABOUR

- © Staff deficit is not a problem for companies being at a higher level of automation and digitization. They need less people in production line, but

require higher technical skills. Training companies and technical schools that have noticed this demand are preparing training courses for professionals of Industry 4.0.

- ◎ Larger companies are able to offer higher salaries and better conditions.
- ◎ Those who have not carried out automation in advance, are experiencing increasing difficulties in finding workers and are unable to deal with wage pressure.

TECHNOLOGY

- ◎ The transformation of Industry 3.0 to Food 4.0 takes place only within large enterprises. Mainly, it is in global companies that were already prepared for the process.
- ◎ Raising capital for investments is more difficult as there is a risk of deepening the recession.
- ◎ Polish IT companies direct their offer mainly abroad. They concentrate on the digital security and artificial intelligence technologies.
- ◎ Few start-ups are interested in solutions for agriculture, food industry and food products. This remains mainly within the area of scientific institutes and universities of natural sciences.
- ◎ Despite the weaker economic situation, there

is a systematic increase in production efficiency. It has become necessary for all companies to optimise all resources, processes and actions. This helps to maintain profitability.

ENERGY

- ◎ Energy shortages and rising energy prices affect the whole economy.
- ◎ High popularity of solutions related to optimisation of energy consumption, including DSR services. Even companies that are not legally obliged to do so, carry out energy audits and implement plans to "joint" their consumption systems.
- ◎ The first blackouts appearance around 2022.

RAW MATERIALS

- ◎ The demand on raw materials at the best price is increasing, which is not advantageous for Polish producers. Imports from Ukraine, Russia and North Africa are increasing. This leads to a crisis for domestic agricultural manufacturers, who are no longer competitive.
- ◎ Increasingly, large companies and corporations are integrating supply chains or relocating crops and breeding to those regions where labour and energy costs are lower and climatic conditions allow to at least double the harvest.

Summary and conclusions

- 01** Future scenarios are not prophecies, but an attempt to capture possible events. They present a picture of the future business environment and can form the basis for building more flexible and effective development strategies for companies and decision making systems.
- 02** Scenarios help in better understanding of a fast changing, complex and uncertain operational environment and provide a systematic approach to identify discontinuities in the rules of the game and their impact on strategy and daily business.
- 03** Scenario planning process conducted within the company encourages creative and systematic strategic conversations. It provides the solutions to get out of situations that seemingly have no alternatives and allows to determine the business opportunities, risks and strategic options faster and test the investments effectiveness.
- 04** The agri-food sector in Poland in the medium term perspective (5 years) should be prepared for a further increase in operating costs. The economic condition of enterprises will be strongly dependent on energy costs, availability and prices of raw materials and labour costs.
- 05** In each of the selected scenarios it is possible to execute a strategic option related to the export expansion.
- 06** Products of food Industry 4.0 have a chance to become an export pearl like „IT business“. However, the implementation of the fourth industrial revolution requires systemic government support.
- 07** Employment increase stoppage, where demography is the source and the possibility of leaving the Polish labour market by immigrants from Ukraine can be a serious shock for the whole market.
- 08** While building scenarios for the future, it is also necessary to take “impossible to predict” events, which are at least unlikely to occur, into consideration. These are so-called „black swans“, which are rarely found in nature. The question must be asked: „what if...? The black swans that appeared in the statements of the survey participants were: Poxite, breakdown or deep division of the European Union, global economic and financial crisis, money and markets digitalization, pandemic, major armed conflict in Europe.



Divisions of the food industry (industries)	first half of 2017	Operational costs in PLN '000	Materials consumption in PLN '000	%	Energy consumption in PLN '000	%	Labour costs in PLN '000	%
Processing and preserving of meat, except poultry meat	12 019 555	8 515 977	70,9	87 858	0,7	734 936	6,1	
Processing and preserving of meat	5 916 144	4 214 206	71,2	65 365	1,1	445 677	7,5	
Production of meat products, including poultry/meat products	14 118 248	9 440 066	66,9	172 610	1,2	1 381 523	9,8	
Processing and preserving of fish, crustaceans and molluscs	5 334 715	3 783 717	70,9	54 187	1,0	474 416	8,9	
Processing and preserving of potatoes	1 269 600	471 927	37,2	26 237	2,1	155 760	12,3	
Manufacture of fruit and vegetable juice	2 652 661	1 480 365	55,8	49 985	1,9	191 695	7,2	
Processing and preserving of fruits and vegetables	4 094 950	2 327 841	56,8	102 673	2,5	531 037	13,0	
Manufacture of vegetable and animal oils and fats	2 225 527	1 512 610	68,0	16 839	0,8	100 595	4,5	
Operation of dairies and cheese making	15 767 657	11 452 995	72,6	235 943	1,5	1 082 022	6,9	
Ice cream production	902 325	456 761	50,6	16 942	1,9	142 141	15,8	
Manufacture of grain mill products	2 953 335	1 842 053	62,4	56 145	1,9	259 740	8,8	
Manufacture of starches and starch products	140 751	28 507	20,3	3 699	2,6	31 462	22,4	
Manufacture of bread, manufacture of fresh pastry goods and biscuits	4 303 771	1 867 036	43,4	106 196	2,5	953 162	22,1	
Manufacture of rusks and biscuits, manufacture of preserved pastry goods and biscuits	1 420 411	700 405	49,3	36 305	2,6	270 305	19,0	
Manufacture of macaroni, noodles, couscous and similar farinaceous products	550 477	313 686	57,0	16 359	3,0	84 463	15,3	
Sugar production	1 531 558	212 649	13,9	13 768	0,9	168 383	11,0	
Manufacture of cocoa, chocolate and sugar confectionery	4 391 640	2 395 462	54,5	65 003	1,5	603 772	13,7	
Tea and coffee processing	1 378 000	902 047	65,5	17 786	1,3	145 132	10,5	
Manufacture of condiments and seasonings	2 710 055	1 196 092	44,1	26 760	1,0	349 613	12,9	
Manufacture of prepared meals and dishes	185 247	102 993	55,6	4 942	2,7	28 694	15,5	
Manufacture of homogenised food preparations and dietetic food	979 499	711 448	72,6	8 695	0,9	88 179	9,0	
Manufacture of other food products n.e.c.	2 668 784	1 155 915	43,3	57 800	2,2	381 691	14,3	
Production of prepared feeds for farm animals	8 151 239	5 264 179	64,6	124 671	1,5	353 108	4,3	
Manufacture of prepared pet food	1 499 235	834 005	55,6	19 056	1,3	139 150	9,3	
Beverages production	13 319 301	3 962 750	29,8	148 411	1,1	933 311	7,0	
Food industry - first half of 2017 in total	117 028 336	66 936 767	57,2	1 569 607	1,3	10 361 408	8,9	

Divisions of the food industry (industries)		first half of 2018					
	Operational costs in PLN '000	Materials consumption in PLN '000	%	Energy consumption in PLN '000	%	Labour costs in PLN '000	%
Processing and preserving of meat, except poultry meat	10 779 995	7 828 498	72,6	94 445	0,9	736 032	6,8
Processing and preserving of meat	6 549 121	4 627 680	70,7	67 827	1,0	496 099	7,6
Production of meat products, including poultrymeat products	14 680 087	9 645 926	65,7	188 198	1,3	1 472 908	10,0
Processing and preserving of fish, crustaceans and molluscs	5 670 295	4 025 484	71,0	51 430	0,9	521 120	9,2
Processing and preserving of potatoes	1 321 743	517 901	39,2	25 871	2,0	160 999	12,2
Manufacture of fruit and vegetable juice	2 459 704	1 632 742	66,4	56 164	2,3	206 519	8,4
Processing and preserving of fruits and vegetables	4 162 640	2 338 123	56,2	115 238	2,8	544 833	13,1
Manufacture of vegetable and animal oils and fats	1 994 319	1 405 180	70,5	13 777	0,7	85 024	4,3
Operation of dairies and cheese making	16 274 439	11 814 293	72,6	247 979	1,5	1 179 286	7,2
Ice cream production	765 853	388 337	50,7	14 271	1,9	130 248	17,0
Manufacture of grain mill products	3 007 854	1 884 391	62,6	53 340	1,8	269 648	9,0
Manufacture of starches and starch products	151 067	35 325	23,4	4 601	3,0	35 430	23,5
Manufacture of bread; manufacture of fresh pastry goods and biscuits	4 601 380	1 985 795	43,2	114 848	2,5	1 025 559	22,3
Manufacture of rusks and biscuits; manufacture of preserved pastry goods and biscuits	1 263 160	612 583	48,5	37 045	2,9	247 872	19,6
Manufacture of macaroni, noodles, couscous and similar farinaceous products	593 263	331 243	55,8	18 530	3,1	91 958	15,5
Sugar production	1 278 924	307 961	24,1	21 006	1,6	175 266	13,7
Manufacture of cocoa, chocolate and sugar confectionery	4 574 256	2 741 621	59,9	72 100	1,6	635 598	13,9
Tea and coffee processing	1 389 097	881 410	63,5	18 411	1,3	156 348	11,3
Manufacture of condiments and seasonings	2 889 016	1 304 707	45,2	30 669	1,1	409 743	14,2
Manufacture of prepared meals and dishes	195 631	100 248	51,2	5 501	2,8	36 221	18,5
Manufacture of homogenised food preparations and dietetic food	1 046 921	773 139	73,8	4 851	0,5	91 005	8,7
Manufacture of other food products n.e.c.	2 888 287	1 272 362	44,1	62 942	2,2	422 892	14,6
Production of prepared feeds for farm animals	7 830 414	4 792 456	61,2	133 640	1,7	370 236	4,7
Manufacture of prepared pet food	1 799 657	1 012 441	56,3	26 225	1,5	172 974	9,6
Beverages production	13 807 261	4 281 927	31,0	151 472	1,1	986 397	7,1
Food industry - first half of 2018 in total	118 861 828	68 330 275	57,5	1 667 345	0,5	11 034 896	9,3

Notes

Notes

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