

tasks to individual identified units as well as precise responsibility, affects efficient and effective management. It can therefore be emphasized that a properly defined structure affects the effectiveness of the implementation of the company's goals and tasks and also proves its flexibility.

Economic separateness is related to the possession by an enterprise of certain resources that it can dispose of according to its own will, on its own, at its own risk and responsibility, according to the principles of economic settlement. This means that all expenses related to the current activity must be covered by the enterprise with the generated income, and the development, in the form of renewal of the possessed property, with the profit generated on the basic activity. It should be emphasized that if it is not possible to cover its liabilities from the generated income, the enterprise is subject to liquidation. This approach is related to the self-financing principle which is a natural verifier of business activity of enterprises. In practical terms, it is assumed that the use of resources at the company's disposal will be characterized by efficiency, manifesting in the difference between outlays and effects (Lichtarski, 2003, p. 58). The relationship between the effects and inputs in an enterprise's activity is defined as productivity which can be considered from the point of view of the whole (total productivity) and individual, specified elements (partial productivity). The productivity of technical equipment, labour, energy and capital is of particular importance in the company's operations. When analysing the economic distinctiveness, some authors identify another feature which is the risk of failure. It mainly concerns high competition from other entities, unsuccessful investments, inadequate production program, lack of sales, inappropriate asymmetric cooperation or poor management (Marcinkowski, 2017).

Legal separation means that the enterprise is an independent entity of rights and obligations in the field of economic transactions which means that it may incur various types of obligations, including loans, conclude purchase and sale contracts and transactions, and conduct settlements with other entities operating under its own responsibility on the market. The essence of separateness manifests itself in the enterprise's ability to enter into economic relations of a civil and legal nature. When running a business, an enterprise with legal personality must comply with specific, detailed legal regulations. It should also be emphasized that not all organizations conducting economic activity have legal separation.

Territorial separateness means that the enterprise conducts business activity in a specific, separated area or territory where buildings, structures, halls and other premises necessary for the conducting of business, are located. However, due to the progressive processes of globalization, unification and the emergence of large corporate companies, this feature is losing its importance, as enterprises conduct activities in diversified territories (e.g. by shifting production to countries with lower costs).

The technical and production separateness concerns the specific production equipment at the disposal of the enterprise as well as the technology and the ability

to use it, licenses, patents, know-how, production organization, etc. It is emphasized that there are no two identical units, even when they are equipped with exactly the same machine park. The distinctiveness is evidenced not only by the machines and equipment but also by production programs which can be identified with the company's offer aimed at the market, relationships, concluded contracts, production capacity, organization and work structure, etc.

The Commercial Companies Code (2000) considers the enterprise as the main object and subject of legal relations. According to it the enterprise is a set of rights, obligations and factual relations:

- the basic rights of the enterprise include: the right of ownership and other real rights, debenture rights, rights to intangible objects and various types of non-property rights,
- liabilities include liabilities arising from the conclusion of various contracts and liabilities on loans and other monetary liabilities,
- the actual relations are expressed in the established system for realization of the finished products, advertising activity, business contacts and the image of the individual enterprise.

According to the legal interpretation, the enterprise is an independent legal entity engaged in commercial activity. As such, it is a real existing structure that enters into relations with other economic entities and is subject to certain general rules and regulations for the implementation of economic activity.

From the point of view of the requirements of the Accounting Act, the term enterprise means a set of a number of economically separate natural persons and legal entities carrying out an activity permitted by law.

Therefore, the enterprise is a business unit in which a specific type of production activity is carried out. It is characterized by legislative, administrative and economic independence. Its legislative independence derives from its status as a legal entity. The administrative one is related to the construction of a certain organizational and managerial structure, and the economic one—is expressed in the final results of its activity.

Every enterprise, regardless of its size and industry affiliation, has an owner. As such, it can be an individual or a group of persons, a legal entity or the state as a whole.

In order to better understand the nature and characteristics of the enterprise, it is necessary to consider it from two different points of view—as an economic system and as an organization of people.

As an economic system, the enterprise is a complete set of interdependent elements for the realization of certain economic goals. The separate parts of this set form the main subsystems of the enterprise: the input, output and transform subsystem.

The main task of the input subsystem is to ensure the normal functioning of the system as a whole. It includes all machines, equipment, raw materials, materials,

labour and capital, which ensure the course of production processes. Their quantity depends entirely on the size and goals of the enterprise.

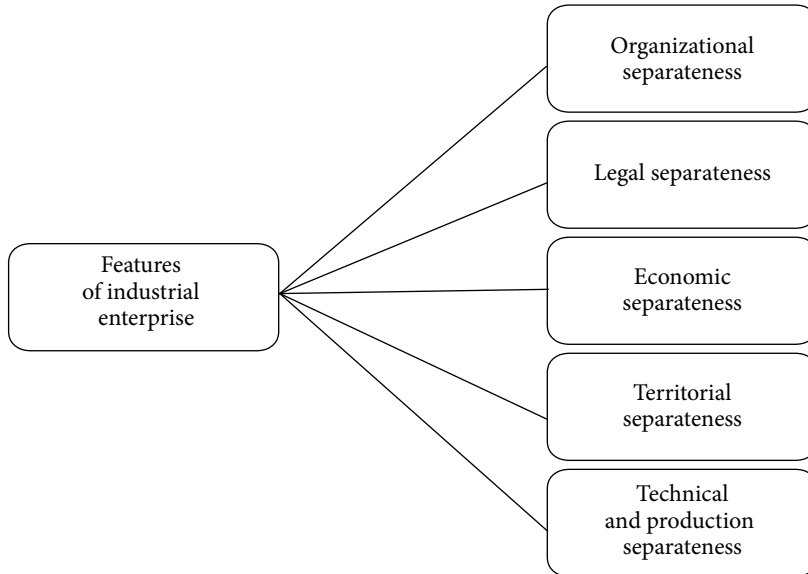


Figure 1.2. The basic features of industrial enterprises

Source: Own study.

In the transforming subsystem is the combination of the main factors of production. Here are the production processes for which the enterprise itself was created. The necessary condition for this is the presence of a certain technology.

The output subsystem includes the quantities of goods or services produced, in accordance with the objectives set in advance. Their realization provides the necessary funds for the existence of the business unit.

An obligatory condition for the normal functioning of the enterprise system is that its separate subsystems are interconnected and coordinated with each other, because each of them has strictly defined functions and tasks in the process of carrying out the production activity.

An enterprises can also be considered as an **organization of people**, which means that:

- it is an association of a certain number of individuals,
- it is created for the fulfilment of predetermined common goals.

In this case, as in any other organization, the main internal variables should be distinguished here, which to a large extent predetermines the results of the enterprise's activity.

1.4. Goals and tasks of an industrial enterprise

When analysing the definition of an industrial enterprise, it is often indicated that it must achieve a specific goal or objectives. In this approach, the goal should be understood as “the objectively and subjectively future, desired state or result of the organization’s operation, possible and planned to be achieved, within the period covered by the short-term or long-term action plan” (Krzyżanowski, 1985, p. 57). The indicated definition is only one of the approaches disseminated in the scientific discourse. According to Krzakiewicz and Cyfert, the goal is an ambiguous concept (2009, pp. 24–25).

The goal should be understood as “the objectively and subjectively future, desired state or result of the organization’s operation, possible and planned to be achieved, within the period covered by the short-term or long-term action plan” (Krzyżanowski, 1985, p. 57).

From the point of view of the company, the easiest way is to indicate what the goal is to specify what the company wants to achieve in the future and in how distant future, and what it must do to ensure the conditions of long-term existence and achieve these goals. There are two synonymous terms associated with the goal understood this way (Stabryła, 2012, p. 31):

- a task which should be understood as a spatially, objectively, subjectively and temporarily separated part of the goal to be performed within the set time limit, consistent with the time interval in which the goal should be achieved,
- mission which is equated with the concept of the company’s business, the idea of its development and message as well as a general promise expressed in terms of the market.

Goals in an enterprise can be classified according to the various criteria. In the simplest terms, they are divided into general (official) and specific ones. In general ones, this is the state that a given entity wants to achieve in the adopted time perspective. Most often they are indefinite, fuzzy, indicating a certain desired position or situation in which a specific subject wants to find itself. They provide a framework for the development of specific objectives which means that they apply to the entire organization. Due to their general nature, they can be precisely broken down by assigning tasks for each unit or division in the organization. The split process continues until each group in the enterprise is held accountable for a subset of goals. This approach is known as the “cascade of goals” (Hatch, 2002, p. 129).

Precise definition of goals is also related to the management levels. The general nature concerns **strategic goals** defined by the top management of the organization which determine the directions of the company’s development in the long term period. The length of this period depends to a large extent on the stability of the

external environment (e.g. political, legal and economic uncertainty shortens it). Due to the changes taking place in the environment, the goals at the strategic level should be formulated within a few or at most a dozen or so months, however, they look ahead for few or even several years. Strategic goals are set at higher levels of management as they relate to the effective use of the company's resources, including, among others, defining the company's mission and its prospects (e.g. entering new markets, including foreign markets, introducing a new product or service, improving the quality of the service provided whether the offered product or expansion of the company).

At the middle level of the organization, **tactical goals** are set that are related to the operationalization of activities necessary to achieve long-term goals. Their time horizon is much shorter and ranges from 6 to 18 months. They are mainly related to the functioning of the company from the technical, organizational, resource, financial and employee side in the medium and short term period. These types of decisions are usually taken at the medium level of management and translate the general objectives set at the higher levels of management into the technique and method of their implementation at the lower level. The goals formulated at the tactical level may concern selection of new varieties of already manufactured products, introduction of a new product, elimination of an existing product from the production program, selection of production organization variants corresponding to the existing production equipment, selection of new technologies, new forms of organization and adjustment of the type and level of production capacity in responses to the changing conditions of the company's operation.

Operational goals, also called current, are set at the lowest management level in enterprises. They are set almost only in weekly intervals but there can be found also a daily shot. They usually relate to areas such as: determining the type and structure of work activities, organization of the working day, allocation of tools and tasks to be performed by individual units, analysis of performance indicators, information flow, etc. Their role is especially important in situations involving uncertainty and risk. The ability to react quickly and appropriately to threats in the core business proves the flexibility of the company and in many situations gives it a competitive advantage.

The goals in the enterprise can also be economic, material and social. The economic ones are often defined as the main goal, as they constitute the measure of the economic effectiveness of the processes taking place in the enterprise. In the context of the group of economic goals, the financial result is particularly important, as it is reflected in the generated profit which is the most synthetic criterion of rational management. It must go under operationalization which consists in decomposing the main goal into specific tasks and assigning them to the specific cells.

2.

THE OPERATIONAL MANAGEMENT EVOLUTION AND ITS ROLE IN THE INDUSTRIAL ENTERPRISE



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Abstract: The topic introduces within the field of operational management from the standpoint of its historical-evolutionary definition context. The essential aspects are clarified, and the levels of operational management are presented. The principles of operational management are formulated in a short, systematized form. The nature and types of production systems are clarified, as well as their main elements. Definitions regarding the production process, organization of the enterprise and its main subsystems, forms of organization of the production process, forms of arrangement of the production units in space are clarified, too. The recommended fields for identifying good practices in the organization of the production process are also defined. It has been presented the main links that need to be made in terms of good practices, derived in theoretical terms and their main contributions to the enterprise to achieve the desired results by applying the good practices.

Keywords: definitions of operational management, good practices of organization of the production process, levels of operational management, organization of the production process, principles of operational management, production system.

2.1. Introduction

As an independent scientific discipline, operational management began in the '80s of the last century. The path that goes through the concept of management of operations is quite long and marked by both significant revolutionary changes and the gradual accumulation of knowledge and skills (see Table 2.1).

Table 2.1. Main stages of operational management

Years	General feature	Key approach
1700–1900	Stage 1. Manufacturing Management	Craft Production, Mass production, Scientific Management
1900–1980	Stage 2. Operations Management	Operations Research, Human Relations School
1980–1990	Stage 3. Operations and Supply Management	Post-mass production, Early imitation of ad hock Japanese approach
1990–2000	Stage 4. Integrated Operations Management	Lean Operations based on Japanese approaches

Source: (Piercy, 2012, p. 178).

As an **independent scientific discipline**, operational management could be classified as one of the “relatively new” economic disciplines. The main prerequisite for its development and validation is the awareness of the need for the implementation of effective and timely management decisions in the emergence of similar management problems in very different in nature organizations.

As a **type of management activity**, it has been practiced for a long time as the first time the term “operational management” was used in English literature, dates as far back as 1852.

Each of the periods in the development of operational management is distinguished by its strictly individual specificity and lasting reflection in both theory and business practice. In the first stages, the foundations of both modern management and economic theory are laid, as well as the scientific organization of the production activity. The beginning was related to the publication of the works of two of the most famous scientists in the field of economic knowledge—Adam Smith and Frederick Taylor. By developing the theory of the division of work, Smith enables a new approach to the construction of the production activity of the enterprise. Frederick Taylor, with his research, launched modern management and the foundations of the scientific organization of production. The role and place of another major researcher from this period—Elton Mayo, who based on an experiment in a specific production structure—the Hawthorne experiment, studied the impact of the environment on labour productivity should not be overlooked (Stevenson, 1993, p. 27). No less is the importance of the theory of standardized elements presented at the time by Eli Whitney, which helped to significantly increase labour productivity.

As a result of these developments and the practical activities carried out (such as the creation of the computer, the development of tables for the representation of dependencies, research and design of production operations), significant progress is made in terms of labor productivity. The main merit of these initial stages is in the search and development of methods to increase the efficiency of production processes.

After 1910, the development of operational management was associated with its mathematization and computerization as a matter of priority. A significant share of developments lead to the creation of specific models such as EOQ (Economic Order Quantity), MRP (Material Requirements Planning), PERT (Program Evaluation and Review Technique), CPM (Critical Path Method). Again during this period, operational management became an independent scientific discipline. The initial names of this discipline are “production management” and “operational management”. It becomes clear that production operations are an essential element of the organization of the production activity.

Practical research is also a significant boost in this regard. The beginning is associated with the production line, used by Henry Ford and Charles Sorenson. A number of specific activities follow in the development of different standards and schemes for stock management, as well as for detecting and overcoming the tight spots in production. Their logical conclusion is the models already mentioned above: “Just-In-Time” (JIT). In the late 1970s one of the most famous models in operational management—5P was developed.

Historically, the development of operational management has been presented in Table 2.2.

Table 2.2. Historical retrospection of operational management

Year	Event / Theory	Author
1733	start of the British Industrial Revolution	James Kay
1764	introduction of steam power	James Watt
1774	machine tooling	John Wilkinson, Henry Maudsley
1776	<i>Wealth of Nations</i> book / Division of Labour	Adam Smith
1790	interchangeable parts	Eli Whitney
1832	<i>Economy of Machinery and Manufacturers</i> book	Charles Babbage
1911	scientific management <i>Principles of Scientific Management</i>	Frederick Taylor
1912 1920	time and motion study	Frank and Lillian Gilbreth
1912	applied Taylor's ideas to organization structure	Harrington Emerson
1912	scheduling and charting procedures	Henry Gant
1913	first moving assembly line / Ford's mass production	Henry Ford / Charles Sorensen
1915	the first mathematical model for inventory management	Ford Harris
1930	human resource based approaches / Hawthorne experiment	Elton Mayo

Year	Event / Theory	Author
1931	<i>The Control of Quality of Manufactured Products</i> book	Walter Shewhart
1938	first computer	Jon Atanasoff
1940	quality control techniques	Harold Dodge
1947	linear programming / simplex method	George Dantzig
1950s	Toyota production	Taiichi Ohno and W. Edwards Deming
1950s	first wave of Quality Gurus	Deming, Juran, Feigenbaum
1951	UNIVAC I mainframe computer / Universal Automatic Computer (UNIVAC)	EMCC
1957	critical path method (CPM)	M.R. Walker / J.E. Kelly
1958	Program (or project) Evaluation and Review Technique (PERT)	M.R. Walker / J.E. Kelly
1960s	second wave of Quality Gurus	Ishikawa, Taguchi, Shingo
1960	Material Requirements Planning (MRP)	Joseph Orlicky
1966	<i>GERT: Graphical Evaluation and Review Technique</i> book	A.A.B. Pritsker
1970	Just-In-Time (JIT)	Taiichi Ohno Toyota manufacturing plants
1971-	E-commerce	
1980s	third wave of Quality Gurus	Crosby, Peters, Moller
1981	6-Sigma	Motorola
1980s	Manufacturing Resource Planning / Management Resource Planning (MRP I and II)	George Plossl; Oliver Wight
1982	Supply Chain Management (SCM)	Keith Oliver
1990	<i>The Machine that Changed the World</i> book	Dan Roos, James Womack, Dan Jones
1990s	agility, mass customisation	
	Computer Aided Design (CAD); Computer-Aided Manufacturing (CAM); Computer-Aided Engineering (CAE)	
1990	Enterprise Resource Planning (ERP)	Gartner Group
1995	Siebel customer relationship management (CRM)	Thomas Siebel Siebel CRM Systems, Inc.

Source: (Sterligova & Fell, 2009, pp. 8–9; Tsvetkov, 1996, pp. 14–18; Kovacheva, 1972, p. 25; Mirchev, 1996, pp. 19–20; Piercy, 2012, pp. 154–178).

Operational management peaked in the 1980s and 1990s, when the integral approach in management began to apply and its new economic paradigm began to be implemented. The beginning is marked by the development of the TQM system, which delivers significant results in the field of quality management. With the appearance of the global network and the Internet, it becomes possible to develop a number of modern operational management systems such as PPS (Practical Project Steering), CAD (Computer Aided Design), EDI (Electronic Data Interchange), ERP (Enterprise Resource Planning), SCM, etc. The development of e-commerce and e-business is provoking new changes in the field of operational management related to supply chain management.

The events played a key role in the emergence and development of operational management are several:

1. The industrial revolution in England of 1770, led to the entry of machines into the production activity of humans and the creation of the first production structures.
2. The promotion of the capitalist, the dominance of the market principle and triggered the emergence of the first commercial companies.
3. Recognition of the role of the human factor in the production activity resulting from the validation of the behavioural theories in the period between the two world wars.
4. The need to economic recovery after The Second World War, including substantial improvement of existing infrastructure.
5. The service revolution related to the modern application of information systems in the economy.
6. Global competition, the completion of a single European market and the expansion of global trade.

2.2. Definition of operational management

Initially, operational management developed as rules and principles, the most famous of which were those of Frederick Taylor. Subsequently, the emergence of new schools in management, the separation of its different directions, the wider application of statistical methods, linear programming and informatics significantly changed its nature and scope. A significant part in shaping its modern vision falls on mathematical modelling, statistical analysis and quality management. The emergence and approving of numerous approaches and management systems requires two main perceptions of the role of modern management: as *science* and as a *practice*.

As a *science* production and operational management (POM) is a set of written rules, principles, and methods of organization management. It is characterized by its certain internal structure and organizational unity. As a *practice*, POM brings together many methods and approaches to manage productive activity of the people. This includes both well-known mathematical models, game theory, computer simulations, and more specific elements such as information technologies, institutions, etc. As a practice, it is defined first and foremost by the interests of individual companies and not by the political interests of the other stakeholders.

The goals and objectives of operational management are to provide basic knowledge about the implementation of the production process of an order in pre-specified terms and quantities. In this way, it defines this process in the “time” and “place”, in the direction of the general to the private (Tsvetkov, 1996, p. 21). In the case of time, the time limits for carrying out the production tasks, which may be

recipients. However, control over numerous processes taking place on the Internet is negligible due to the possibility of creating informal networks for the exchange of opinions and views. In this way, company can quickly promote a product / service, but also destroy, e.g., the company's reputation.

Along with the development of this concept, the conditions that must be met in order to classify the competence as core have been defined:

- must make a significant contribution to the value of the manufactured product or the service provided,
- it must be unique, so it does not exist in the competition and is difficult to copy,
- it must form the basis of the company's operation, so it can be used in various areas of the company's operation.

Core competencies fulfill three criteria:

1. Provides potential access to a wide variety of markets.
2. Should make a significant contribution to the perceived customer benefits.
3. Difficult to imitate by competitors.

The combination of the indicated features into one coherent area allows enterprise to achieve the synergy effect, work coordination and optimal use of resources (Nowak, 2016, p. 14). This definition mainly focuses on certain production aspects of the enterprise. Production companies in the operational management phase, need to examine their core competencies, which are identified with the issues that contribute most to creating value for buyers. They should be adjusted and harmonized with other areas of the business unit's activity, in such a way that the company can react appropriately to the conditions dictated by the environment and at the same time implement the market policy. The lack of properly defined values / strengths of products, processes and production procedures prevents rational management of the company's assets. However, properly defined strengths allow, for example, to decide to outsource those areas and functions that play a smaller role in the value creation process (Halevi, 2001, p. 114). However, proper identification of core competencies is required, which should harmonize with each other. Only properly matched and correlated advantages can be the basis for development.

An essential element of the operational management of any company is the selection of specific strengths, enabling the company to distinguish itself in the market. This choice should take into account the best attributes of the organization that have a comprehensive impact on all areas of activity. The selection of the appropriate composition of distinguishing properties is the essence of the core competencies of the organization, which allow to use all possessed resources to a high degree: material, personal, financial, relational, organizational. However, identifying core competencies is not an easy task. Correct diagnosis requires compliance with

strictly defined procedures, the involvement of many employees (of various levels, representing various cells), knowledge of the market, contractors and competitors, and above all, own potentials and capabilities.

4.5. Just-In-Time (JIT)

The Just-In-Time method is known as the philosophy of enterprise management, and its essence is inventory, production and supply management. In simple terms, it consists in delivering and maintaining raw materials, materials, semi-finished products or finished products in exactly the right amount, at such a time and in such a place that it is possible to produce or deliver the right amount of products. A certain level of inventory should be available when the company actually needs them (Piasecka-Głuszak, 2011, p. 209).

Just-In-Time was first used in the 1920s by Henry Ford and perfected among suppliers by Toyota's vice president, Taiichi Ohno, from the 1950s to the early 1970s (Porter, 2009). His innovative approach to applying the JIT concept to Toyota factories has led to a reactive approach to Kanban inventory shaping. In addition, the time for retooling machines and devices was reduced to 1 minute and the distance between machines used in subsequent production stages was significantly reduced (Witkowski, 1998, p. 47). Nowadays, the JIT method is applied by many other companies such as General Motors, IBM, Apple and others.

Just-In-Time means doing only what is needed when needed and to the extent that is needed. In this way, they ensure the elimination of losses, incompatibilities and excessive needs and increase productivity.

Just-In-Time is a philosophy of action that seeks to maximize productivity by influencing all parts of the company such as purchasing control, engineering, marketing, personnel and quality control (Deneva, Hristova, Ivanova, & Petrova-Vakinova, 2017).

Most production systems use the so-called "Push" (Vonderembse & White, 1988, pp. 474–518) system for moving materials in the production process. Its main idea is that the materials are pushed through the individual operations according to a prepared schedule. The products are "pushed" from one work centre to another, but the centres are not aware of the real needs.

In contrast, JIT uses the so-called "Pull" system (Vonderembse & White, 1988, p. 485). Instead of pushing materials into the manufacturing process, the JIT system uses exactly as many materials as needed. The concept of the "pull" system is built on the basis of consumer demand. Just-In-Time concept aims to create a production system that meets market needs by eliminating all losses and striving

for continuous improvement. The phase Just-In-Time is applied because through it the system works with a low stock of goods and a small amount of inventory from the already finished products (Kumar & Suresh, 2009, p. 189). The products are assembled just before they are sold, the assembly elements are made just before they are assembled, and the components are made and assembled just before the assembly elements are made. This leads to lower costs and reduced deadlines.

Full JIT implementation is not limited to the company's production system, but also includes suppliers and customers. The process of achieving continuity and flexibility of flow between the production system, suppliers and customers is presented in Figure 4.6.

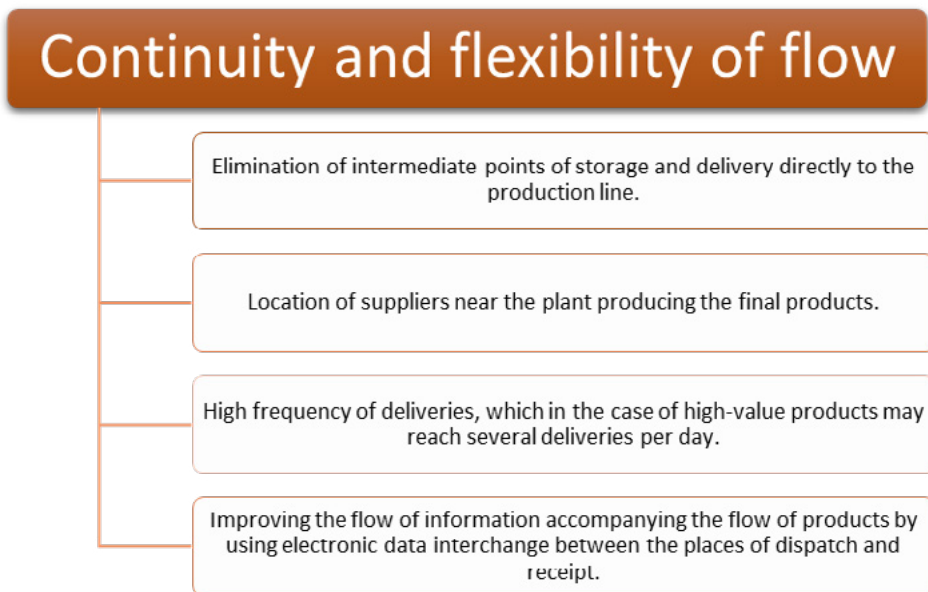


Figure 4.6. The process of obtaining continuity and flexibility of flow

Source: Own study based on (Witkowski, 2010, p. 195).

The Just-In-Time method is based on the waste elimination system (from the Japanese muda) and is based on the continuous improvement of the product flow processes and accompanying information. There are 6 basic principles that should be followed in the Just-In-Time method (Figure 4.7).

The Just-In-Time implementation process should be preceded by a detailed analysis of all factors determining its functioning, including transport costs and problems related to the natural environment. The effectiveness of the implementation work for the JIT method may depend on a number of factors, such as (Bendkowski & Radziejowska, 2011, pp. 161–162; Lysons, 2004, p. 250; Witkowski, 2010, p. 202):

- 1) gaining the approval of the crew, full commitment and training of employees,
- 2) achieving long-term and harmonious cooperation with suppliers,
- 3) the use of an appropriate material needs planning system based on production schedules, which will allow for precise formulation of requirements in the scope of delivery,
- 4) maintaining small stocks in the form of safety stocks only,
- 5) close IT connection based on a system of planning and control of supplies between enterprises and advanced Electronic Data Interchange (EDI),
- 6) proper organization of external transport, taking into account reliability time and transport costs.

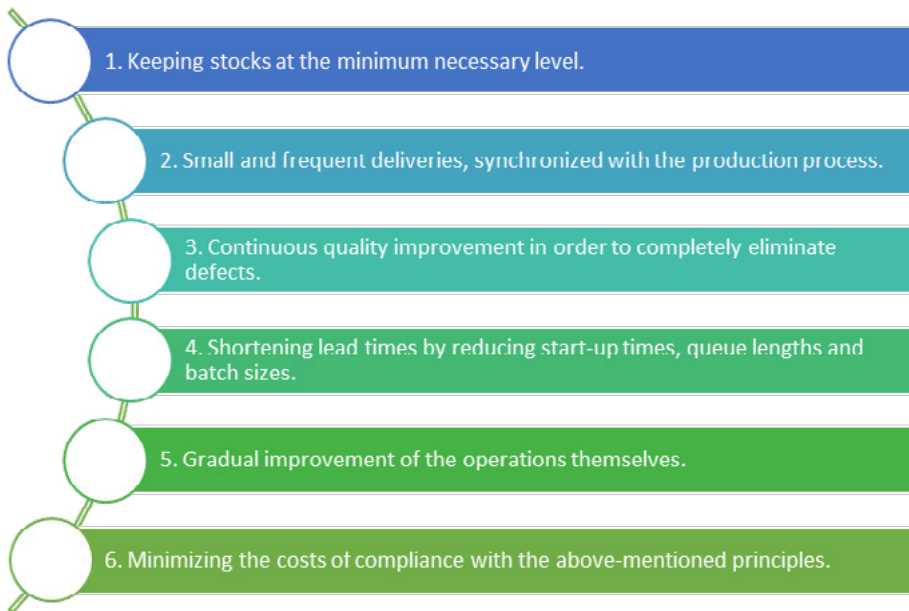


Figure 4.7. Rules for applying the Just-In-Time method

Source: Own study based on (Bozarth & Handfield, 2007, p. 627).

JIT is a manufacturing methodology that aims to improve overall productivity by eliminating losses, which in turn leads to quality improvement. This technique ensures efficient production in the organization and delivery of only the necessary parts in the right quantity, at the right time and place, using minimal resources.

Loss means an activity that does not add value to the operation, so Toyota formulates several types of losses that can be eliminated through operations Just-In-Time (Kumar & Suresh, 2009, p. 189):

- 1) overproduction: it is defined as the biggest source of loss for the enterprise—it should not produce more than is necessary for the next process,

- 2) waiting time: this is the time spent preparing,
- 3) transport: unnecessary transportation of raw materials during the work process is another source of loss, planned changes can significantly reduce travel time,
- 4) manufacturing process: some operations do not add value to the product but exist due to poor design or maintenance of the machines, design improvements or preventative maintenance can eliminate these losses,
- 5) inventories of goods: inventories of various types of goods must be reduced because they are also considered a source of loss,
- 6) movement: simplifying labour movement will reduce losses caused by unnecessary relocation of labour and equipment,
- 7) defective goods: total costs for poor quality can be very high and include scrap materials, wasted working time and fast order time, leading to outstanding orders.

The greatest benefit of applying JIT technique is to improve the firm's adaptability to market changes, thus gaining a competitive advantage through (Kumar & Suresh, 2009, p. 189):

- Production costs: a reduction in costs is achieved by shortening the production cycle, reducing losses, inventories and eliminating value-added operations.
- Quality: is improved through continuous quality improvement programs.
- Design: changes are developed in a timely manner thanks to the quick response from engineers through alternative designs.
- Increase productivity.
- Flexibility of the production system.

In addition to the above-mentioned most important benefits related to the introduction of the Just-In-Time system, it is also worth presenting the advantages and disadvantages of this concept (Table 4.3).

Table 4.3. Advantages and disadvantages of Just-In-Time method

Advantages	Disadvantages
<ul style="list-style-type: none"> • improvement of cash flow and reduction of working capital • reduction of stocks of materials, work in progress or finished products • faster information flow, reduction of documentation • lower demand for warehouse space • less means of transport used in warehouses • establishing close cooperation with suppliers • increasing the level of logistic customer service • faster reaction to changes in projects 	<ul style="list-style-type: none"> • difficulty in eliminating inventories with variable and difficult to predict demand • transport unreliability, delays affect the continuity of the production and sales process • suppliers should be located in close proximity to the company • fear of lowering the level and increasing costs associated with production downtime • difficulty in finding regular suppliers • during implementation, it is necessary to adapt the production and supply subsystem • requires a new approach to management • there must be solutions in the company that eliminate the effects of any disruptions

Source: Own study based on (Piasecka-Głuszak, 2011, p. 208).

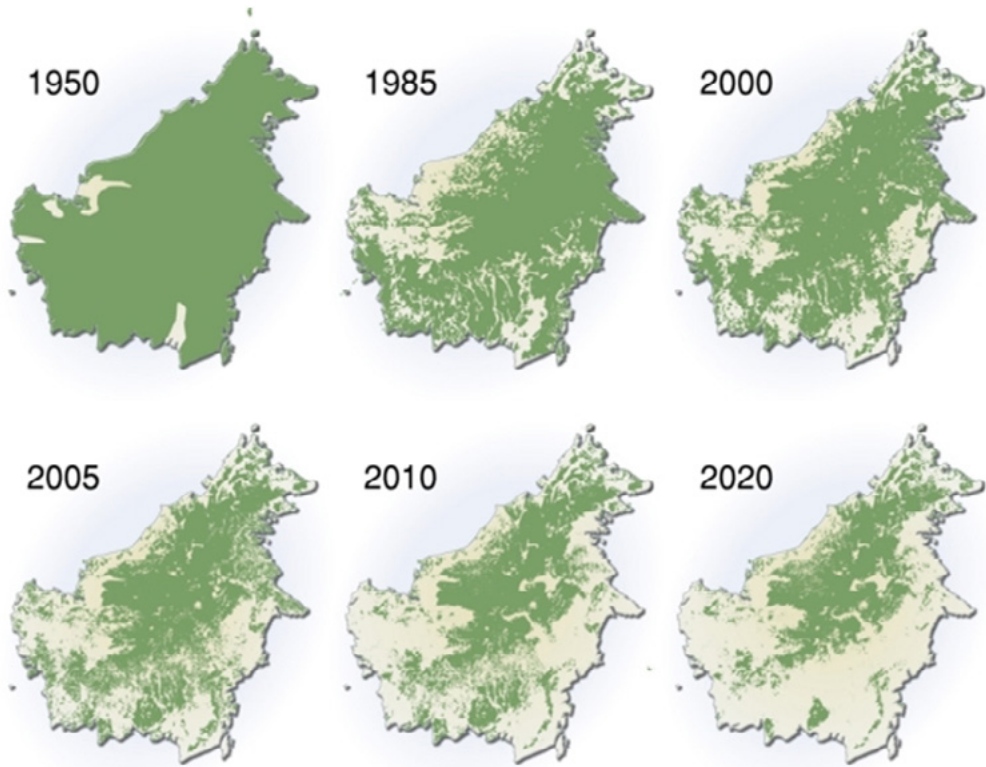


Figure 6.1. Deforestation of Borneo 1950–2020

Source: (*Extent of deforestation in Borneo, 2006*).

6.2.2. Fossil fuels and global warming

One of the biggest threats to the environment is climate change related to global warming. Here it is necessary to distinguish the concept of global warming from climate change.

The first represents a systematic global increase in temperature of the atmosphere, oceans and the earth surface which has accelerated significantly in the last two decades (MacMillan, 2016). Climate change, on the other hand, is a set of complex factors that affect the weather and climatic systems of the planet (Nunez, 2019).

The increase in pollution contributes to the absorption of light and solar radiation which is reflected from the earth surface. As light and energy are absorbed,

the temperature rises, making the planet warmer. Under normal conditions, in the absence of pollution, this radiation would be emitted into space. Factors influencing climate change can be divided into external and internal ones. The external one is related to solar radiation, while the internal one is related to natural processes, such as volcanic and seismic activity of the earth and human activity which uses natural resources to excessively exploit the environment. It is indicated that the main sources of greenhouse gases include (Europejska Agencja Środowiska, 2019; Dobrowolski, 2020):

- the power plants based on hard coal and lignite, which have the greatest impact on global CO₂ emissions; it is shown that one third of the world CO₂ emissions are generated when this raw material is burned; the largest coal production is in: China (3,550 million tons), India (771 million tons), the United States (685 million tons), Indonesia (549 million tons), Australia (483 million tons), Russia (420 million tons), Germany (71.3 million tons), Poland (48.7 million tons) and Turkey (44.6 million tons) (BP, 2018; IEA, 2019),
- the road, air and water transport, especially the growing number of cars, planes and container ships, which emit, apart from CO₂, many other harmful substances, such as: nitrogen oxide, dusts and soot generated during the combustion of mazout (fuel oil) in maritime transport,
- the industry that produces a significant amount of poisonous and toxic industrial waste in the production of goods and services, which is usually emitted directly into the environment; it should be emphasized that the industry also uses oil, gas and coal; these raw materials are used to produce plastics, fertilizers, pesticides, rubber, drugs, solvents, dyes, asphalt and many other products, the production of which emits significant pollutants into the environment,
- the households, especially the energy generated by burning waste and low-calorie coal in the process of heating the house and producing energy,
- the cutting down forests, including tropical forests, which are largely responsible for the reduction of greenhouse gases.
- the agriculture, including animal production and changes in land use, deforestation, drying up of lakes, lowering of the groundwater level,
- the production of waste and their improper storage in landfills,
- the use of fluorinated gases in industry.

The ongoing climate change may lead to a global crisis. A 2-degree increase in temperature will render large parts of Africa and Asia unfit for life due to lack of water and arable land. This will cause a huge, estimated at 250 million people, wave of refugees by 2050 (Dobrowolski, 2020). Therefore, it is required to undertake various types of initiatives aimed at, on the one hand, making global communities aware of the need to reduce greenhouse gas emissions and to use alternative sources to fossil fuels.

Problems of sustainable development and challenges related to production

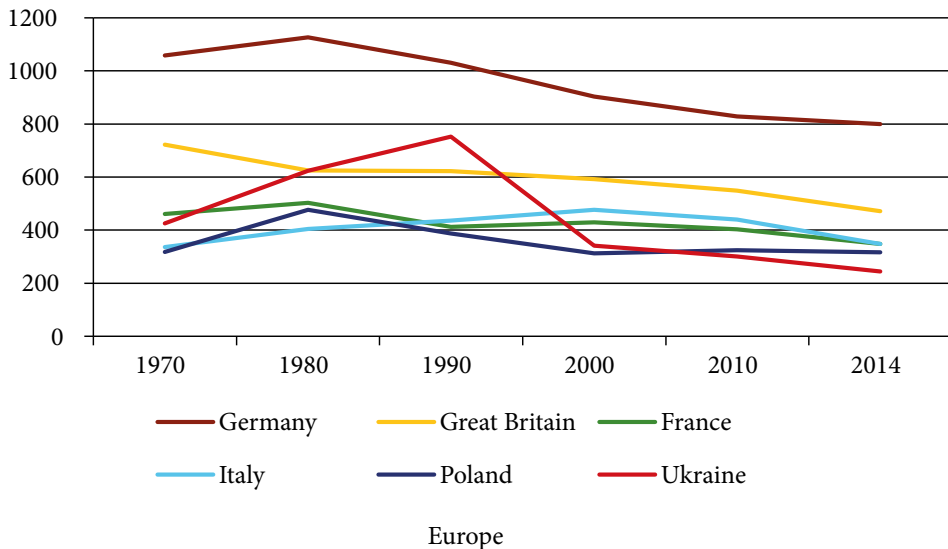
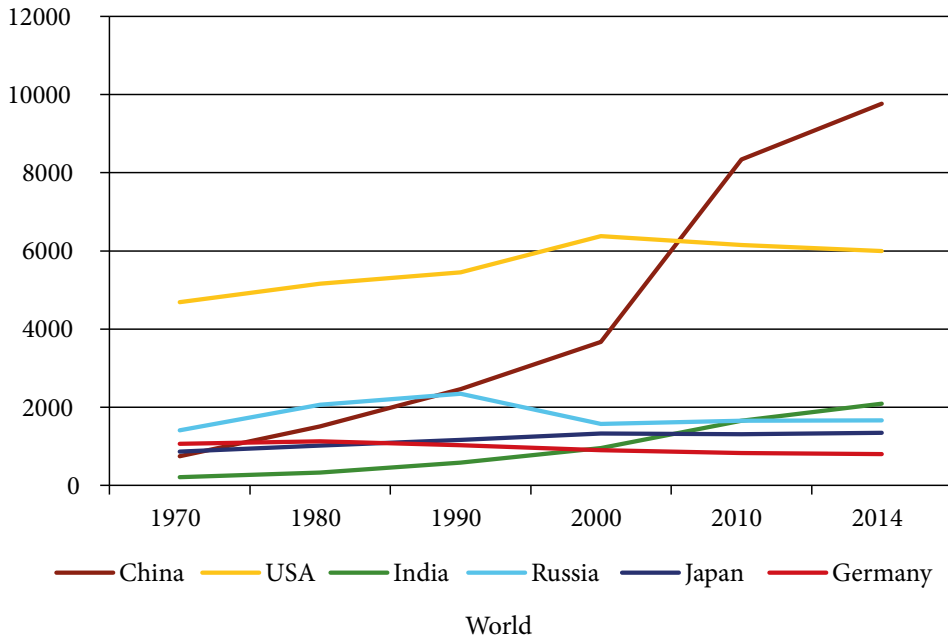


Figure 6.2. The largest producers of CO₂ in million tons in the world and in Europe during the years 1970–2014

Source: Own elaboration based on (BP, 2018).

6.2.3. Waste, air, water and land pollution

Waste, which is defined as consuming more than it is necessarily needful is another threat facing today's organizations. It mainly concerns resources, time, energy, etc. (Hornby, 2000, p. 1459). According to the Polish language dictionary, wastage is identified with "(...) reckless, useless, unprofitable dispensation, managing something, prodigality" (Drabik and Sobol, 2007). The authors also add that it is spending money excessively, dispensation, squandering of something, not using properly what we have, exposing to losses, unjustified spending of resources. It can also be described as a reckless, unprofitable and useless dispensation of some resource, often ignoring the possibility of doing something with less resource expenditure (Wyrwicka, 2009). The dictionary of synonyms shows that they are identified with such words as: mismanagement, extravagance, inefficiency or ineffectiveness (Cieńkowski, 2000, p. 100).

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Wastage also found its explanation on the basis of praxeological sciences. Kotarbiński, in the *Traktat o dobrej robocie* (Treaty of Good Work) (1974, pp. 156–157), thinks that the waste is: "(...) wasting of resources, or consuming resources of rare specific values for the goals achieved through the use of easily replaceable resources, the sluggish ending of the started work where the preparatory contribution is then lost, any unnecessary contribution, the excessive consumption of materials, apparatus, energy—over the real need, incorporating everything what is irrelevant."

Wastage applies to all entities operating on the market, starting from the state or from regions separated legally and organizational, through enterprises, institutions, self-government bodies and offices, and ending with the society and individual households. Each of them, conducting business or operating in a specific environment, needs a variety of resources with strictly defined parameters that provide him with the satisfying ever-growing needs. In practice, however, it happens sporadically that the demand reported by a specific entity closely corresponds to its consumption. The discrepancy between these two parameters contributes to the waste, i.e. the lack of use or incomplete use of certain resources at the disposal of the organization or a natural person. The essence of waste is the disproportion between the effective use of resources and other parameters influencing and deciding on the standard of living or the goals set by the organization. In the case of households, the waste primarily relates to food as well as other articles of everyday use, such as clothing, footwear, household appliances, electronics, etc., which serve

to meet the constantly growing consumer needs. In the case of enterprises and other business entities, this problem concerns raw materials, materials, production potential, space and even labour, its skills and experience. However, taking into account the self-government or state structures, there should be indicated the irregularities in the rational use of resources, including transfer of ownership, abuse, mismanagement, etc.

Wastage can be identified with the non-utilization or misuse (partially or not at all) of certain things. In other words, the unprofitable management of resources that remains with the organization or a specific entity. From the point of view of the company, it applies to all activities undertaken that do not increase the value of the product or service from the point of view of the buyer. This means that waste is all that brings no added value in the process of creating the product and delivering it to the buyer (Roother & Shook, 1999).

Analysing the considered concept from the point of view of the company, it should be pointed out that the sources of waste can be considered through the prism of eight types, seven of which are typically hard, and one is soft. The starting point is the division of activities into such ones that add value from the point of view of the buyer and those that do not make much sense which means that the client will not be ready to pay for them. Analysing the basic activity of the enterprise, particularly important types of waste are (Wiśniewska, 2005, p. 24):

- overproduction understood as the production of more and earlier than the customer needs,
- waiting: i.e. idle production, in other words it is hidden unproductivity caused by delayed delivery of materials or machine failure, planning errors, etc.,
- excessive processing: redoing activities or returning to activities that have already been done earlier in the previous positions,
- excessive transport: carrying out transport activities above the expected level,
- excessive stocks: purchase over demand, storage of additional parts or products that the customer does not currently need. In other words, this problem is related to the capital frozen in articles or work completed and waiting for its turn,
- excessive traffic: all additional or too long lasting activities needed to complete the task,
- errors and defects of products or otherwise the production deficiencies,
- unused human potential, including wasting employee creativity.

The presented approach is associated primarily with the production aspects, however, it should be noted that waste also affects the non-production sphere, associated with the organizational, administrative, legal work, etc. Summing up the considerations of the essence of wastage, it should be emphasized that in practice this phenomenon cannot be completely eliminated. Many activities must be performed although from the perspective of the buyer they do not create the value