CREATIVITY AND INNOVATIVENESS IN PSYCHOLOGY AND MANAGEMENT

Agnieszka Czerwińska-Lubszczyk, Michalene Eva Grebski
Wieslaw Grebski, Dominika Jagoda-Sobalak
Dariusz Krawczyk, Aleksandra Kuzior, Radosław Wolniak

CREATIVITY AND INNOVATIVENESS IN PSYCHOLOGY AND MANAGEMENT

CREATIVITY AND INNOVATIVENESS IN PSYCHOLOGY AND MANAGEMENT

Agnieszka Czerwińska-Lubszczyk, Michalene Eva Grebski
Wiesław Grebski, Dominika Jagoda-Sobalak
Dariusz Krawczyk, Aleksandra Kuzior, Radosław Wolniak

Wydawnictwo
„Dom Organizatora"
jest członkiem
Polskiej Izby Książki
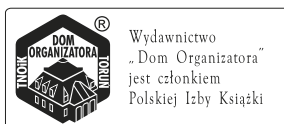
Recenzenci
Ks. Prof. dr hab. Józef Bremer SJ
Akademia Ignatianum w Krakowie
Dr hab. inż. Katarzyna Hys, Prof. PO
Politechnika Opolska

Table of Content

This monograph is a multidisciplinary attempt to identify conditions enhancing the creativity and innovativeness of the workforce. Modern knowledge-based economies rely on creativity and innovativeness more than ever. Modern enterprises need to create an atmosphere of psychological safety, tolerance of failure and celebration of successes while applying modern management styles. Modern management styles need to be based on mutual trust and respect, delegation of authority and sharing responsibility. The authors of this monograph represent the scientific community in Poland and the United States (USA). The disciplinary backgrounds of the authors include business administration, economics, engineering, management, psychology as well as the social sciences.

Authors

1. Concept of Creativity

The word *creator* dates from Biblical times. The term creativity is often used interchangeably with the term innovativeness. The Oxford English Dictionary (2012) dates the word *creativity* (*creation, create*) from its use in terms of poetry. There was an increased use of the word *creativity* in the 19th century through the 21st century writings. Related to economics, the word *creativity* began to be used more frequently in the 20th century. [1.1]

"Creativity is the process of making an idea your own by modifying something that already exists or combining ideas together to make something satisfying."

Ellis Paul Torrance is a Father of Modern Creativity. [1.2, 1.3]

Creativity allows us to view and solve problems more openly and with innovation. Creativity opens the mind. A society that has lost touch with its creative side is an imprisoned society. Creativity broadens our perspectives and helps us overcome prejudices.

Creative people like to daydream and imagine the possibilities and wonders of the world. They can immerse themselves in imagination and fantasy while remaining grounded enough to turn their daydreams into reality. They are often described as dreamers, but that does not mean that they live with their heads in the clouds. [1.4]

Creativity is the ability to think about a task or a problem in a new or different way, or the ability to use the imagination to generate new ideas. Creativity enables you to solve complex problems or find interesting ways to approach tasks. Creative individuals look at things from a unique perspective [1.5].

Creativity is neither a skill nor a talent themselves. However, creativity requires talent and skills and is a desirable method to find a way to solve any problem.

The steps for cultivating creativity, along with tips that can help promoting creativity are as follows: [1.6, 1.7]
1. Ask the right question. ...
2. Become an expert. ...
3. Be open and aware. ...
4. Play and pretend. ...
5. Generate lots of ideas. ...
6. Fuse ideas. ...
7. Choose the best ideas. ...
8. Make something out of your great ideas.

Creativity is thinking of new ways to do things. It involves producing ideas or behaviors that are original. The strengths in wisdom are creativity, curiosity, judgment, love of learning and perspective.

Teresa Amabile (Harvard Business School) mentioned three components of creativity.[1.8]
• Expertise
• Creative thinking skills
• Motivation.

Within every individual, creativity is a function of three components: expertise, creative-thinking skills, and motivation. The most creative people are also innovators. They spend countless hours learning, honing their skills, and acquiring expertise. [1.9]

Sternberg [1.10, 1.11] has proposed that creativity has five components.
• Expertise
• Imaginative thinking skills
• Venturesome personality
• Intrinsic motivation
• Creative environment
    (Sparks, supports, and refines creative ideas)

His research segments creativity into four types.[1.12]
- Deliberate and cognitive
- Deliberate and emotional
- Spontaneous and cognitive
- Spontaneous and emotional.

Every creative process goes through four stages: preparation, incubation, illumination, and verification. [1.13]

Building on the *Threshold Theory* of Guilford, [1.14, 1.15, 1.16, 1.17] Torrance, the "Father of Creativity" talked about four elements to creativity.
- Fluency
  (Number of ideas)
- Flexibility
  (Variety of ideas)
- Originality
  (Uniqueness of ideas)
- Elaboration
- (Details of ideas).

Torrance found that learning and thinking creatively takes place in the process of sensing difficulties, problems, and gaps in information; making guesses or formulating hypotheses about these deficiencies; in testing these guesses and possibility, revising and retesting them; and finally, in communicating the results.[1.18, 1.19]

2. Concept of Innovation

The European Union (European Commission, 2001) defines *innovation* as the renewal or increase of products or services, implementation of new methods of production, inbound logistics and outbound processes as well as the implementation of changes regarding the workforce and its capabilities. The European Union (EU) expands the idea of innovation to include industries within EU countries. Innovation improves products and services by using new manufacturing technologies and the introduction of new business models. The European Commission (EC) develops policies which help speed up the broad commercialization of innovations and engages in many activities that support innovation in the European Union. The EU/EC has further subdivided the concept of innovation as business innovation, regional innovation, European innovation, workplace innovation and social innovation.

"Innovation means to improve or to replace something, for example, a process, a product, or a service. Innovation is a process by which a domain, a product, or a service is renewed and brought up to date by applying new processes, introducing new techniques, or establishing successful ideas to create new value" [2.1]

Innovation is the spark of insight that leads a scientist or inventor to investigate an issue or phenomenon. That insight is usually shaped by an observation of what appears to be true or the creative jolt of a new idea. Innovation is driven by a commitment to excellence and continuous quality improvement (CQI). [2.2]

Innovation is the creation, development and implementation of a new product, process or service, with the aim of improving efficiency, effectiveness or competitive advantage.[2.3]

Some of the key practical benefits of innovation [2.4] include the following:

- improved productivity,
- reduced costs,
- increased competitiveness,
- improved brand recognition and value,
- new partnerships and relationships and/or
- increased turnover and improved profitability.

Innovation means to always be questioning ourselves about whether or not we are doing the things we do to address a real need, or just because we have become too comfortable with the status quo. It is about acting on the basis of our values and taking the risks necessary to act upon what needs to be changed.

One of the methods for categorizing innovation is dividing them into two types: incremental and radical. Incremental innovation is an improvement in an existing thing (e.g., product, process or service). Radical innovation is finding an entirely new way of doing something. [2.5] The incremental and radical innovations can apply to the following: [2.6]

- Product
  (What do we want to produce and sell?)
- Service
  (How can we meet or exceed customer expectations?)
- Process
  (Continuous improvement of how we do things.)
- Management
  (What business and management strategies, systems, structures are to be used.)
- Open
  (What is necessary to work beyond boundaries and collaborate globally.)

Innovation normally helps to gain more customers and grab a bigger share of the market. [2.7] Innovation also makes it easier for the business to grow (whatever may be its size or type). [2.8, 2.9]

Innovation is risky. Radical innovations are riskier than incremental innovations. Radical innovations often fail, so many companies just keep making the current products and services better (i.e., incremental innovativeness). [2.10] Failure is considered bad for morale and for the careers of those who were responsible for failure. [2.11, 2.12, 2.13]

There are proven methods to promote creativity and innovativeness. Those methods are as follows: [2.14, 2.15]
1. Choose creativity.
   (Stop squashing that little kid inside of you.)
2. Think like a traveler.
   (Explore new areas.)
3. Daydream.
4. Be empathetic.
5. Be an anthropologist.
   (Learn from the past.)
6. Ask "why"?
7. Reframe challenges.
   (Do not be afraid of challenges.)
8. Build a creative network.

There are also strategies for generating innovative ideas. [2.16, 2.17] Those strategies are as follow:
1. Combine two different ideas.
2. Generate lots of ideas.
   (Brainstorming)
3. Review constraints to boost your creativity.
4. Collect and manage your ideas.
5. Take time away from your desk.
   (Reflect on your idea(s).)
6. Adopt an "experimental" mindset.
   (Follow the scientific method.)
7. Encourage team members to come up with their ideas.
   (Do not be afraid to either delegate authority or to let team members feel free to challenge your authority.)

The innovative process especially related to technological inventions is often triggered by some unexpected change of events, such as [2.18, 2.19]

- Unexpected Occurrences
  (Consider, first, the easiest and simplest source of innovation opportunity, i.e., the unexpected.)
- Incongruities
- Process Needs
- Industry and Market Changes
- Demographic Changes
- Changes in Perception
- New Knowledge

In order for the innovative process to begin a number of barriers and resistances need to be overcome.[2.20, 2.21, 2.22] Some of the barriers are as follow:

- We do not have enough time to try new things.
- There is no budget for experimentation.
- We are risk averse.
- There is a fear of failure.
- Approval processes are long and difficult.
- There is always initial resistance.

3. Adaptive and Innovative Personalities

Human personality is the combination of adaptive and innovative personality. School systems as well as family values and social norms nurture the adaptive personality. During the educational process, the innovative personality may be harmed rather than developed. By promoting adaptive personality, the educational process may become easier to manage. In most school systems, everybody is required to comply with an expected behavioral model. It is a well-known fact that innovativeness and creativity are the foundation for success in many areas (e.g., art, business, engineering, marketing, etc.) as well as personal and family life. Innovative personality and adaptive personality are two extremes on opposite sides of the spectrum. (Fig. 3.1) Most people are somewhere in the spectrum with a combination of innovative and adaptive attributes. Individuals within the entire spectrum can be creative. They demonstrate their creativity in different ways.

2.14%	13.59%	34.13%	34.13%	13.59%	2.14%
Strong Innovative	Moderate Innovative	Mild Innovative	Mild Adaptive	Moderate Adaptive	Strong Adaptive
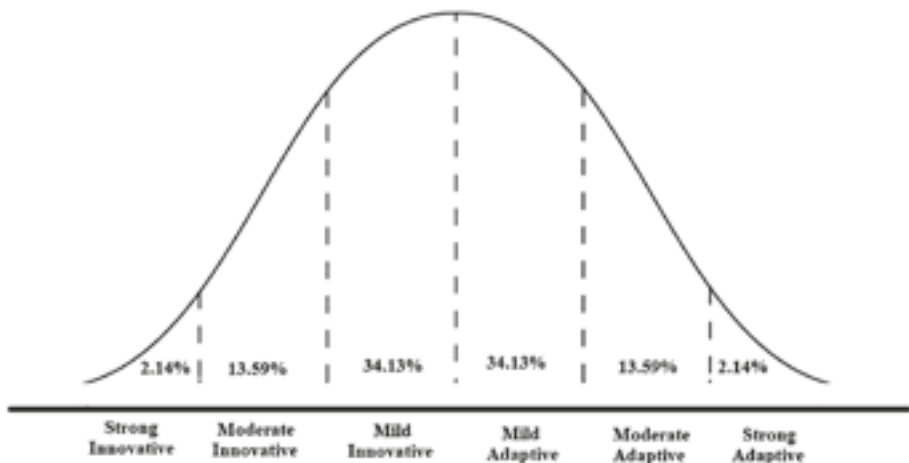
Fig 3.1.   Spectrum of Innovative and Adaptive Personalities.
Source: Authors' compilation based on [3.1, 3.2]

There are a number of tests for the purpose of estimating the level of comfort on the innovative and adaptive spectrum. [3.1] A ten-question test (Qualtrics) for estimating creative style was developed by Mr. Rich Rafferty and Dr. Stephen Harris at the Barnes Center for Enlisted Education, United States Air Force, in collaboration with Dr. Kathryn Jablokow, Penn State University. This test is available on the website. [3.2]

This test provides a general (but sufficiently accurate) estimate of the creative style. The test can be taken online by answering ten questions. The score of the test is available immediately and the interpretation of the score is shown in Table 3.1.

Table 3.1.   Interpretation of the scores of the Qualtrics test.

Test Scores	Interpretation
10–21	Strongly Adaptive
22–34	Moderate Adaptive
35–50	Mildly Adaptive
51–65	Mildly Innovative
66–78	Moderate Innovative
79–90	Strongly Innovative

Source: Authors' compilation based on [3.1, 3.2].

All the creative styles allow the individual to be creative, but in different ways. There are also a number of psychometrically accurate evaluation methods of assessing creative styles. One of the tests is KAI (created by M.J. Kirton). [3.3, 3.4, 3.5, 3.6] This test, however, needs to be administered by a certified psychometric.

Another test allows individuals to self-test their level of creativity. [3.7] The test scores as well as interpretation of the results are also available immediately after taking the test.

Individuals with adaptive personalities[3.8, 3.9] work well within a highly regulated structure of the organization. They understand the historical background and the importance of continuing the company's

traditions. Those individuals accept the changes, but those changes need to be methodical, well-thought out and planned in advance. Adaptive individuals understand the purpose of rules and regulations and follow them. Those individuals want the company to be stable and successful. They take pride in the company's history and accomplishments. Often they suggest innovative ideas for improvement as long as they are not disruptive ideas and do not expose the company to any significant risk of failure and/or losses. People with adaptive personalities prefer small incremental changes. They are cautious and respect management and co-workers. They promote teamwork where everybody contributes to the company's success according to their job description and position within the company. Adaptive individuals have a respect for hierarchy. They also seek consensus and support from others while working toward the company's goals. Adaptive individuals are not comfortable with uncertainty, risk and unexpected quick changes. They are dedicated to stability and maintaining the status quo.

Individuals with innovative personalities [3.10, 3.11, 3.12] are risk oriented. They do not have respect for rules and regulations as well as the company's hierarchy. They suggest and support risky and disruptive changes. An individual with an innovative personality is willing to implement quick changes which are not yet well planned as well as not supported by rules and regulations. Individuals with innovative personalities are team players, but they seek excitement and enthusiasm from the members of the team. They are willing to risk a lot to gain a lot. An individual with an innovative personality does not have any respect and appreciation for the company's traditions and history. They often take bold steps of defiance.

According to the Bell's curve of natural distribution (Fig 3.1), there are only 2.14% individuals with either strong innovative or adaptive personalities. A majority of people have either an innovative or adaptive personality (with 34.13% of the population on each side of the spectrum. There are also either moderate adaptive or moderate innovative personalities (with 13.59% of the population on each side of the spectrum). [3.13, 3.14] A majority of the population,

therefore, share a combination of attributes of innovative and adaptive personalities. This fact allows individual companies to properly structure the workforce according to the company's objectives. [3.15]

Creative style is a stable cognitive preference that reflects the characteristic manner in which the individual solves problems, makes decisions, and seeks to bring about change. In other words, it reflects *the way in which someone can be creative.* Among general populations (and across *continents and cultures), creative style spans in a wide bipolar spectrum in a normal Bell curve* distribution, ranging from those with a strong preference for more structure to those with a strong preference for less structure. M. J. Kirton* , one of the leading scholars in this field, uses the terms "highly adaptive" and "highly innovative" to describe these two poles, respectively, with most people falling somewhere in between .To describe a person's style preference we can describe them as "more adaptive" and "more innovative" relative to others. [3.16]

From the creative style perspective, both more adaptive and more innovative people regularly implement novel ideas, but they do so in different ways – and their ideas are novel in different ways too. [3.17, 3.18, 3.19, 3.20]

No position along the creative style spectrum is ideal . In general, complex problem-solving and creative endeavors require a diversity of creative styles for success overall. **Creative style** is independent of **creative level**, which means that people of all levels can be found at all places along the style spectrum – and vice versa. [3.21, 3.22, 3.23] Creative style **does not** change during our lifetime, although someone can behave in ways that do not align with their style when they have sufficient motive to do so. (This is called coping behavior, and it comes at an extra personal cost).

4. Innovative Potential

Innovative potential is the individual capacity to generate novel useful ideas in unique boundary-breaking ways. Those ideas may inspire others to produce growth and development. There are conditions and practices strengthening innovative potential or suppressing innovative potential. We are subject to those conditions from early childhood until retirement. Therefore, fostering practices conducive to strengthening and nurturing innovative potential are important in our lives. Innovative state-of-the-art companies are effectively creating conditions strengthening innovative potential. However, there are many companies which do not recognize these opportunities. In addition, our school systems from kindergarten through Grade 12 (or even university level) operates under conditions which suppress innovative potential. Human personality is the combination of adaptive and innovative personality. School systems as well as family values nurture the adaptive personality. By nurturing the adaptive personality, the educational process is easier to manage. During the educational process, the innovative personality may be harmed rather than developed. There are some individuals who are resilient to the harm and maintain an innovative personality and do not lose their innovative potential. Innovative potential cannot be measured per se and can only be assessed by innovative behavior and future innovative outcomes.

Innovative potential is the likelihood of the employee to demonstrate innovative behavior. Innovative potential is, therefore, the ability and capacity of a person to generate innovative ideas and demonstrate innovative behavior. Innovative potential can be assessed only by assessing innovative outcomes.

<u>Personality Traits and Characteristics of Individuals with High Innovative Potential</u>

The personality traits and characteristics of innovative peoples are as follows:
- Thinking creatively
- Being honest and candid
  (Honest and candid individuals are more creative and innovative because they are less inhibited.[4.1] Individuals open to new experiences are likely to be more creative and innovative.)
- Taking a proactive approach
  (These people solve personal and professional problems in a creative and innovative way.) [4.2]
- Being self-confident and brave
  (This type of person is more creative and innovative. [4.3] Proposing a solution for problem-solving or conducting business requires risk-taking behavior that is positively correlated with innovativeness.)

There are some conditions and company practices enhancing innovative potential.
- Dynamic work environment
  (This type of work environment involves multiple unique tasks. Creative and innovative individuals crave excitement and novelty.) [4.4]
- Diversity of the workforce
  (This type of workforce increases innovative potential. Diverse, multicultural and multiethnic experiences increase innovative potential. Diversity helps individuals to think out-of-the-box.) [4.5]
- Participation in many different groups.
  (Making individuals members of many different groups help them to think in an innovative way.) [4.6,4.7]
- Nurture and strengthen desirable behavior
  (Allowing desirable behavioral traits to be nurtured and strengthened.)
- Employee autonomy
  (Encouraging the autonomy of employees affects motivation and innovativeness of the employees.)[4.8,4.9]
- Self-determination
  (A feeling of being in control and making a difference increases innovative potential.)

- Management style
  (Management based on trust and support increases innovative potential.)
- Organizational culture
  (The organizational culture should be based on transparency and communication. This type of organizational culture that supports trust, psychological safety supports and increases innovative potential. [4.10,4.11]
- Shared responsibility and non-hierarchical management
  (This type of management style creates and increases innovative potential.)
- Creative thinking and problem-solving
  (Institutional support for creative problem-solving increases innovative potential.)

There are also some conditions and business practices hindering innovative potential Some of those conditions are as follows:

- Lack of tolerance for risk
  (Innovative individuals are dissatisfied by the lack of stimulants and low tolerance for taking risks.)
- Lack of autonomy
  (The lack of autonomy decreases motivation and negatively affects innovative potential.)
- Lack of self-determination
  (Feelings by the employee that they do not have an impact on the decision-making process suppresses innovative potential.)
- Micromanagement
  (This type of management style decreases innovative potential.)
- Lack of transparency, communication and psychological safety
  (These factors hinder innovative potential.)
- Traditional hierarchical management
  (This style of management hinders creative potential.)
- Lack of institutional support for creative solutions
  (This factor hinders innovative potential.)

Modern leaders have a great influence on institutional innovative potential, by creating and nurturing a culture enhancing innovative behavior.

5. Innovative Behavior

Innovative behavior is a result of applying innovative potential. People with innovative potential will be more likely to demonstrate innovative behavior. The ability to think innovatively is important from the perspective of hiring, team building and the development of long-term organizational goals. In management science, innovative work-behavior (IWB) is defined as "all employee behavior aimed at the generation, introduction and application of ideas, processes, products and procedures which are new and benefit the relative unit of adoption". [5.1, 5.2] Innovative behavior has five components which need to be applied.

Innovative behavior is a process of implementing new processes and practices leading to technical and economic progress. Innovative behavior has five stages.[5.3]
1. Recognition of opportunities for change and growth
2. Identification of opportunities and new methods to tackle them
3. Championing the change within the company
4. Invention planning and implementation
5. Evaluation of the results of the implemented invention(s)

Innovation is an ongoing process. The structure of the company as well as the work environment and conditions affect the innovativeness of the employees. The innovative potential of the employee impacts the innovative behavior and determines the success of the company. An organizational culture conducive towards innovative behavior like work autonomy, transparency and communication cannot be implemented in one day. This is a process that needs to be created and nurtured for an extended period of time. There is evidence of a link between innovative potential and innovative behavior.[5.4] There are

factors conducive to both. Innovative behavior can be enhanced by the following:

- Implementation of modern non-hierarchical management style
- Promoting work autonomy and delegating authority
- Promoting a culture of transparency and good communication
- Hiring people with personality traits conducive toward innovative behavior
- Allowing for flexible work hours
- Improving the employees mental and physical health

Before the implementation of innovative ideas, especially disruptive innovation ideas, a number of difficult questions need to be asked.[5.5] Successful business leaders and successful inventors have the ability to ask questions that nobody else is asking. Asking those questions allows them to find very valuable answers. Many inventors are focusing on the invention itself and the technology associated with the invention while underestimating the challenges associated with the business and marketing aspects.

A very helpful concept is to associate the invention with the good-cause principle. Many young customers and young employees like to be associated with good causes. Making a profit can be the secondary objective.

The new generation of the workforce is looking for higher meaningful engagement at work. Research indicated that 21% of the young workforce change the company due to being dissatisfied with low engagement at work.[5.6] There is a big challenge for leaders to be very innovative and engage the young workforce.

Engagement of the young workforce is needed to unleash the innovative potential and increase their innovative behavior. Workers in general favor modern management techniques based on mutual trust and transparency (less hierarchical). [5.7], [5.8], [5.9], [5.10]

Creative and innovative behaviors of the employees need to be recognized and rewarded to increase employee satisfaction and boost innovative behaviors.

6. Methods Enhancing Creativity and Innovativeness

Methods for creative problem-solving and generating ideas are many. The choice of method to be applied depends on several factors. The application of creative thinking in practice affects the choice of method.

The use of attributes in the fields of management, economics, sociology and production engineering, it seems appropriate to use innovative methods (Fig. 6.1).

Fig. 6.1. Inventory with feeding disciplines [6.15]

The characteristics of the innovative methods are as follows [6.2, 6.9]:
- constructing and "calling to life" new products,
- solving difficulties or problems in a creative way,
- progress and supporting attributes relating to the creative process,
- posting of links between the facts,
- individual investigation of results,
- defining theories and assumptions,
- no security and no guarantee to resolve the problem.

CERMA (the acronym for the French name of the well-known methodology for the study and research on the use of the *Centre d'Etudes et Recherches en Méthodologi. Appliquee*) has grouped the methods into one of four phases:

- defining and resolving problems,
- gathering information and modelling the problem,
- analyzing and evaluating the problem,
- finding solutions.

The characteristics of the methods used in the tests are listed are shown below. The descriptions have been designed to allow quick acquisition of the methods and the efficient use of them. Numerous graphics and schematics have been used to describe these methods.

6.1. Morphological Analysis

Morphological Analysis is a method which promotes the emergence of a many ideas. It was developed by Fritz Zwicky in 1940. It is an attempt to organize the system, according to the components or form of the system. The method is most often used to analyze a very complex problem or system. Its application covers areas such as designing a new product, introducing technological changes, market research and conducting a social problem analysis.

The stages of Zwicky's method are as follows:

1. Prepare a list with all possible aspects that are related to the problem or system being analyzed. The aspect (characteristic) of the new product can be the shape or material from which it will be designed/developed
2. Identify attributes that specify previously mentioned aspects, e.g., the shape attribute can be oval, square, triangular, rectangular, etc.
3. In turn all aspects and their attributes should be presented in a combinatorial way (create all variants of the statements) in the area of the research problem.

4. Then you should verify the received statements, reject the absurd solutions and leave only those that will be valuable for the enterprise and will be possible to realize in the future.

6.2. Brainstorming
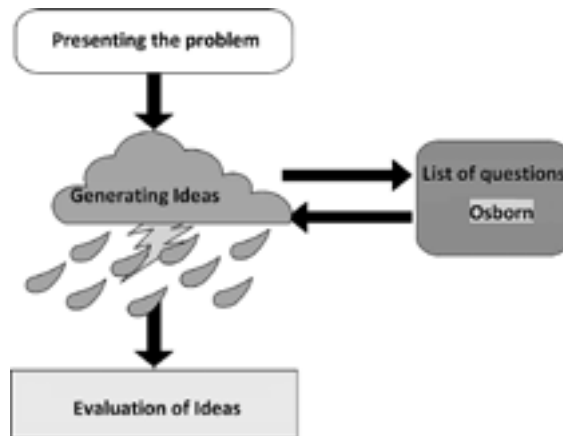
Fig. 6.2. Brainstorming.
Source: Own development.

Brainstorming was developed by Alexa Osborn and consists of the following stages [6.4]:

1. Identify the problem.
2. Familiarize participants with the problem and encourage a joint discussion on the subject.
    (The information provided is only intended to lead the participants to the problem. It is recommended to present the problem in the form of a question that should start with the word "how" (How to increase profits?). At this stage, you should also be familiar with the brainstorming rules.)
3. List all ideas.
    Prioritize the ideas in the order of importance.
    In the case of a small number of ideas or a decline in creativity, the group can contribute to the list of Osborn's questions.
4. Evaluate and analyze the of ideas.

The basic rules of brainstorming are as follows:
- principle of deferment of assessment
- (Any assessment during a brainstorming session is prohibited.),
- principle of fantasticating
  (It is desirable to come up with even the most unlikely, fantastic, absurd ideas.),
- principle of passing quantity to quality
  (A higher the number of ideas means a greater the chance of finding the optimum solution.),
- principle of modification
  (It is advisable to improve and modify the ideas of other people.),
- principle of suggestion
  (It is advisable to use the ideas of others in inventing your own.).

6.3. Defect Method

The *Defect Method* consists of revealing as many defects as possible (shortcomings) in the system concerned. The defect method requires teamwork to stimulate the "defect generation" process. The role of the team is also objectivity of defects (which for some is a disadvantage, for others can be an advantage).

The stages of the defect method are as follows:
1. Exchange, search for shortcomings.
2. Assessment and ordering of these shortcomings.

The method gives the basis to improve the existing system or to replace it with a new one, satisfying better-awaited functions (with fewer defects).

6.4. Ishicoff Diagram

The *Ishicoff Diagram* is also referred to as a cause-and-effect plot or a fish-shaped diagram. It is based on the outline of all possible factors of

the problem being analyzed. It is also used during the presentation of all the factors related to the problem.

The diagram is used to graphically represent the links between the elements interacting with the process as well as the aftermath they may cause. It is most often used in the procedure of eliminating and resolving emerging difficulties that may arise during the process.

Designing this type of schema should be done in a group, bearing in mind the three basic steps of implementation shown in Fig. 6.3.

Step 1. – Determination of the main causes.
   (The name of the priority groups of factors affecting the outcome of the process.)
Step 2. – Designation of secondary components.
   (What is the clear development of key factors to which they are directly related.)
Step 3 – Selection of determinative factor (critical)
   (Specify the components (factors) that are most influential on the problem or occurring in the process.) [6.17]
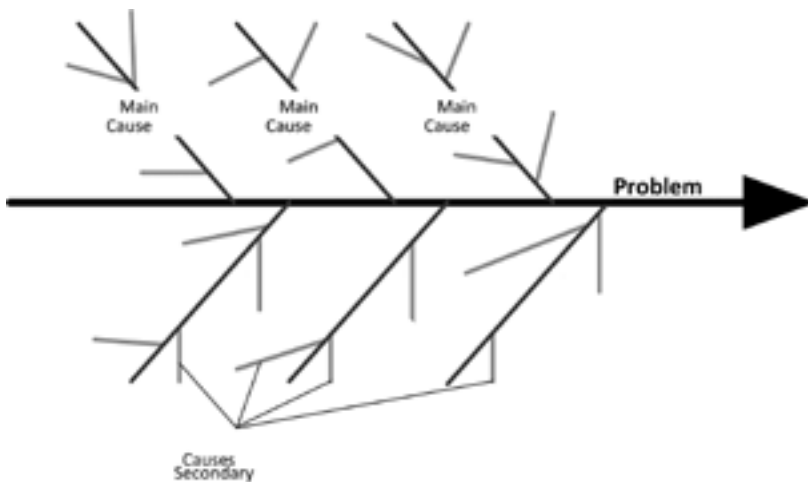
Fig. 6.3. Building an Ishicof diagram.
Source: Own development.

The diagram inspires attention to all dimensions of the problem. It encourages the inclusion of various links between them, considering the various components. This structure also gives you the ability to determine the logical order of elements.

6.5.Method of Good Examples

Fig. 6.4. Method of good examples.
Source: Own development.

The use of the *Good Example Method* determines how to resolve the problem based on specific cases. It consists of creating ideas to solve the problem based on similar examples occurring at the same time. The company should compare itself to its industry leaders and analyze the activities of market leaders. The Good Example Method will enable them to achieve their goals [6.18].

6.6. Harmonization Method

The creator of the Harmonization Method is a Polish management theorist, Karol Adamiecki. The method of harmonization is a graphical method for analyzing and scheduling work in a team. It is based on the Law of Harmony, which is the accuracy of the selection of work elements and the maximum alignment of their operating times. The performance of the team (its usability) depends on the element, which is characterized by the smallest performance.

The Law of Harmony consists of the following two partial rights[6.1].

1. The right of harmony in the selection of bodies, which stipulates that in work divided into many co-operating bodies. The better economic effect (effect-to-effort ratio) results in better selected co-operating bodies. The measure of organization selection is the economic characteristics defined by the law of increasing production, while performance depends on the body that has the least efficiency. In accordance with that law, it is appropriate to select the bodies (elements) that interact in order to have similar performance.
2. The right of harmony in the operation of organizations is the work divided into many co-operating bodies. The better economic effect is achieved when the times of each organ are better (more precisely) mutually agreed. In accordance with that law, it is necessary to ascertain precisely all the moments of starting up by the collaborating entities.

In later elaborations, Adamiecki points out three fundamental rights of harmony of an organization.

- Right of harmony of selection,
  (Lower costs to a minimum by performing activities in a way that reduces time.)
- Time of harmony of action
  (Set the time standards needed to perform a specific action.)
- Law of Spiritual Harmony
  (Integrate worker and the creation of emotional bonds between them, which support the efficiency of work.)

Adamiecki also drew attention to the gradual introduction of changes to the organization without disrupting the whole system.

6.7. Method of Combining Two Theories

The *Method of Combining the Two Theories* is also called the *Theory Superposition Technique*. Its essence is to create a combination

(synthesis) of two (or more) known and developed theories in order to obtain a single theory which will allow the explanation of more phenomena and facts [6.14].

6.8. Crushing Method

You may find that the *Crushing Method* is an inverted brainstorm. It is based on the use of fundamental principles of brainstorming.
- No evaluation
- Focusing on quantitative and not qualitative parameters
- Complementing the members of the creative session

The essence of the method is to detect as many negatives and defects of the test object. Crushing can be counted as a session of exaggerated criticism. The Crushing Method provides for free unfettered expression of concepts and ideas. The team members express their opinions without fear of meeting the condemnation of other participants in the creative session. It is a technique suitable for realization in the group.

The method gives impressive results when it comes to modifying, refining and adapting a real problem/object. Crushing can also be subjected to an item that does not currently exist. The item is already designed. In this case, it is advisable to build a prototype (even if it the most primitive). Then the technique is used to analyze the prototype. Finally, the refining is proposed.

The stages of the Crushing Method are as follows [6.10]:
- Preparation for crushing operations
  (Identification of the problem, gathering necessary data, information about the object)
- Execution of crushing process
  (Selection of crushing questions for the idea, concept of the object analysis, crushing procedure)
- Development of possible options for improvement or improving the functioning of the facility (based on Point 2).

The main crushing stage is dynamic and lasts from 5 to 30 minutes, no longer to avoid a sense of meaninglessness and boredom . It is followed by a logical-analytical stage in which a thorough analysis and the ordering of the signaled defects are performed.

The defects are divided into four groups.
- Uncomplicated (trivial) defects
  (Suitable for immediate removal, simple to settle),
- Non-trivial defects
  (possible to be eliminated in the event of possession of the necessary resources)
- Latent (hidden) defects
  (They stain defects, of which the existence was not previously realized. Their removal requires creative thinking, and productivity).
- Imaginary defects
  (Unreal reality)

he result of the crushing procedure is not always the rejection of the object or the idea. Sometimes the crushing method can meet with the fortification of the object or idea.

Criticism undermines the theses (objects) that are not entirely justified., and it supports those duly justified.

6.9. Lotus Flower Method

The essence of the *Lotus Flower Method* is divergences thinking, which is based on the search for many different solutions and ways to deal with the problem.

The steps of the Lotus Flower Method are as follows:
   Step 1
- Start by characterizing the problem.
- Mark the word or password (slogan) in the middle of the sheet of paper.
  (This place will be the center of the lotus flower.
- Add petals on which to write ideas to settle the outlined problem.

The key here is to preserve the appropriate differentiation. Ideas should not be similar. If this stage proves to be too difficult, it is advisable to use other creative troubleshooting techniques that will help to facilitate the task (e.g., brainstorming). The number of ideas should be around six to eight proposals. After extracting the concept of interest, place the ideas around the main problem in the way the petals enclose the center of the plant. (Fig. 6.5)
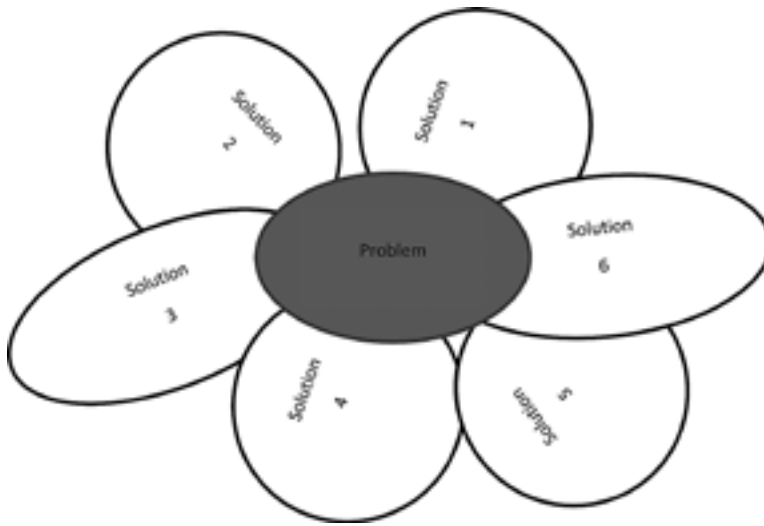
Fig. 6.5. Lotus flower structure – Step 1.
Source: Own development.

Step 2

The next stage is the development of a predetermined flower by the "tear-off" of the next "petals". It is possible to prescribe individual solutions so that they can be the means of successive lotus flower structures. After the whole process is repeated, a solution is added around the proposed solutions ("post-dissolution"). They no longer need to relate to the originally defined problem. As a result, concepts are somehow distantly relative to the initial issue. The completion of this stage is the achievement of the "flower" of the main lotus and the six "flowers" of the side. The continuation of the creative process of "flower development" contributes to the creation of ever-wider solutions of ideas that translate into a definitive solution to the integral problem
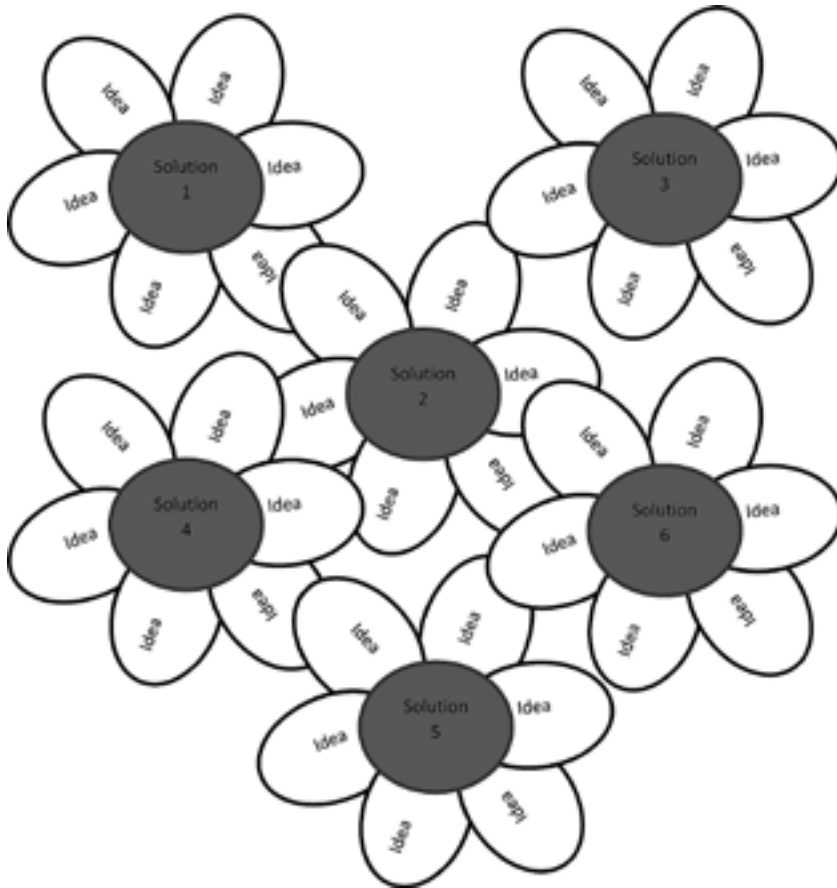
Fig. 6.6. Lotus flower structure. – Step 2
Source: own development.

6.10. List of Osborn Questions

The *List of Osborns Questions* is based on the use of a list of questions that facilitate the execution of contractual changes and selected attributes of the analyzed object. The choice of questions depends on your needs, your expectations about the subject and its modification. These queries are often confined to the verb itself in the form of an intensifier, culminated in a question mark. (Fig. 6.7)

Osborn's list of questions

- Use differently?
- Adapt?
- Modify? Give a new form? Change the destiny, movement, color, sound, shape, smell?
- Enlarge? Add something? Increase the frequency? Why do you need to spend more time? Increase the number of ingredients?
- Reduce? Should it be made lower? Less? Mini□ Use differently?
- Adapt?
- Modify? Give a new form? Change the destiny, movement, color, sound, shape, smell?
- Enlarge? Add something? Increase the frequency? Why do you need to spend more time? Increase the number of

Fig. 6.7. List of Osborn questions.[6.5]

The advantages of the Osborn Method are as follows:
- simple,
- universal,
- opportunity to receive multiple ideas,
- immediate results,
- working in a group that increases efficiency.

6.11. The Explorative Matrix Method

The *Explorative Matrix Method* consists of creating an array in which the characteristics of the analyzed topics are placed in rows and columns. At the intersection of the row and column, there are different ways to solve the problem. Empty fields indicate yet unexplored possibilities. The Explorative Matrix Method plays an important role, showing the fields occupied and directing the search for yet unexplored possibilities freely. It is a type of heuristic procedure that tends to enrich the creativity of a person or team, and guiding thoughts on problems still unframed. This technique combines verbalization with visualization and multiplies the resonance of creative exploration [6.12].

6.12. Method of Incompetence

The *Method of Incompetence* consists in taking the views of many non-professionals and the professionals in the field of the problem under consideration. It is assumed that if a thousand of the projects are presented, nine hundred and ninety eight will be absurd and without value. One may prove to be valuable and different from the proposals that specialists could present. Experts in a field tend to seek less radical or creative solutions in order not to expose themselves to incompetence. The dilettante, however, is easy to release and imagination, will offer the strangest solutions. The dialogue between the expert and incompetent person creates the possibility of heuresis. Naïve opinions and surprising questions of incompetent people allow you to look at the analyzed problem from a different perspective and find creative solutions [6.15].

6.13. Method of New Material (Plastics)

The *Method of New Material* involves the application of plastics, (in the broad sense of the word) in other places. This method uses the capabilities of the material properties where it has not been used before. The method is to stimulate the participants of the session with the properties of the raw material (we play with it) to use possible and so far considered to be impossible to apply. In this way, the possibility of transferring solutions from one field to another, the use of dependencies and material characteristics in other completely areas, is emerging [6.8].

6.14. Look Method

The method of a new look assumes that by moving away from a given problem in space or time, a new look is found, the imagination is altered and the way of thinking changes. It is an example of the so-called Thinking Next, which involves transferring attention from the outbreak

of the problem to its periphery or going back to the genesis of the problem. It is recommended, among other things, to refresh the gaze, to conduct sessions in cent distant from the company. In this method it is also advisable to interrupt the consideration of the problem for some time, also to carry out the process of incubation (fermentation). This method also uses the opinions of non-company experts not related to the establishment and its problems.

The basic rules of the Look Method are as follows:
- You must depart from the problem in time or space. (Consider what will be for example 10 years, or what would be if you were acting on another market, etc.
- You should cleanse your mind. (Don't be guided by prejudice.)
- It is advisable to use the opinions of experts not employed in the company.
- Sessions should be conducted away from the problem (other building, studio trip, etc.).
- The incubation time of the problems is indicated, a break in search of solutions.

6.15. Crop Rotation Method

The Crop Rotation Method is also known by the name of Forced Removal. The Crop Rotation Method has been taken from the economic tradition, where the farmer receives better yields if, in subsequent years, they change the type of cultivation on a part of the field. The same work on one problem (one job) can cause fatigue, burnout and/or lack of objectivity. Therefore, it is recommended to change positions or thinking order to see new opportunities and horizons. Creativity is stimulated.

6.16. Dichotomic Distribution Method

Dichotomic Distribution Method is to make successive selections by repeating some form of inferring. The selection is done by analyzing

the yes or no answer to the questions. Defining a set of questions is an essential element of the method requiring a very good knowledge and precise analysis of the problem [6.13].

6.17. Graphical Presentation Method

The Graphic Presentation Method consists in presenting the phenomenon or its characteristics in the form of drawings, graphs, diagrams, etc. Graphical interpretation has an advantage over verbal and makes it easier to see the various aspects of the problem that were not originally associated with the problem [6.3].

The advantages of the Graphic Presentation Method are as follows:
- The act of elaboration,, of a graph has important heuristic properties.
- A ready-made schematic or diagram facilitates and enriches analytical reasoning.
- Communication between members of the group increases.

6.18. Translation Method

The Translation Method involves translating a given term into different languages (computer, specialized, foreign) in order to enrich its content by considering the characteristics and indications of the foreign counterparts of the given phrase. It is a game with words in different languages [6.14].

6.19. Method of Transfer Analogous

The Method of Transfer Analogous uses the possibility of certain regularity in a given field to describe similar phenomena, but which occur in another field of reality. The method is suitable for finding analogies among seemingly different, but structurally similar items

(systems). Later these analogies are used for the improvement of selected systems. (Fig. 6.8).
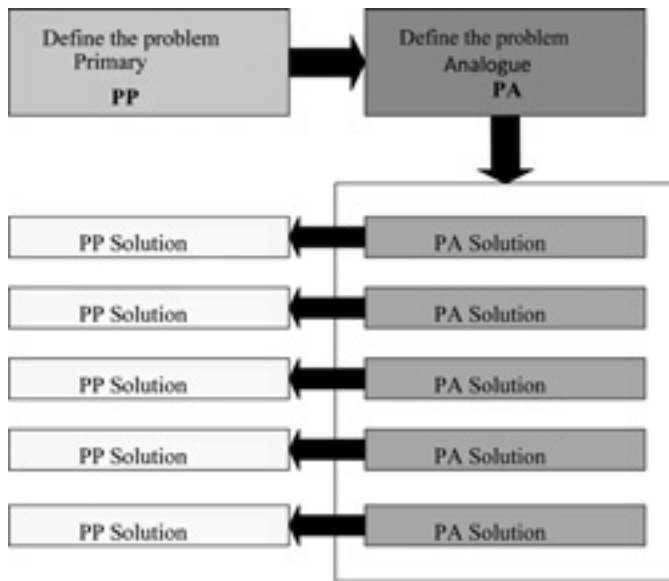
Fig. 6.8. Method of transfer analogous.
Source: Own development.

The stages of the Method of Transfer Analogous are as follows [6.11]:
1. Define a basic **PP** problem that needs to be solved.
2. Determine a problem of an analogous **PA,** not directly related to the problem of basic, that is uncomplicated and well-known participants in the session.
3. Search for solutions to an analogous problem.
4. Find solutions to the basic problem based on analogous solutions to the secondary problem.

6.20. Concept Transfer Method

The Concept Transfer Method is to transfer a term that has been established in a one field to a field in which it has not yet existed. A time-limit should be clarified and formulated. The purpose of this

method is to use research carried out in one sphere to understand processes in the less known sphere or notion e.g. medical (neural networks, artificial intelligence) in computer science. In order to solve the problems of the company, it is popular to equalize it to the living organism and using the terms derived from Biology [6.15].

6.21. Detail Method

The Detail Method is also known by the name of the detective method. Its idea is to search for a set of detailed symptoms that would allow you to challenge an existing (or proposed) solution (as the detective undermines the alibi, revealing a small, dissimilar fact, so the group is looking for a seemingly trivial element that hinders or prevents the functioning of the system) [6.11].

6.22. Six-thoughtless Hats de Bono

The basic rules of the Six-thoughtless Hats de Bono are as follows [6.6]:
- Hats represent the attitude to be taken.
- Each headgear can be used any number of times.
- If there is a problem with strong emotions, it is advisable to start a red hat first to realize it and call it precisely.
- If the difficulty is not raised, we begin by founding a white hat, which is the source of information. Next, we put the green hat to reveal several different opportunities to settle the problem. Then we judge any ideas by taking the rules of the yellow hat followed by the red hat rules. Ultimately, we choose only one of the many possibilities that we give final verification in the black hat. We are finally applying a red hat and we check to what extent the opportunity has come to our liking.
- The yellow hat always has the advantage of being black, as it is well known that it is much harder to see the positive side of the solution if we reveal the negative ones first.
- The final assessment of the idea is carried out in a black hat, after which we put a red hat to check the relevance of the idea.

- There are two possible ways to use a black hat: when we want to discuss either the shortcomings of the idea in detail or to conduct a general verification of the idea.Advantages of the Six-thoughtless Hats de Bono Method are as follows:
- Ability to play different roles – in-kind hats allow you to think, as well as to speak things that in real situations we do not say. We protect our ego, because by giving different suggestions we take on a another role.
- Comfort and simplicity – great ease of movement between the subjects, not just for each hat, but for others.
- Focus (Remarks) – Provide an opportunity to address the problem from six different points of view.

The hats are presented with the six attitudes to be taken. (Fig. 6.9).

White Hat Facts	Red Hat Emotions
• Neutral, impartial, objective rations	• Expresses emotions, feelings, judgements
• No argumentation, no opinion	• Do not justify, explain your emotions
• Helpful when disciplining, proper orientation of thinking	• Sixth sense, intuition
Black Hat Criticism	Yellow Hat Positive
• Negative, critical remarks	• Positive, valuable features
• Disclosure of defects, errors, imperfections	• Optimism
• Risk indication	• Disclosure of Benefits
	• Hopes, dreams, visions
Green Hat Crativity	Blue Hat Summary
• New alternatives, creative thinking	
• Provocation, moving away from classic patterns	• Organizing the thought process
• Biggest number of ideas	• Systematization of dedaction process
• Transforming ideas into a new concept	• Session Summary

Fig. 6.9. Six-thoughtless hats de Bono [6.6]

6.23. Teratologic Method

The Teratologic method is based on the principle that the pathological situation illuminates the normal situation. Assuming an absurd, shocking, paradoxical solution, you can lead to finding a solution to the problem investigated. The extreme cases stimulate heuristic inspiration. Examples of an extreme and caricurity bring the problem to the boundaries of materiality and enable its precise definition. Another advantage of the method is the reflection of participants in the course of research, so that they immediately eliminate false hypothesis.

For example, to make changes to the production system, you can formulate the following assumption: production has doubled during the month. In the next step, you should be curious where such effects are. The thought process would, as a result, make proposals for changes in the production system, increasing its efficiency, etc.

6.24. 5 Why Method (5 times "why?")
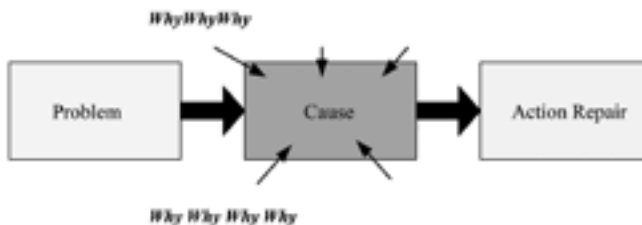
Fig. 6.10. The 5 Wh
Source: Own development.

The 5 Why Method (5 times "Why?") allows you to detect the causes of the problem. Asking a few questions like "Why?" allows you to come to the source of the problem, thoroughly investigate its cause and focus on effective resolution. By asking further questions like "Why?", the problem becomes more understandable, making the underlying cause of its creation easier to identify and eliminate.

- The method allows you to get answers to the questions:
- Why was the problem?
- Why didn't we notice it?
- How to solve it?

Steps of the 5 WhyMethod are as follows:

1. **Gather information about the problem**
   Start your work by gathering as much information as possible about the problem. The more information you gather, the more chances you will have to identify the correct cause of the problem. At this stage, consider the following points.
   - What happened?
   - When?
   - What is the magnitude of the problem, how many defects are there, etc.?
   - What is the problem for the customer, the user and/or the company?

2. **Select a working group to determine the causes of the problem.**
   The members of the Working Group should be those who know the most about the problem.

3. **Provide a detailed description of the problem.**
   A precisely described problem facilitates the concentration of individual group members.

4. **Ask questions and search for answers.**

5. **Verify the responses.**
   Verify that the response obtained is logically related to the problem (on a cause and effect basis).

The advantages of the 5 Why Method are as follows:
- It is simple to use and easy to use in any organization.
- You can enter this method easily and quickly.
- The effectiveness of this tool does not require any specialized personnel to prepare.
- This method prompts employees to think and identify the problem independently.

6.25. Setting Standards Method

The method of setting the standards was created by the Polish engineer Edwin Hauswald. It consists in the experimental and computational setting of standardized patterns corresponding to the best production conditions, the equipment and the means of work, which are later used to assess the results achieved in practice.

Standard

A document adopted by consensus and approved by an authorized organizational unit establishing, for widespread and repeated use, rules, guidelines or characteristics relating to different activities or their results and aiming at an optimum degree of orderness within a specified range.

Setting Standards Methods include the following:
- Statistical,
- Laboratory
- Estimated
- Comparative
- Analytical
- Computational
- Research

The method of setting standards is mainly used to determine working time standards.

Two groups of working time standards methods are used including [6.16]:
- **Summary Methods**
  The Summary Methods consist in determining the total time required for the production unit to be performed without a detailed process breakdown into component activities. The summary methods include the following: Estimation Method, Statistical Method, and Comparative Method.

- **Analytical Methods** consist of determining the time required to perform the production unit. They include the following: Duration of the component activities, Machine and equipment capabilities, and Validation of the execution technology.

6.26. Walt Disney Method

The *Walt Disney Method* is an easy way to create effective and creative solutions. It is considered one of the methods of modifying the brainstorming, but also works in individual creative work as one of the *Perspective Change Techniques*. The essence of the Disney technique is to transform the most daring ideas into a real, constructable, innovative product. (Fig.6.11) To do this, it is necessary to look at the problem with three different perspectives: dreamer, realist and critic.
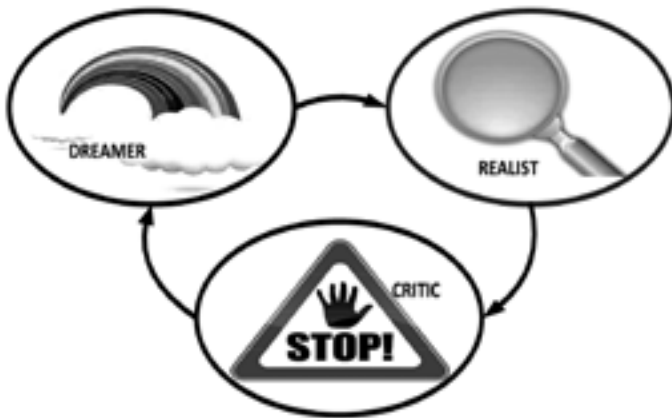
Fig. 6.11. Walt Disney Method.
Source: Own development.

The definitions of these three perspectives are as follows:
- **Dreamer**
  Being a dreamer is the privilege of being able to circumvent any limitations and invade anything, in any scale, size, type or type. Everything is acceptable. The main assumption is that there is no impossible thing.

- **Realist**
  The realist must look at the ideas of the dreamer and process them so that they become feasible.
- **Critic**
  A critic should think critically to find weak spots. This is an extremely important role that allows you to improve your ideas.

The technique(s) can be used by a single person, a team, and a team. If it is used singularly, one person assumes the role of a dreamer, realist and critic. This is difficult from a psychological point of view, but possible.

It is much simpler to use this technique in a team and teams where individuals take on the roles of dreamers, realists and critics.

It is worth noting that the Disney technique is not linear. The steps used in the Walt Disney Method are as follows [6.7]:
1. Work on the new idea from the perspective of a dreamer.
2. Look at ideas from a realistic point of view.
3. Verify their value of the solution by assuming the attitude of a critic.

However, this is not the end of creative work. If there are any arguments pointing to the imperfection of the idea, you should return to the dreamer's perspective and repeat the cycle. In this way, the strategy adopts its final shape. It is a creative circle of thought

7. Individual Innovations

The issues of innovation are very important for the modern economy. Basic concepts of innovation can be defined as follows: [7.1]

- Innovation - the result of creative activity, aimed at introducing changes in the system of the organization concerning products, processes or management which meet the needs of the organization and brings benefits in terms of growth, profits and prestige.
- Innovative activities – the whole of the organization's activities focused on the development and implementation of the necessary and beneficial innovation.
- Innovation process – a process involving clarification of the needs of innovative idea generation, its design, implementation and operation.

In the literature, the most common division of innovation is as follows:
- product innovations,
- process innovations,
- service innovations.

Most of the literature defines innovation as the implementation not just of new ideas, knowledge and practices, but also of improved ideas, knowledge and practices [7.2; 7.3; 7.4]. Innovation is different from reform or change, which does not necessarily mean the application of something new, nor does it imply the application of improved ideas or knowledge [7.5]. The competition between three concepts: innovation, reform and change (Table 7.1) can be very interesting. By referring to Table 7.1, we can say that innovation is not the same as change.

Table 7.1.   Innovation, reform and change.

	Innovation	Reform	Change
Definition	Implementation of improved ideas, knowledge and practices	Structured and conscious process of producing change	Transformation or alteration that may be an intended or unintended phenomenon
Key characteristics	Implies novelty and brings benefits	Produces change (though in some cases only little or none)	Is historical, contextual and processual
Types	Process, product, marketing or organizational; Incremental, radical or systemic in form	Radical, incremental or systemic	Differentiated by pace (continuous or episodic) and scope (convergent or radical)

Source: [7.2].

These types can be defined as follows: [7.2]
- Product innovation is the launch of the product when the technological characteristics or intended use differs significantly from previously manufactured products or the operation of which has been substantially improved, and at the same time it can provide the consumer with objectively new or increased benefits.
- Process innovation is the adoption of new or significantly improved methods of manufacturing or delivery of products. This might involve changes in the organization, technology, human resources, working methods, hardware, or a combination of such changes.
- Service innovation is the launch of a service which is new or is perceived by someone as new. It is therefore a service which offers consumers a new benefit or value. Such innovation is the change of an existing service or proposes a new one. Innovation in services is defined by multiple divisions including product innovation.

Although innovative processes benefit from collaboration (see next chapter of this book), new knowledge in real-life networks can begin with an individual. Individual perspective to innovation is underrepresented in research [7.6; 7.7, 7.8] The competences needed in innovation processes can refer to knowledge, skills and attitudes, but the influence of an individual characteristic on it also seems to be significant. [7.9].

Employees are a knowledge resource for their employing organizations. In many areas of management, they should have realized that the human element of organizational development is connected with the innovative capability of an organization. To recipe a success on the market an organization is claimed to be focused on a creative and innovative workforce [7.17].

We can find in the literature conception of individual innovation competence. It can be understood as a synonym to the set of personal characteristics, knowledge, skills or abilities that are connected to creating concretised and implemented novelties via collaboration in complex innovation processes. Similar to other competences, innovation competence can be learned and developed [7.10].

The growth of importance of individual innovative behavior in the organization is due to current trends in the management sciences. In table 7.2 we presented the main trends which have an impact on individual innovations in organizations.

Table 7.2. Trends in management with impact on individual innovations.

Trend	Characteristic
Dynamicity and turbulence.	Market arenas are getting more and more turbulent and dynamic: customer needs, competitors, business models and the set of competencies necessary to compete in a definite industry change over time with a frequency much higher than ever.
Globalization of markets and business activities.	Globalization has fostered homogeneity in customer needs but, at the same time, has renewed companies' interest toward the satisfaction of local demand
Increased competition.	Globalization, liberalization and convergence of markets and technologies have increased competition in several industries, both at a domestic and at a global level
Rapid advances in technology.	New knowledge is developed and applied to products and services faster and faster. Consequently, life-cycles are shortening in some product categories, a greater number of new products and services are being introduced over time, and the time between subsequent innovations is decreasing.

Trend	Characteristic
End of the linear model of innovation.	Traditionally, technological innovation was conceived as a sequential process that linearly proceeded from idea generation, through development, prototyping and testing, manufacturing and market launch. The input of this process was either a technology advancement (the technology push approach), the identification of a market need (the market pull approach), or a combination of the two (the interactive or coupling model). This point of view has radically changed in the last decades; technological innovation has become a flexible, iterative process, contemporarily involving R&D and other functions, characterized by a strong participation of both suppliers and lead users and by a systemic nature.
Increased reliance upon external sources of technology.	Firms generally lack the financial and technical resources to build the whole range of competencies they need and hence move towards a higher level of technical specialization, concentrating internal R&D efforts on core activities where they are more likely to excel. Contemporarily, they rely strongly on external sources of technology to access the other required competencies and to feed their innovation pipeline with higher frequency and continuity.
Leverage on multiple channels for technology exploitation.	Traditionally, firms have exploited innovations, incorporating them into products or services that were internally developed and launched in the final market. Nevertheless, the costs required to develop new technologies and the speed at which new knowledge is developed make sustainable long-term growth even more dependent on the continual and full leverage of a company's technology basis. Therefore, firms are contemporarily using multiple channels for converting their technologies into incomes, among which external exploitation paths (such as patent sale or licensing out, new venture spin-off or contract research) are used more and more.
The entrepreneurial nature of R&D.	Traditionally, R&D was considered part of the firm's overhead costs and conceived as a technology-led unit where all innovation opportunities were generated and developed until ready to be released to manufacturing and marketing. Nowadays, internal R&D becomes the repository of the firm's core technological competencies but, at the same time, it is the engine of the innovation process and performs critical brokering functions, such as the scouting of the external environment for the identification of valuable sources of knowledge and the integration of internally generated with externally acquired technologies.
Birth and growth of markets for technology.	The search for multiple channels for commercializing the output of firms' innovative efforts, the specialization in knowledge production and the related division of labor within innovative activities have brought the birth of so-called markets for technology. The capability to interact with these markets for technology has become a further critical determinant of most successful firms' innovative behavior.
Management of R&D and innovation on an international scale.	Finally, the management of technological innovation has assumed a prominent international dimension. In fact, studies of the internationalization of innovation processes indisputably show that foreign R&D is becoming a significant component of many countries' R&D base

Source: On basis. [7.11; 7.12; 7.13].

Some research suggests that obtaining conventional rewards play a very small role in stimulating innovativeness. The participation itself is a sufficient reward for conducting an innovative behavior of peoples. Also, it is worth mentioning that when employees perceive that efforts are fairly rewarded by the organization, they are willing to cope innovatively with higher levels of demand in the work environment [7.17]. According to literature we can define innovative behavior as a complex process consisting of generating, promoting and implementing ideas that are novel and useful within a particular social context [7.16].

Organizations can take many activities towards enhancing the innovative potential among their workers. Especially organization which is adjusted to innovative people enhancement should follow points like [7.11]:
- the organization for external innovation,
- the coexistence of innovating and operating organizations within the firm's overall structure,
- the organizational decentralization of innovative activities,
- the organizational separation between research and development activities,
- the resource allocation mechanism in the organization for innovation.

Spite of several action could be used to spur innovation at the organizational level, including [7.14]:
- leadership,
- creative work environment,
- organizational culture,
- organizational climate.

The social network a particular person exists has an important impact on the innovative behavior of this person. Social networks characterized by weaker relationships are an important determinant of creativity. The weaker ties an individual has, the better it would be for his creative outcomes. The intermediate level of weak ties was positively related to creativity when the employees' conformity value was low. Also, a more central position of an individual in respect to the others is associated

with creativity, because such a position provides an individual with higher social status. Because of that the social network can provide an individual actor with opportunities for exhibiting innovative actions [7.15].

Another very important factor influencing individual innovative behavior is work motivation. It plays a critical role in organizational behavior because it determines the quality and extent to which the employees would engage into the working activities. In the case of intrinsic qualities self-determination and sense of competence at work are feelings that give rise to people's intrinsic motivation. When an individual is enjoying a high level of intrinsic motivation, his interest and involvement in the job task rises to a level that can provide him with a sense of merging with his working activity and higher level of innovativeness [7.15].

Innovativeness is also enhanced by personal values of the particular person. Some studies show the relation between personal values and creativity and innovative behavior [7.18]. The natural way to pursue important values is to behave in ways that express them or promote.

Therefore, we can expect that some values can be useful to foster innovative behavior in employees and others to be negatively related to. The very important value from an innovative point of view is openness to change which comprises self-direction and stimulation. Self-direction has been argued to be a value that is the most important for creativity. The motivational goal of self-direction involves independence in thought and action, self-direction can be reflected through exploration and free choice which are perceived to be crucial for creative individuals. In the case of situations when employees ranked low on openness to change they were less creative [7.19].

Other, conservative values like: conformity, security and traditions seem to have a negative effect on employees' innovativeness [7.20]. Such values predispose individuals to attempt customary behavior and establish procedures and ideas which are undoubtedly not conducive to innovativeness. Because the goal of conformity is to restrain actions,

inclinations and impulses to avoid upsetting social norms, employees who attribute high importance to this value may avoid undertaking innovative initiatives because it is not easily welcome for others within the organization [7.19].

There are two ways of enhancing the innovative attitude among people. We can use a totally centralized approach or totally decentralized approach. In the case of strong centralization R&D activity is undertaken at the corporate level, with a single top manager in charge of the organization. In the case of decentralization R&D gives the opportunity to easily identify market opportunities and threats to efficiently adapt new products and processes to requirements of the various businesses in which the organization operates. This solution also simplifies the transfer of the outcomes of R&D activities to manufacturing and marketing. In table 7.3 we tried to compare differences between enhancing innovation among people in the case of strong decentralization of R&D activities.

Table 7.3. Strong decentralization of R&D activities.

Advantages	Disadvantages
Possibility of scouting and identifying market needs, opportunities and threats.	Risk of under-investment in developing core technological competences and bounded innovation
Possibility of adapting new products and processes to specific business requirements.	Risk of losing the capability to synthesis and integrate knowledge from different sources and technical domains
Simple transfer from R to D.	Risk of delaying investments into promising technologies not yet exploited or exploitable at the business level
Simple transfer from R&D to manufacturing and marketing.	Problems in supporting radical innovation programs within certain and delayed outputs
Possibility of measuring R&D performance more simply.	Problems in building a long-term vision in technology strategy
Great emphasis on development time, costs and quality.	Difficulties in leveraging a common technology basis across different business

Source: [7.11].

8. Team Innovations

We can distinguish four interaction processes in teams that promote team innovations:
- exchanging innovation,
- learning,
- motivating,
- negotiating.

We have described those functions in table 8.1.

Table 8.1.   Interactions in team negotiations.

Interaction	Characteristic
Exchanging negotiations	Exchanging information refers to the accumulated individual inputs of information, knowledge, and experience necessary for team functioning. Exchange of information expands knowledge and experience resources available to team members, improves the analysis of the problem, and allows better assessment of the usefulness of potential solutions all of which are important in regard to innovation. In implementing innovation, information exchange leads to a more complete and accurate specification of the needs of the different parties, to interventions and solutions that suit the characteristics of the organization, and to more realistic exp ectations. Nevertheless, information exchange is not sufficient for innovation, because it does not ensure changes in subsequent behavior.
Learning	The learning function is defined as the extent to which team members overtly reflect on the team's objectives, strategies, and processes for the purpose of creating a team-level intellectual product that initiates change. Empirical evidence indicates that organizational and collective learning is a prerequisite for the development and adoption of innovation at the organizational level. Although not directly investigating innovation, research has revealed that team learning results in improvements in detecting and identifying problems, scanning the environment, and producing creative solutions, all of which might be crucial to team innovation.
Motivating	Motivation focuses on the cognitive processes whereby team members become committed to their innovative goals. The issue of motivating innovation is complex. Empirical research has indicated that external rewards can often serve to diminish creativity. Hence, in describing the motivation of those involved in an innovation process, process-oriented motivation theories offer more support than those that are mostly based on reinforcement or oriented to the content of motivation. This approach led researchers to focus more on the cognitive motivational processes that foster innovation, as suggested by Locke and Latham's goal-setting theory. In the context of innovation, research findings have emphasized the role of team participation in goal setting to establish a high level of acceptance of goals, to overcome resistance, and to generate commitment to team projects

Interaction	Characteristic
Negotiating	The negotiating function constitutes the political dimension of team interaction and is evident when team members strive to express their opinions, which allows mutual influence. Although not directly examining the negotiating process, research has shown that teams exposed to minority views prove to be more original and use a greater variety of strategies to invent novel solutions. In addition, we can say that allowing opposing opinions within teams promoted mutual influence of team members and, consequently, team effectiveness and innovation.

Source: On basis: [8.2].

The enhancing innovative solution in teams depends on the attributes of innovations – we described them in table 8.2. Those attributes have an impact on the innovativeness and dissemination of innovative solutions in teams.

Table 8.2.   Attributes of innovations.

Attribute	Characteristic
Relative advantage	Potential adopters want to know that an innovation will be worth the cost, in terms of time, effort, and money. Incentives and rewards can play a role by increasing the relative advantage or reducing the costs of implementation.
Compatibility	Closely related to relative advantage is compatibility—not only with professional activities but also with the values and beliefs that affect an instructor's behavior.
Complexity	complexity is negatively related to the rate of adoption, and once again his insights are consistent with experiences in the dissemination of innovations.
Trialability	This quality refers to the degree to which an innovation can be tried experimentally. In innovations generally, trialability seems more important among early adopters.

Source: On basis: [8.3; 8.11; 8.12].

When we organize anything, we can impose upon it sequential or spatial form. People or things are put together; they are fitted into their proper place in relation to one another [8.13; 8.19; 8.20]. The end result of this process is an organization: a complex structure of independent and subordinate elements whose relations and properties are largely determined by their function in the whole [8.14]. The main important factors in the process of enhancing team's creativity are described in table 8.3. We can distinguish following key point how to boast team creativity within an organization [8.4]:

- Order banishes chaos. Organizing reduces confusion and introduces formality into relationships. But chaos, confusion and informality are the seedbeds of creativity.
- Organizations can delegate or subcontract the work of innovation, in the form of research and development, to specialist units. They can also seek to transform themselves into innovative organizations. These options are not mutually exclusive.
- Any organization falls somewhere on the Creative/Productive continuum. It is important to establish both where you are now and where you want to be on that continuum, for it affects your whole understanding of leadership and management.
- Innovative organizations do not happen by chance. They are the end products of good leadership and management. The essence lies in getting the balance right between freedom and order, between the anatomy of the parts and the integrity of the whole.
- Innovative organizations outside your field of work may hold secrets for you. Suspend your natural impulse to discard the experience of others in different walks of life as irrelevant to your purposes. In this context you can learn from other organizations that may have a much higher requirement for creativity than your own. How do they go about organizing themselves?

Table 8.3. Factors enhancing team creativity.

Attribute	Characteristic
Order and freedom	Now serious creative thinking demands a great deal of freedom. The less constraints you are under – subjective or objective – the better. Although creative thinking is much more of a social activity than most people imagine, creative thinkers are often markedly individualistic. They can be rather solitary, more by necessity than temperamental preference. They need fairly long periods of time on their own. Nor can they always predict when they will need to be alone with their thoughts. This is why creative thinkers do not tend to make good organizational men or women.
Integrating creativity into industry	Good communication between researchers within a large group of companies is essential for many creative developments. To separate the functions of creating and developing new products or services from the functions of production, marketing and accounting – in the sense of having them take place in different organizations or sub-organizations within the group – does therefore offer to solve a lot of problems. It still leaves the possibility of the more commercial sides of the organization employing managers and work people who can suggest detailed and more incremental improvements in existing products and services, and actively encouraging them to do so.

Attribute	Characteristic
Getting the balance right	There is a general trend for research organizations to become more like businesses, while at the same time industrial organizations are beginning to take on a more creative and innovative role. There are, of course, natural limits to both these processes which wise leaders will recognize and respect. No organization today is wholly creative or completely productive. The latter cannot be the case; partly because organizations employ people, and people by their nature cannot avoid thinking, and thinking in turn leads to new ideas; and partly because an organization which solely interested itself in reproducing existing goods and services, regardless of technological or market change, would soon – as we have seen – cease to exist.
Leadership for innovation	It follows from this analysis that the direction of research or ideas-oriented institutions does call for the distinctive qualities of leadership, coupled with management knowledge and abilities, especially in the areas of management finance and marketing (remembering that you have to market your services within a large group or organization as well as to outside potential clients).

Source: On basis: [8.4].

Successful gig organizations plan for innovation and allocation of resources to enhance innovativeness should fulfill the following points [8.5; 8.15]:

- They identify outmoded and aging products and processes, and schedule them for replacement. These organizations recognize that everything in business has a life cycle, and the end of a life cycle has to be anticipated so that replacements can be planned. Even systems that are running successfully and profitably today must be examined to see if it is time to replace them with something better. It is much better to make your own products obsolete by introducing superior versions than to find that the competition has beaten you to it.

- They set targets and deadlines in each area and department for the generation of new initiatives in order to replace the items selected as outworn. The general rule is that three new initiatives should be started for each new process needed. A one in three success rate for trials of new products is a good batting average, so it is best to generate a large list of ideas and then whittle down to at least three to be prototyped. Each innovation project should have a project plan, with a deadline for customer feedback and a planned date for a go/no go decision.

- They measure progress against targets for individual projects and for the organization as a whole. They monitor key metrics, including how many new products or processes have been implemented in the last year, what proportion of revenues are coming from new products or services, how many new launches are scheduled for the coming period, and so on. They also try to assess more subjective parameters, such as who is seen as the innovative leader in the industry, and how the organization compares to its competitors in innovation in the marketplace.
- They systematically search for sources of new ideas, from trends in the technology and the industry, from unexpected successes in the marketplace, from customer feedback and from input from employees at all levels.
- They apply gating processes to projects and prototypes to check that they meet their milestones. They ensure that projects pass marketing, technology and financial hurdles in order to progress and have additional financial and development resources released to them.

When you want to have a good team of innovative people, a very important thing is a proper recruiting system. Recruiting creative people to the company is not easy [8.16; 8.21; 8.22]. You should look carefully for the particular traits and behavior of people to achieve the sufficient level of creativity and innovativeness within the organization. We can distinguish following list of main characteristics to look for during interviews of potential employees [8.4]:

- Superior general intelligence. That includes analytical powers, as well as the ability to store and recall information.
- A high degree of autonomy, self-sufficiency and self-direction.
- Relatively little talkativeness or gregariousness. Creative thinkers tend to be ambivert: a balance of introvert and extrovert. If anything, they tend towards introversion, although they need contacts with stimulating colleagues.
- Marked independence of judgment. They are resilient in the teeth of group pressures towards conformity in thinking. They see things as others do, but also as they do not.

- They often express part-truths vividly. It is their way of drawing attention to the unobserved or unrecognized. They may sound unreasonable. But remember George Bernard Shaw's provocative comment: 'The reasonable man adapts himself to the world: the unreasonable one persists in trying to adapt the world to himself. Therefore, all progress depends on the unreasonable man.'
- A broad range of interests. A special interest or motivation in the kind of 'wagering' which involves pitting oneself against problems or opportunities in which one's own effort can be the deciding factor. 'There is no greater joy in life,' said the inventor Sir Barnes Wallis, 'than first proving that a thing is impossible and then showing how it can be done.'
- Sustained curiosity and powers of observation. Often they are good listeners.
- Dedication and commitment to hard work.
- A truly creative individual lives closer to his or her purposeful unconscious mind than other people. He or she listens to the truth from within, in the form of intuitions. They inhabit more the world of imagination, reverie and fantasy.
- They are able to hold many ideas – often apparently contradictory ones – together in creative tension, without reaching for premature resolution of ambiguity. Hence they can sometimes reach a richer synthesis.

In the process of creating innovation it is important to engineer the complex system of measuring the team performance towards innovations [8.6; 8.16]. This team performance is a complex phenomenon that involves person, behavior and environment parameters interacting with and influencing each other over time [8.7]. Besides mentioned points it is important to use following points to increase the level of team innovativeness within your organization [8.5]:

- Hold meetings that are focused on opportunities rather than problems. Communicate the benefits to the whole organization of investing in innovation.
- Set targets for innovation in products, services and processes.
- Identify existing products and processes that are scheduled for retirement.

- Target three new initiatives for every innovation needed.
- Set up cross-functional teams with clear innovation objectives, and motivate them to be radical and take risks.
- Put prototype implementation into a separate department or function (the 'innovation incubator') staffed by go-getters who have a good diversity of skills.
- Set goals and deadlines.
- Implement a gating procedure to evaluate ideas and prototypes using a system such as Stage-Gate (a trademark of R G Cooper and associates).
- Measure innovation performance for people, products and processes against targets. Put someone with clout and prestige in charge of innovation efforts.
- Encourage people to move laterally within the organization from department to department to cross-fertilize ideas and cultures.
- Put your best people on innovation projects, and ensure that such projects are seen as good for career development.

The conceptions of enhancing team innovativeness are very useful because of the increasing complexity of the scientific and technical innovations required to address social, economic, health, energy, defense, and other national problems [8.9]. In the case of strategic approach to team management boasting innovativeness, senior executives must remember that [8.8, 8.17]:
- Every authorized program and project clearly supports an approved strategic objective of the organization.
- All significant innovations are achieved through application of the principles of project, program, and portfolio management.
- Each project's risks are identified, evaluated, and managed using currently available methods and systems.
- All projects are evaluated, prioritized, and approved on the basis of the same corporate criteria.

The team management to create an innovative environment should go towards open innovations [8.18]. Open innovation is commonly seen in contrast to closed innovation (we compared them in the table 8.4).

Closed innovation refers to an innovation model where a company develops, evaluates, tests and commercializes only internal innovations using only internal resources and employees [8.10].

Table 8.4. Close innovation versus open innovation.

Close innovation	Open innovation
The smart people in our field work for us.	Not all the smart people work for us. We need to work with smart people inside and outside our company.
To profit from R&D, we must discover it, develop it, and ship it ourselves.	External R&D can create significant value; internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to market first.	We don't have to originate the research to profit from it.
The company that gets an innovation to market first will win.	The company that gets an innovation to market first will win.
If we create the most and the best ideas in the industry, we will win.	If we make the best use of internal and external ideas, we will win.
We should control our intellectual property, so that our competitors don't profit from our ideas.	We should profit from others' use of our intellectual property, and we should buy others' intellectual property whenever it advances our own business model.

Source: [8.10].

9. Traits of highly innovative peoples

Creative and innovative persons are often referred to as indication of creative potential in general. Proper innovation management needs highly innovative people. Organization which wants to be innovative should find those people and manage them properly. The very important problem is also to identify what traits very innovative people have. According to some research, personality, intelligence, knowledge, thinking style, motivation and environment are examples of important factors associated with creativity [9.15]. Many researchers have found relations between innovation potential and intelligence. We can divide this concept into five categories described in table 9.1.

Table 9.1. The role of cognition in innovativeness.

Attribute	Characteristic
General intelligence	Early research claimed that creativity was equivalent to high intelligence. The best known researcher in this field is Guilford. In his theory of the Structure of Intellect (SI) published in the 1950s, he claimed that creative thinking was a mental ability, involving divergent production as 'thinking that goes off in different directions'. Other investigations have tested the possibility of a curvilinear relationship between intelligence and innovation where intelligence would potentially become less influential as the level of intelligence increases beyond a certain point.
Genius	Some researchers have suggested that genius, as the most obvious manifestation of high intelligence, is closely tied to the propensity for innovation. However, there has been a substantial lack of evidence to support a direct relationship between innovation and intelligence. Many, including Eysenck himself, have concluded that intelligence is a necessary, but not a sufficient, condition for innovation. Recent studies conclude that intelligence and innovation potential are moderately related, but once IQ scores go over 115 the relationship is near zero. This finding has been described as 'threshold theory'.
Cognitive abilities	Ward and Smith suggested that in order to understand the role of cognitive abilities in idea generation, we must draw upon current models in cognitive psychology, and use experimentally based observations of the processes that underlie generative tasks. The model proposes that many creative activities can be described in terms of an initial generation of ideas or solutions followed by an extensive exploration of those ideas. Initial ideas are referred to as 'pre-inventive', in the sense that they are incomplete solutions, but offer promise in terms of originality and utility. The model assumes that one would alternate between generative and exploratory phases, refining the structures according to the demands or constraints of the specific task. This 'creative cognition' approach emphasizes that generative capacity is a property of normative human cognition.

Attribute	Characteristic
Observer judgments of intelligence	Innovative individuals are often perceived and rated by others as more intelligent than less innovative individuals. For example, in MacKinnon's studies of architects in the 1960's, supervisors rated innovative architects as more 'intelligent' than less innovative individuals. MacKinnon described the innovative architects to have high 'effective intelligence', and argued that traditional measures of intelligence (e.g. IQ) do not fully explain this 'real-world' intelligence.

Source: On basis: [9.1; 9.2; 9.3; 9.4; 9.16; 9.17].

The next very important set of factors connected with innovativeness is knowledge. Almost all researchers conducted analysis about innovativeness have assumed that knowledge is a very important variable in both innovativeness and creativity. Immersion in domain specific knowledge is very important to boast innovativeness. Domain-relevant knowledge reflects how much an individual knows about a given area. An individual who wants to make an innovative contribution must not only work within a system, but must also reproduce that system in his or her mind. Personal mastery and an accurate sense of domain are necessary factors for innovations [9.1].

Next important factor boasting innovativeness is motivation. High levels of motivation are required for innovation and innovative people are viewed as displaying devotion and very bug absorption in their work [9.5]. While intrinsic motivation is Clearly a prerequisite for innovation, the very role of extrinsic motivation is less clear. The evidence suggests that constructive evaluation in an organization can enhance innovation. Some researchers suggest that intrinsic and extrinsic motivation might serve different functions; whilst intrinsic motivation might be linked to work on a task, extrinsic motivation might affect choice of task, field or implementation strategy [9.6]. Sagerman and Cohen have found that intrinsic and extrinsic motivation affected both individual effort and the overall quality of the innovative endeavors. They have found that extrinsic rewards, such as pay, were not as important as certain aspects of intrinsic motivation such as the desire for individual change in the process of enhancing motivation [9.7].

Many researchers have found relations between innovation and personality and from those analyses a consistent set of characteristics has emerged. The Five Factor personality model (openness to experience, agreeableness, conscientiousness, extroversion, neuroticism) was used to analyze relations between innovativeness and personality. Those relations are described in table 9.2.

Table 9.2. The role of personality in innovativeness.

Attribute	Characteristic
Openness To Experience	There is good empirical evidence of a positive association between various characteristics associated with innovation and those used to depict openness (e.g. imaginative, original, flexible, unconventional). Research suggests that openness enhances an individual's intrinsic motivation towards novelty and therefore works in a multiplicative way to produce innovation. Although there are some inconsistencies in the findings – with recent findings suggesting that the relationship may be moderated by contextual factors – openness is perhaps the most important personality dimensions to predict the propensity for innovation.
Agreeableness	Several studies have demonstrated a negative association between agreeableness and Innovation. In other words, being more disagreeable is linked to innovation. Empirical studies have confirmed the negative association between innovation and agreeableness by showing that innovators have high social rule independence. These findings are consistent with Eysenck's emphasis on the potentially negative dispositional characteristics of innovators, where innovators are often outspoken, uninhibited, quarrelsome, and sometimes asocial. Related to these findings are results showing that agreeableness is negatively associated with creative achievement but not with creative thinking. Thus, agreeableness is likely to be important in the implementation process of innovation but not for idea generation. This affords intuitive sense in that the implementation of new ideas is likely to be a group effort which involves social processes and activities. Such findings have important repercussions for the selection and management of employees.
Conscientiousness	The vast majority of research has demonstrated that lack of conscientiousness is associated with innovation. Defined by terms such as fastidious, ordered, neat and methodical, the evidence shows that individuals high on conscientiousness are more resistant to changes at work, and are more likely to comply with current organizational norms. A recent study reported that the negative association between conscientiousness and creativity is likely to be moderated by contextual factors, such as lack of autonomy and support.

Attribute	Characteristic
Extroversion	With regard to the relationship between Extroversion and innovation, findings are not clear cut. Introversion is positively associated with innovation. Similarly, many have argued that isolation and withdrawal are necessary conditions for generating new ideas. However, there is little evidence from organizational contexts and more recent research indicates that extroversion is a positive predictor of innovation. In meta-analytic studies of occupational work performance in general, extroversion has been shown to be a positive predictor for many occupations. This is particularly the case in large organizations where interpersonal factors are likely to be important for effective job performance (e.g. sales, managers and other professional occupations). The association between extraversion and innovation seems to be context dependent. Introversion is likely to be related to real-life artistic endeavor whereas extraversion seems to predict performance measures of creativity and innovation
Neuroticism	King and colleagues found no association between neuroticism and creative thinking or innovation. Conversely, other research literature suggests a positive relationship between neuroticism and innovation. One explanation for these inconsistencies is likely to be that the association between neuroticism and innovation is domain-dependent. A more thorough investigation in this area is necessary, particularly in organizational settings with a broader range of occupations. Some suggest a curvilinear association between emotional stability and performance, (where too much or too little anxiety is detrimental to innovation) and moderate levels of anxiety, for example, can enhance innovative potential.

Source: On basis: [9.1; 9.5, 9.8, 9.9, 9.10, 9.10, 9.11; 9.18; 9.19].

We can distinguish many important factors we should expect from creative people. The most important of them we have described in table 9.3. There are extensive characteristics of those traits encouraging creativity.

Table 9.3. Traits encouraging creativity.

Trait	Characteristic
Recognition and appreciation	Because the results of creative work are often postponed for a long time (many geniuses in history received no recognition in their lifetimes), creative people stand in special need of encouragement and appreciation. The recognition of the value or worth of their contribution is especially important to them, particularly if it comes from those whose opinions they respect.
Freedom to work in areas of greatest interest	While the predominantly analytical person concentrates and focuses down, the creative person wanders in every possible or feasible direction. Freedom to move is the necessary condition of creative work. A creative person tends to be most effective if allowed to choose the area of work, and the problems or opportunities within that area, which arouses deep interest. Clearly within an innovative organization this freedom has to be bounded by its definition of general purpose and by the consequent parameters of its broad strategies.

Trait	Characteristic
Contacts with stimulating colleagues	Creative people need conversation with colleagues in order to think, not merely for social intercourse. In the social sense they may be inclined to be 'loners', but they cannot intellectually be 'loners' all the time. Organizational structure should facilitate these formal and informal interactions. Buildings, especially the position and character of rooms where people congregate for coffee, tea or meals, play an important part. Random meetings with colleagues and visitors in such meeting places may spark off new ideas or suggest new avenues of thought.
Encouragement to take risks	Innovation is a gamble. If you have never worked on the edge of failure, you will not have worked on the edge of real success. Creative people respond well to an organization which encourages them to take calculated risks.
A willingness to accept risk	The potential downside of freedom given to a colleague or team, as we have seen, includes mistakes, failures or financial loss. As delegation should not mean abdication, you as the leader may well have been a party to the risk. You may at least have understood the consequences of things not going as intended or planned. You have to be willing to accept an element of risk, for without freedom there would be no mistakes. But to eliminate freedom is the biggest mistake of all: freedom alone breeds innovation and entrepreneurial success. Mistakes are a by-product of progress.
An ability to work with half-baked ideas	Ideas seldom leap into the world fully-formed and ready to go. They are more like new-born babies, struggling and gasping for life. They hesitate before dismissing an ill-formed idea or an imperfect proposal, for it may contain the germ of something really useful. It follows that team creativity in groups and organizations calls for listening leaders.
A willingness to bend rules	Rules and systems have their place, but they can obstruct the process of innovation dreadfully. A leader, as a member of the management team, should respect rules and procedures but he or she should not think like a bureaucrat. Sometimes creative dyslexia – the inability to read rules – is a strength rather than a weakness. Rules can sometimes be stretched where they cannot be broken. Without this you end up being bogged down in organizational treacle.
An ability to respond quickly	The innovative organization must have leaders who are able to commit resources and not have to defer everything to committees or upwards to Higher Authority. To be able to allocate or obtain small resources now may be far better than being able to summon mighty resources in a year's time when it is too late.
Personal enthusiasm	Only leaders who are highly motivated themselves will motivate others. Enthusiasm is contagious. Moreover, enthusiastic leaders and colleagues tend to be intellectually stimulating ones.

Source: On basis: [9.12].

Another conception of highly creative people's traits gives us more information of their potential characteristics. We put those traits into the table 9.4 with brew characteristics of them. We should remember that creative characteristics can vary according to tasks within the domain

[9.14]. But there can be distinguished typical creative traits that can be useful in the case of almost every type of creative activities.

Table 9.4. Traits of highly creative people.

Trait	Characteristic
Sensitive	Being sensitive helps creativeness in many ways: a. it helps with awareness of problems, known & unknown b. it helps people sense things easier c. it helps to cause people to care and commit themselves to challenges or causes
Not motivated by money	As important as money is in most societies or economies it is not a driving force for a creative person. Generally, they have an intuitive sense of the amount of money they basically need and once that need is fulfilled then money stops affecting or driving them.
Sense of destiny	Intuitively creative people know that they have a purpose, a destiny or they realize that they can choose or create one to drive them to reach greater heights of skill, ability, or talent.
Adaptable	Without the ability to adapt people could not become creative. But rather than adapt to something they choose to adapt things to suit them, their needs or the goals they are striving towards
Tolerant of ambiguity	Two or more things or ideas being right at the same time challenges the thinking of a creative person. They love to be ambiguous to challenge other people and ideas. Ambiguity helps them see things from many different perspectives all at the same time.
Observant	Creative people constantly are using their senses: consciously, sub-consciously and unconsciously, even non-consciously.
Perceive world differently	Thoreau talked about people drumming to a different drum beat. Creative people thrive on multiple ways of perceiving: seeing, hearing, touching, smelling, tasting, sensing things. These different perspectives open up their minds to unlimited possibilities.
See possibilities	Average people, people who don't believe they are creative, people who are fearful or resistant to creativeness or creative thinking prefer to work within limits with limited possibilities. Creative people love to see many, even infinite possibilities in most situations or challenges
Question asker	Creative people, especially highly creative people, probably came out of their mothers' wombs asking questions. It's in their nature to question. Question yes, not actually criticize. Their questioning nature often mistakenly appears as criticism when it is simply questioning, exploring, examining, playing with things as they are or might be.
Can synthesize correctly often intuitively	This is the ability to see the whole picture, see patterns, grasp solutions with only a few pieces, even with major pieces missing. Creative people trust their intuition, even if it isn't right 100% of the time.

Trait	Characteristic
Able to fantasize	Highly creative people love to wander through their own imaginary worlds.
Flexible	Creative People are very flexible when they are playing with ideas. They love to look at things from multiple points of view and to produce piles of answers, maybe, almost, when other people are content with the or an answer or solution.
Fluent	It could be a door stop, a boat anchor, a weapon, a prop, a weight for holding down papers, etc., etc., etc. This is what a creative person would say about the possible uses of a brick.
Imaginative	Creative people love to use their imagination to play to make it seem real to experiment.
Intuitive	The more creative a person is, the more they tap their intuition skills; the ability to see answers with minimum facts, to sense problems even when they aren't happening.
Original	Being original is a driving force for creative people. They thrive on it.
Ingenious	Doing the unusual. Solving unsolvable problems. Thinking what has never been thought of before. These are all traits of a creative person that make them be ingenious at times.
Energetic	Challenges, problems, and new ideas once committed by a creative person truly excite them and provide them with seemingly unlimited amounts of energy; such as Sherlock Holmes once he grasps a sense of the mystery.
Sense of humor	Laughter and creativity truly go together. Many experts believe that creativity can occur without a touch of humor believing that seriousness tends to squelch creativeness or creative thinking
Self-actualizing	The psychologist Abraham Maslow created this term in the 1960s representing the ultimate motivator of people: the need or desire to be all you can be, to be what you were meant to be.
Self-disciplined	This is one trait that appears to be ambiguous in highly creative people. They can appear disorganized, chaotic at times while at the same time they are highly self-disciplined. At the same time, they greatly resist the discipline of other people who do not have a creative mind.
Self-knowledgeable	One of the few things highly creative people had in common is that they all kept some form of journal and were constantly striving to better understand themselves.
Specific interests	This is still another ambiguous trait of creative people. They appear on the surface to be interested in everything, while at the same time they have very specific interests that they commit their true energies and efforts to. By being willing to be exposed to seemingly unlimited interests they discover more about their particular specific interests
Divergent thinker	Creative people love to diverge from the norm, to look at things from multiple positions, to challenge anything that exists. Because of this they are seen at times to be off-key, deviant, atypical, irregular, or uncharacteristic.
Curious	Creative people are continuously curious, often child-like.

Trait	Characteristic
Open-ended	In order to explore many possibilities creative people, tend to stay open-ended about answers or solutions until many have been produced.
Independent	Creative people crave and require a high degree of independence, resist dependence but often can thrive on beneficial inter-dependence.
Severely critical	Creative people challenge most every-thing, every idea, every rule. They challenge, challenge, and challenge some more to the point that most other people see their challenging as severe criticism
Non-conforming	Conforming is the antithesis, the opposite of creativeness and in order to be creative, creative people must be non-conforming and go against the norm, swim upstream.
Confident	This is another ambiguous trait in creative people. When they are at their most creative they are extremely confident. When they are in a stage of frustration when nothing seems to be working they often lack confidence. After much positive experience they begin to trust themselves and know that they will become depressed, frustrated, nearly devastated but their internal subconscious confidence keeps them moving or at least floating until they experience or discover an aha! (a breakthrough idea or piece of information).
Risk taker	This trait is a general misunderstanding of many non-creative people or people who fear the creativeness of creative people. Highly creative people are not really risk-takers because they do not see what they are doing as a risk. They simply see it as a possible solution or path towards a solution. They have other possible solutions, often many others in their head or their notes to use if a particular idea or solution does work.
Persistent	Creative people do not give up on things that mean a lot to them.

Source: On basis: [9.13].

10 Creativity in the Organization

Increasing the creativity of employees in thinking and acting can led to innovation of the co mpany. It also creates conditions for success in the competitive market [10.21, 10.22, 10.42].

The generation of innovation by small and medium enterprises (SMEs) can be supported by raising creativity in the organization through inventive methods [10.29]. Creative thinking uses existing information and knowledge expanded with new visions and solutions [10.54]. The purpose of inventive methods is to solve the problem by stimulating the creativity that is necessary in search of new processes, products [10.31]. In this way, you can discover previously unknown solutions, reduce the financial cost at the development stage of an innovative idea, identify the technical conditions for its implementation and shorten the implementation time of innovation [10.41, 10.11]. Consequently, the company has a chance to become innovative and more competitive [10.5].

10.1. Concept of Creativity

Creativity is the ability of man to make creative use of brainpower when creating new original ideas in the form of concepts or products· [10.40]. It is the skill of creative thinking, combining different ideas in an original way, adopting new assumptions, seeing things in a new perspective, brainstorming ideas and/or doing something new or the same in an unusual way as well as associating different ideas and views [10.2, 10.36]. Creativity is a way out of what is known, widespread and obvious [10.43]. Creativity is the process of implementing novel ideas to meet needs or solve problems [10.9, 10.10].

The concept of creativity is used with the idea of creation. As a creative individual, you can define what is a personal contribution complementing

the data received from the outside [10.18, 10.22, 10.25]. The essence of creativity is to discover a phenomenon that has already existed but was universally hidden or unknown. It relies on the search for original novel attributes. Creativity is the process of constructing and calling for existence [10.26]. This procedure is intended to produce innovative work, which is generally considered to be useful, satisfactory [10.7, 10.51].

This chapter assumes that creativity is the ability to search, research and create new ways of solving problems.

10.2. Creative Unit

The concept of creativity refers to both the whole organization and individual employees.

Creative human beings show evidence of or display the following characteristics [10.13, 10.23]:
- sensitive to problems, disputes the existing way of doing things as well as existing ideas and process, examines new possibilities,
- think flexibly, consider many possibilities, have extensive knowledge and experience,
- originality,
- friendly
- motivated to action,
- know-how/experience,
- can judge facts, recognize good ideas, look critically at the shortcomings.

Trompenaars has listed the following attributes characterizing a creative person [10.47]:
- linkage
  (Finding links between things that seem unrelated),
- perspective
  (Changing the way of looking at situations in terms of time, space, people),
- curiosity
  (Desire to improve the things others accept as a norm),

- Courage
  (self-confidence, going beyond the adopted framework),
- complexity

(Assimilation of large amounts of data and creation of links between information),
- persistence
- motivation,
- separation
  (Ability to search, filter concepts from ideas).

Creative people are interested in exploring difficult complicated phenomena. They seek a fuller understanding of them and finding a solution.

Creative people are characterized by high motivation, determination in pursuit of the goal and determination to solve problems encountered during the work [10.16]. Creative people are characterized by the desire for autonomy which may lead to incompatibility. They are faithful to their opinions and their views. For creative people, situations that most people may feel uncomfortable are often positively perceived. They feel satisfaction when they are forced to improvise [10.28]. A creative person, to feel comfortable, must have the freedom and comfort level to pursue their ideas. It is essential that the workplace allows the creative person to decide freely, so that the creative person does not have to be overly controlled by their supervisor [10.35]. An equally important feature is their belief in their own strength [10.24]. The hallmark of creative people is the willingness to take risks. They adopt changes to improve the results of their work [10.8]. People endowed with great creativity have extraordinary mental energy. They can do their job outside the mandatory hours dimension. They are characterized by concentration, quality of freshness and enthusiasm [10.48, 10.49].

Necka has listed the fundamental qualities and abilities of a creative person, which include the following [10.38]:
- flexibility
- (ability to generate a set of diverse ideas),
- liquidity
- (ability to generate many ideas about the same subject),

- originality
- innovation, unconventional, uniqueness or novelty,
- elaboration of details
- (ability to correct, broaden the problem and the ability to link different viewpoints and opportunities).

The analysis of the characteristics of creative people reveals that they are distinguished by a specific system of individual characteristics. They can be described as smart people who stand out because of independent thinking and a high level of intuitiveness and openness while striving for a predetermined goal persistently.

10.3. Creative Organization

The creative environment is understood as the environment and conditions at any dimensions that affect individuals struggling with creative work while seeking to gain new knowledge or creating innovations [10.14, 10.27, 10.34]. The creative environment has two dimensions.

- Individual
  (Work by a single employee)
- Collective
  (Work by a number of people)

Fig. 10.1. shows these dimensions in greater detail.

Individual dimension	**Collective dimension**
Openness to changes	Diversity of competences
Need for increasing qualifications	Recognition of common principles
Thinking and acting flexibility	Equal status of partners
Intellectual and cognitive abilities	Reduced hierarchy
Emotional values	Free information flow
Learning creativity	Team responsibility
Persistent pursuit of the goal	Team self-control
Independence form opinion of others	Orientation for surroundings
Sense of freedom in thinking and acting	accepting transitional forms of tasks
Courage in undertaking projects	Motivating atmosphere
Holistic thinking skills	Common good creation

Fig. 10.1. Creative Organization Components
Source: own development.

The concept of organizational innovativeness should be based on the following assumptions [10.15, 10.30, 10.32, 10.35].

- The creative organization is based on multifunctional creative teams called for specific tasks or processes.
- The creative team is a group of employees, creating an expressive whole under common leadership. It is characterized by a great knowledge, a novel way of thinking and the search for unconventional solutions.
- The team is responsible for the task entrusted to them.
- Teams are treated as flexible work organizations.
- The configuration of the team depends on the chosen members, the potential of intelligence and experience, creative consciousness as well as the team leader.
- The level of autonomy of the team depends on the maturity and efficiency of the team members.

The concept of a creative organization is presented in Fig. 10.2.

Structures
- Teams are built according to changing needs, which are characterized by: partnership, self consciousness, professionalism, assertiveness
- Dominating role of information connections in shaping cross-team relations and their availability in the whole organizational system
- Candor and fluency of the structures
- Teams – platforms as target structural links, internally diversified and interdisciplinary

Output assumptions
- Idea of an organization based on a metaphor of a united mind, combining intelligence processes with creative consciousness into an integrated model of a creative imagination process
- Convention of an organization based on knowledge
- Flat structure based on teams
- System and team-process thinking
- Process, changes and surroundings orientation

Creative organization

Management
- Creative management style
- Atmosphere of open communication and cooperation, stimulating emotionally - spiritual bonds, setting higher level values in creative organization management
- Avoiding formalized rules in management towards unconventional methods, with emphasis on the emotionally-spiritual and awareness methods

Attributes
- Innovation of thinking, acting, implementing latest technical and organizational solutions
- Flexibility, ability to adapt and evolve
- -stimulation of employees, teams, and whole organization for creative behaviors
- Creativity capital of the organization should be located in processes, teams and on particular levels of management, being the basis of innovation -implementation processes
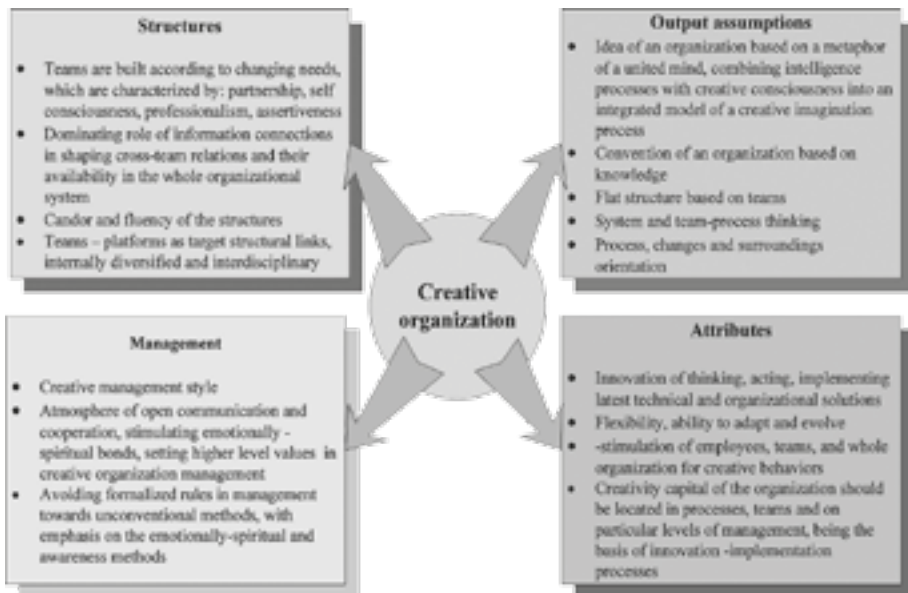
Fig. 10.2. Creative organization.
Source: Own development.

The proposed model for creative organizations consists of many elements that interact with each other. Together these elements contribute to the development of a creative organization (Fig. 10.3).

Fig. 10.3. Creative organization model.
Source: Own development.

The creative organization model has four distinguishing attributes [10.12].

- Teams
- Knowledge
- Creative management
- Empowerment

Empowerment means allowing employees to independently think about the use of knowledge, experience and motivation to accomplish the company's tasks. Empowerment is the creation of an organizational climate in which employees are looking for solutions. Empowered creative individuals are curious. They take the initiative. The culture of empowerment builds on the following characteristics [10.20, 10.39].

- Vision
- Cooperation
- Self-monitoring

- Team responsibility
- Functional structure
- Projects
- Team leadership
- Own judgement of the situation
- Freedom of movement of information and knowledge between employees and functional divisions

The introduction of enterprise empowerment (employee empowerment, involvement in decision-making) requires education of the potential leaders who will be able to take the initiative. As part of this idea, employees are treated as valuable assets that increase their value, experience and knowledge. The dimensions of empowerment are presented in Fig. 10.4.
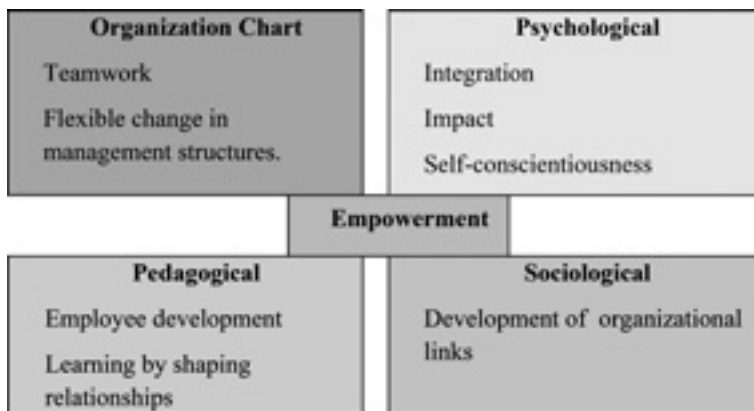
Fig. 10.4. Empowerment dimensions [10. 36].

It is important to emphasize the dynamic nature of empowerment which is a continuous process in the organization. The essence of empowerment is to enable workers to act in a creative way and to express their own initiative by giving them the opportunity to make decisions while maintaining responsibility for their implementation. Worker empowerment is the extraction of enthusiasm and engagement by giving employees them autonomy, self-expression and responsibility as well as being able to control their actions [10.53].

Creative teams are a key part of the company's strategy. The team is a group of employees creating a distinct whole under common leadership. It is characterized by great knowledge, a novel way of thinking and the search for unconventional solutions. The team is responsible for the task entrusted to him. Teams should be treated as a flexible work division. The configuration of the team depends on its personal composition, the potential of intelligence, its creative consciousness and the team leader. The level of team autonomy depends on the maturity, experience and efficiency of the team members. The source of success is the knowledge of the collection and synergy of the different characteristics of team members.

Teams work better, faster, smarter and adapt to external conditions quickly than a hierarchical structure. People in well-chosen teams (compared to individual employees) make more relevant decisions and solve more complex problems.

Teamwork stimulates creativity, discussions, interactive behaviors, and creative enrichment of the ideas of all employees. Teams (as opposed to one individual) are characterized by versatility and flexibility in the search for creative solutions.

To build an effective team, it is necessary to implement the various stages of the team development processes as follows:
- team evaluation according to the performance model,
- creation of a team card
  (defining specific goals, principles of cooperation and communication)
- diagnosis of team development level,
- matching leadership style to team development level, and
- strategies for increasing team efficiency.

The idea of a creative organization relates closely to the theory of **creative management.** This type of management supervises the following [10.4, 10.50]:
- activities of creative teams,
- formulation of strategic objectives,

- setting criteria for assessing ideas,
- providing the necessary resources, and
- controlling the course of tasks.

The basic activities of creative management should be clarified according to specific tasks [10.53].

- creating a system of gathering postulates and ideas for new solutions,
- ensuring an objective assessment of the postulates and ideas in the light of the criteria adopted,
- assessing the desirability of taking tasks, and
- assessment of financial and executive responsibilities (to mention a few).

Another task of the creative managerial staff is to enable individual creativity to be transferred to different team levels within the entire organization. This process enables explicit and implicit knowledge flow.

To allow for efficient implementation of tasks requiring creativity, management should take the following action.

- Remove obstacles that hinder the fulfilment of tasks.
- Prevent obstacles to the achievement of tasks.
- Reduce the negative consequences of obstacles and difficulties.
- Change the organizational structure and plans to avoid obstacles.

The team needs to have some autonomy. It also needs management support, an adequate system of motivation, resource preservation, decision making, and support for legitimate risks.

Knowledge needs to be based on education and experience if it is going to develop sensible results and make sensible decisions. Every decisionmaker needs to bring out the information that will be useful in the management process. The available information available is an element which influences the quality of the decisions. Two categories of knowledge closely related to the human influence on reality are important. The first is an experience-based on practical knowledge that

provides information on how to change reality. The second is theoretical knowledge, providing data relevant to reality. There are standards for the conversion of scientific assertions into practical knowledge. Firstly, there are no strict algorithmic solutions for most difficult and interesting problems. Many important tasks arise in the complex context of social or physical phenomena not subject to exact and strict descriptions, for example:

- planning tasks,
- law practice,
- medical diagnosis,
- military decision analysis, or
- economic decisions.

Secondly, the importance of knowledge determines pragmatic considerations, such as specialists achieving excellent results through their knowledge. Computer programs can contribute and apply to this knowledge. Thirdly, knowledge has self-worth. Individual knowledge is a finite. Its refinement and reproduction contribute to the success of the company, according to Drucekra [10.20]. No problem in any form can be solved directly and immediately by a decision. Elements that seem at first glance to be the essence of the problem are at best its symptoms. The first step in the decision process is to establish and define a real problem. This task takes time. The decision-maker needs to identify the problem correctly and not try to solve it based on symptoms. Many problems can have the same symptoms.

Next, you need to determine how to solve the problem, that is to formulate the solutions, goals and rules. This way the decisionmaker can limit the search for a solution.

The analysis of the problem has two phases.
- Qualifying the decision-making problem
- Gathering information.

The qualification of the problem is necessary for the following reasons.
- Determine who should participate in the preparation of the problem who should participate in its preparation.
- Comment before the decision about who should be informed about the problem,
- Delegate responsibility/responsibilities to each team member.

The recommendation for the gathering of information is a first-place directive in most of the work devoted to decision-making. However, it is only the qualification of the problem that determines which information will be needed. The decisionmaker is never able to gather all the information. This information is either unavailable or the gathering of it would cost too much time and/or money. Knowledge of all information is not necessary, but knowledge of what information is lacking is necessary. This knowledge allows the decision-makers to determine the degree of risk involved and to adopt the appropriate degree of generality, simplification and flexibility.

Based on the information gathered, possible solutions are developed. The rule of decision-making should be to strive to develop a significant number of different possible solutions for each problem. Producing a variety of possible solutions is essentially the only way to mobilize and use your imagination.

Possible solutions are followed by the choice of the best solution, which should be done according to the criteria and can include (but not limited to) the following:
- risk,
- effort,
- economics,
- time, and
- resource constraints.

Knowledge influences how decisions are made because is a prerequisite for their relevance. Knowledge is a critical factor in the development of the company.

10.4. Barriers Limiting Creativity

Barriers to creativity in the organization can include the following [10.19, 10.37]:
- emphasis on managerial control
- (Autonomy and a margin of freedom are essential components of creative thinking.),
- analytical ineffectiveness
- (Ideas often tend to undergo too long analysis, which results in a loss of time and a loss of competitive advantage.),
- rigid hierarchical structures
- (Variable market environments require flexible organizational structures.),
- belief that only some people are creative,
- functioning of companies with current problems and tasks push creative thinking toward a future plan,
- inadequate incentive scheme
- motivational system that promotes perfection and hinders creativity,
- punitive-oriented incentive for errors (errors are almost necessary in the innovative process.,
- incentive system for perfectionism

(Rewarding perfectionism affects labor productivity),
- incentive system to reward organizational conformism,
- lack of systematic approach to innovation
  (no ideas for new solutions),
- fear of risk-taking,
- rivalry
  (focusing on position behavior, competing with colleagues),
- inadequacy, and
- lack of faith.

There is also a group of barriers inhibiting individual creativity. Some factors that should be replaced are the group of barriers [10.1, 10.6,10,45].

- negative setting
- focus on unwanted side problems instead of actively finding a solution,
- fear of failure
- ridicule in front of colleagues,
- lack of time to think
- lack of experience that can be exploited
- high stress and workload can hamper objective reasoning and inhibit natural thought processes,
- rigid treatment of rules and rules,
- lack of creative freedom
- excessive rules that can lead to mental laziness,
- adopting erroneous assumptions,
- emphasis on logic and not considering intuition
- (limit oneself to logic inhibits imagination),
- self-doubt (belief in your own lack of creativity).

Arnold and Adams distinguished the main groups of barriers that block individual creativity as follows [10.17]:

- perceptive barriers,
  (These barriers interfere with the reception of true, adequate images of the external world.)
- cultural barriers
  (These barriers stem from the pressures exerted by society),
- emotional barriers,
  (These barriers include fear, jealousy, euphoria),
- intellectual barriers, and
- communication barriers.

There are methods to overcome those barriers. The most popular methods are as follows [10.3, 10.44, 10.46]:

- encouraging workers to take moderate risks,
- ensure the freedom of thinking,
- sound management approach to innovative ideas and its involvement in the actions implemented,
- attractive system for motivating and rewarding specific achievements,

- constant flow of ideas,
- positive emotions.

Creativity is extremely important in designing innovation. Familiarity with the characteristics of creative people and the idea of creative organization are important in building a creative and innovative business. Identifying and eliminating barriers to creativity in the organization contributes to the growth of creativity among employees and reinforces the process of designing innovative solutions.

11. Characteristics of Innovative People

The definition of innovative people can be derived from the concept of innovation. In this case, it can be said that innovative people are individuals who "transform existing possibilities into new ideas." However, such a definition is too narrow. In a broader aspect, innovative people are individuals who skillfully create new ideas and a new reality while introducing something new to everyday life, enterprises, institutions and society. They also create ideas that are not yet rooted in reality, previous experiences, phenomena, things. These ideas are completely new. It can be said that they create reality from what appears to be science fiction. Innovative people look to the future. Their ideas transcend the present. Their ideas are unusual, sometimes crazy, but they bring something completely innovative, pioneering, revealing and original to everyday life. So what qualities do innovative people have? Is innovation an innate trait or an acquired trait?

The basic characteristic of innovative people is creativity. Creativity (or creative attitude) is defined as the mental process that leads to the creation of new ideas. Creativity is defined as an ability, as well as a character trait. Creative abilities combined with intelligence are considered as predictors of professional, scientific and personal success. It can be considered that abilities are an innate trait, but the environment in which we are brought up and educated has a fundamental impact on the development of abilities [11.17.]. These considerations refer us to the concept of talent. The *Polskie Wydawnictwo Naukowe* (PWN) dictionary defines talent as an outstanding talent for something. A person with talent is a person endowed with outstanding creative abilities. Therefore, before the innovation process takes place, we must have creative people, endowed with talents, intrinsically motivated to think creatively. Creative people are openminded individuals who skillfully use their talents. (External motivation also supports the process of innovativeness.)

Research has confirmed that creativity and innovation are extremely important for the performance of an organization [11.1.]. Modern society, however, largely uses ready-made patterns. Often, cognitive technologies and artificial intelligence suggest ready-made solutions. These types of solutions can hinder innate human creativity which may remain dormant and never develop. A new type of society called Society 4.0 is being formed by artifical intelligence (AI), information technology (IT) and cognitive technologies (CT) as well as the knowledge-based society. Currently, we are already observing the symptoms of social polarization associated with the division into creators and users of the information technology (IT) industry, cognitive technology (CT) and artificial intelligence (AI). As a result, we have many fewer creators than users. Modern technologies dominate almost all sectors of the economy and social life. However, apart from creators and users, in modern society we also have the so-called "technological margin" associated with technological exclusion, which often leads to social exclusion and forces people into the "social margin". A kind of technological illiteracy means that people from the "technological margin" will be neither creators nor users. Therefore, it will be difficult for them to function in Society 4.0. The users who, as a result of thoughtless use of products and services offered by innovative IT, CT and AI technologies, may lose the ability to think independently and the ability to reflectively approach reality and natural creativity. The intellectual laziness that will characterize the users can lead to biological and psychological changes and regression of human nature and the distinguishing features of the human species, such as: consciousness, free will, morality, creativity, abstract thinking, symbolic thinking, the ability to cooperate. A further consequence of the progressive blurring of the differences between man and machine – a robot equipped with artificial intelligence combined with human intellectual laziness may be the dependence of natural intelligence on artificial intelligence, which might result in learned helplessness [11.9.; 11.11.; 11.7.]. The result is a diminished intellect of the human species and a regression in social development. In the long run, there may be a complete infantilization of the human species and regression rather than social development. On the other hand, there may be an increase in manipulation of

information and data. Society will not even notice this phenomenon. To preserve human creativity and critical thinking, everyone must be properly educated. It is important to introduce innovative curricula that also shapes the moral sphere of man [11.10]. and promotes sustainable social development in which innovative technologies serve man [11.12.; 11.13.; 11.14.]. The tasks facing 21st century education include preparing modern man for the skilful use of available technical solutions, selective and critical use of Internet resources as well as developing talents and stimulating creativity. Institutional support tools for innovators are also important. However, the differences in this respect between individual countries of our planet are significant [11.4.; 11.5.].

It should also be noted that the modern world needs cooperation among innovative individuals. Increasingly, breakthrough innovations are created in interdisciplinary teams. Thus, the ability to cooperate with others is also a feature of a modern innovator. Mutual inspirations of members of interdisciplinary teams intensify motivation and increase creativity. The COVID-19 pandemic has also posed new challenges. Virtual teams are currently being formed. However, this is not a complete novelty. Before the pandemic, such teams also functioned. Research found that in 2016, 85% of respondents worked in virtual teams, and 41% of them had never met in the real world [11.1]. The reason is the globalization of the workforce, which has led to the creation of international and global teams, cooperating in a virtual environment. However, there is little empirical research on the impact of cybernetic devices and tools on creative problem solving, creative thinking and innovation [11.16.]. In virtual teams, both individual creativity and team creativity can develop. A necessary condition is to share your thoughts, ideas and information [11.15]. Modern communicators make this possible. Virtual teams have no geographical limitations and can be staffed by experts from different locations. Virtuality can, therefore, strengthen a team and influence its creativity provided that the technological communication is good enough. Studies have shown that virtual brainstorming results in the generation of more ideas than traditional brainstorming [11.15.]. However, working in a virtual team also has its drawbacks. First of all, traditional bonds and social relations are not formed, which

affects the level of trust, which is also needed to work in a creative team. Research also confirms that working with video conferencing can lead to increased meeting fatigue [11.3.]. However, there are no clear conclusions as to which new communication media affect creativity and innovation. There is also no clear research on whether stationary or virtual teams are more creative. These teams should be comprised of creative individuals with open minds and innovative ideas.

What are the characteristics of a creative person? Some of these distinguishing characteristics are as follows:

1. Energy
   (Possibility of many hours of concentration during the creative process.)
2. Intelligence
   (Above an IQ of 120)
3. Carelessness and playfulness combined with responsibility, perseverance and endurance.
4. Imagination combined with rational and realistic thinking.
5. Exhibiting both introverted and extroverted traits
6. Self-esteem and strong ego
7. Passion and commitment
8. Sensitivity
9. Willingness to risk
10. Self-realization
11. Approval of life.
12. Cognitive curiosity
13. Internal controllability
14. Activity
15. Strong motivation [11.6.]

Among the personality traits of a creative person, one can identify negative attributes, such as:

1. Tendency to depressed mood and experiencing negative emotions.
2. Tendency to be dishonest with oneself and others.
3. Narcissism.
4. Nonconformity [11.6.].

Creativity is associated with innovation, but there is no conclusive research whether it results unequivocally from nature or is the result of upbringing (nurture). It is probably a combination of both.

12. Innovativeness Network and Ecosystem

Presently the educational system (from pre-/elementary school to the university level) was designed to develop the skills and attributes important and needed for the manufacturing economy. Those values and attributes are as follows:

- Responsibility
- Ability to follow directions
- Zero tolerance for mistakes and failures
- Only one right answer for every question
- Only one right way to solve a problem

Those values, skills and traditions from a manufacturing economy are not valid and can be counter- productive in a knowledge-based economy. A knowledge-based economy requires very different values, skills and traditions than the manufacturing-based economy. The values and skills required by a knowledge-based economy include the following:

- Culture of tolerating failures and celebrating successes
- Nurturing creativity and innovativeness in every individual
- Lateral thinking in the problem-solving process
- Consider various solutions to a problem
- Lack of traditional hierarchy
  (We all work together as equals.)
- New management model based on mutual trust and delegation of authority
- Culture of challenging authority rather than listening to the authority
- Global holistic approach

The existing systems of education do not reflect the need of the knowledge-based economy. The current systems of education from pre-/ /elementary school through the university levels inclusive does not

reflect the needs of the knowledge-based economy. The current systems of education are still teaching and promoting values and attributes which are counterproductive to creativity and innovativeness.

Attributes and skills conducive toward innovativeness and entrepreneurship are extremely important attributes in the knowledge-based economy. The individual components of the innovativeness and entrepreneurship ecosystem need to be properly aligned while complementing and enhancing each other in development of innovativeness skills.

The author of this text identified six components of innovativeness/ /entrepreneurship. ecosystem. Innovativeness and entrepreneurship attributes are being developed at every level of the ecosystem. Every component of the ecosystem nurtures and develops skills and attributes needed to be successful in the knowledge-based economy. The individual components of that network are as follows: (Fig 12.1)

1. Cultural and ethnic integration center(s) in the area.
   (This may not be available in some areas or countries due to the small percentage of immigrants. It may be needed if the amount of immigrant workforce increases.)
2. Entrepreneurial center(s) in the region,
3. Business incubator center(s) in the region,
4. Elementary and secondary schools in the area,
5. Higher education institutions in the region,
6. Industry in the geographical area of the region.

Cultural and Ethnic Integration Centers

Modern knowledge-based economies rely to a significant extent on an immigrant workforce. This workforce can be innovative and productive. For the immigrant workforce to perform to full capacity, it is necessary to provide help related to cultural and ethnic assimilation. Local community-based, public-private, national and international cooperative projects have been identified for this purpose. The Integration Centers provides language classes for adults as well as help in finding employment and legal
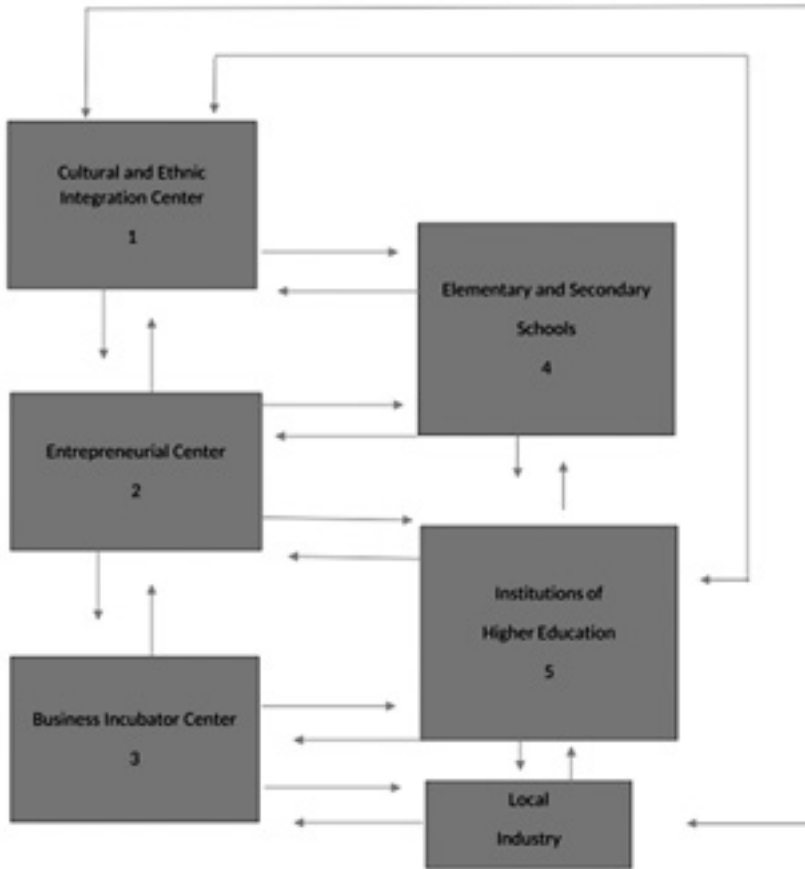
Fig. 12.1. Components of an entrepreneurship and innovative ecosystem. Source: Authors' compilation.

assistance. The Center also organizes enrichment activities for children and young adults. One of the goals of the Cultural and Ethnic Integration Centers is to allow immigrant families to adjust to the economic conditions in their new country. One of the main objectives of the Cultural and Ethnic Integration Centers is to create and a nurture a culture of tolerance and acceptance without regard to ethnicity, religion and sexual orientation.[12.1, 12.2, 12.3] These centers are being established more often. They are also seen as places to provide other resources for the integration between native populations and new immigrants. Cultural and ethnic integration centers are starting to show economic benefits[12.4, 12.5] because of a multicultural diverse workforce.

Entrepreneurial Centers

An entrepreneurial center is a community effort to nurture creativity and innovativeness from many perspectives and at many different levels. The main goal of an Entrepreneurial Center is providing guidance in exploring business ventures. Skills and attributes of entrepreneurship as well as innovativeness and creativity are needed for any business venture.

This type of center can have an outreach to the adult population as well as high school students. This outreach to the adult population focuses on conducting free-of-charge entrepreneurial workshops related to developing business ideas. Every member of the community can approach an entrepreneurial center for assistance in evaluating business ideas or developing a business plan. The Pennsylvania State University has twenty-one innovation hubs.[12.6] The Entrepreneurial Center in Hazleton, Pennsylvania USA has one full-time employee. Coordinator of the Center, as well as volunteers conduct training programs, workshops or meetings with community members to discuss their business ideas.[12.7] Outreach to local secondary schools, colleges and universities is one of the key missions of the Entrepreneurial Center. The Entrepreneurial Center conducts workshops for high school students either at the high school location during school hours or during evening hours at the Entrepreneurial Center.

Business Incubator Centers

Business incubator centers have an important role as a component of the economic development ecosystem. A business incubator center is an essential component for creating and nurturing an atmosphere of entrepreneurship, innovativeness and creativity.[12.8] The best projects initiated at the Entrepreneurial Center are converted into reality at the Business Incubator Center. The role of the Entrepreneurial Center is to

generate business concepts and do feasibility studies. At the Business Incubator Center the activities taking place include, but not limited to the following:

- Development of a detailed business plan
- Identifying the funding sources
- Development of a product which can include detailed drawings, structural analysis, etc.
- Initiating the procedure for protecting intellectual property e.g., applying for patents, etc.
- Development of a website for the new company
- Development of the marketing strategy

The Business Incubator Center nurtures new businesses usually for three years with an option to extend for a few more years, if needed. New companies in the Business Incubator Center receive many low-cost services which are needed during a company's development stage. Cooperation of the Business Incubator Center with faculty and students at local universities is a highly effective and cost-efficient method for providing valuable services to start-up companies. [12.9] [12.10]

Elementary and Secondary Schools

Schools are an important element contributing to the development of entrepreneurship, innovativeness and creativity.[12.11]The curriculum in elementary and secondary schools needs to be conducive to the development of those skills.[12.12] Elementary and secondary schools are either preparing students for the job market or continuing their education in post-secondary programs. In both cases, it is important to provide students with some entrepreneurial training and to develop an entrepreneurial mindset. This entrepreneurial mindset increases their chance for success either in the workforce or further academic studies. An entrepreneurial mindset needs to be developed at an early age at the elementary or secondary school level. An entrepreneurial center can also assist elementary and secondary schools in developing creativity and entrepreneurial mindset.

Institutions of Higher Education

The institutions of higher education are essential in the economic development ecosystem. [12.13] These institutions are the hub for creativity and innovativeness. The role of institutions of higher education is important in the development of skills and attributes which are conducive toward entrepreneurship and innovativeness. [12.14] The college curriculum needs to be structured to emphasize and nurture the skills needed in the knowledge-based economy. [12.15]

The institutions of higher education cooperate with the following:
- Secondary schools
- Entrepreneurial centers
- Business incubator centers
- Local industries

Students and faculty from institutions of higher education provide expertise to start-up companies in business incubator centers as well as established companies representing local industries. The cooperation between the university and industry can take place in the following disciplines:
- Engineering
- Business Administration
- Information Science Technology
- Communication

For the university, faculty and student industry-cooperation is an opportunity to gain first-hand industrial experience. [12.16]

Local Industry

Existing industry is probably the most important component of the economic development ecosystem. Local industry has a vested interest

in promoting entrepreneurship, innovativeness and creativity among its employees. [12.17] The success of a company can be dependent on entrepreneurship/innovativeness skills and attributes of the employees. In a knowledge-based economy, industry is very dynamic and needs to cooperate effectively with faculty and students at higher education institutions in the area. Knowledge-based industries [12.18] require an innovative workforce with a creative mindset. Entrepreneurial and innovativeness attributes are being developed gradually and from many perspectives . Every component of the ecosystem nurtures and develops skills and attributes needed to be successful in the knowledge-based economy. [12.19]

13. Intelligent Fast Failure Method for Problem-Solving

The concept of **intelligent fast failure** was introduced and promoted by Dr. Jack Matson (The Pennsylvania State University).[13.1, 13.2, 13.3] Dealing with failure is an important component of the innovation process. According to Dr. Matson, the innovative process is cyclical and includes four components. Fig. 13.1

1. Experiment
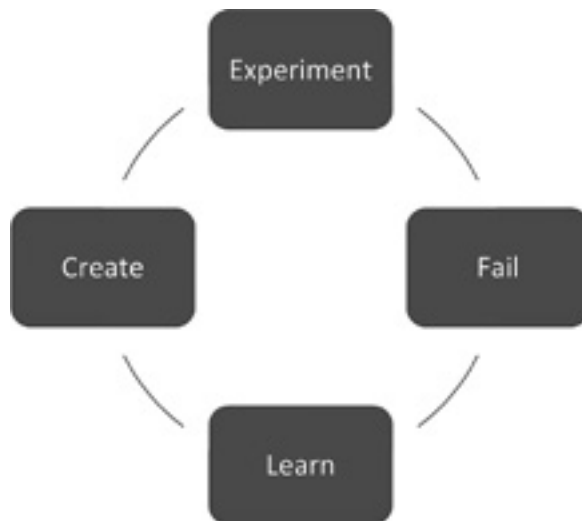2. Fail
3. Learn
4. Create

Fig. 13.1. Cyclical nature of the intelligent fast failure methodology.
Source: Based on [13.4].

The frequency of the innovation cycle can be used to measure the effectiveness of the process of innovation. Thomas Edison and Albert Einstein understood and used the intelligent fast failure method. Edison's invention of the light bulb was preceded by about ten thousand

trial-and-failure attempts. Einstein quoted "Genius is making all possible mistakes in the shortest period of time." Intelligent fast failure needs to be supplemented with scientific methods which analyze data and take calculated risks. The main purpose of the intelligent fast failure methodology is working quickly through the cycle of hypotheses and either validating or not validating them. This allows for the elimination of ideas which are not working well, so that the resources can be assigned to working ideas having higher chances of success. This methodology supplements the traditional methods of strategic planning and risk mitigation. Like every other method intelligent fast failure needs the support and commitment from management.

The intelligent fast failure method can be viewed as a *rapid prototyping of ideas of product or processes.* As Dr. Jack Matson explained in his book *Innovate or Die : A Personal Perspective on the Art of Innovation* [13.5] [13.6], the meaning of intelligent fast failure is as follows:

- **Intelligent**
  The experiment needs to be designed to gather as much information as possible within the shortest period of time. [13.7], [13.8], [13.9]
- **Fast**
  The experiment needs to be designed so that it can be conducted quickly and provides valuable information within a small amount of time. [13.10], [13.11], [13.12]
- **Failure**
  Most projects or attempts to solve a problem will fail. The failed attempts, however, will provide information needed for the successful solution of the problem. [13.13], [13.14], [13.15]

14. Systematic Approach for Moving from Problem to Solution to Commercialization

The engineering design process is a systematic procedure which is normally followed during the development of a new product as shown in Fig. 14.1.
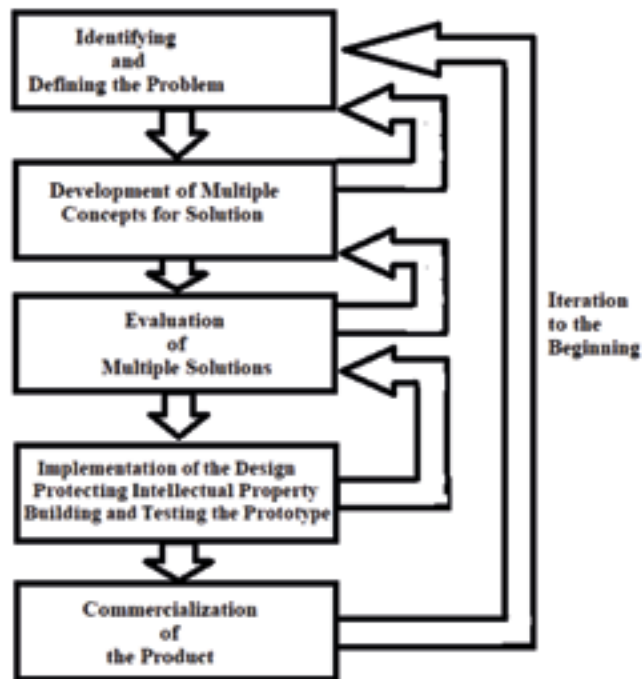

Fig. 14.1. Engineering design process. Source: Authors' compilation based on [14.1],[14.2]

The design process starts from defining a problem as well as the required specifications and consumer expectations. The steps normally followed in defining the problem include the following:
- Identify the problem.
- Contact the prospective customers as soon as possible.

- Ask people about the problem (as many people as possible).
- Listen to the customer's perspective.
- Reorganize the information.
- Identify the customer's expectations and requirements.
- Define the functionality of the product.
- Check the state and industry standards.
- Define the criteria for the evaluation of the design.

There is also an alternative more simplified procedure as follows:
- Define the problem.
- Conduct research.
- Brainstorm and conceptualize.
- Create a prototype.
- Build and market the new product.
- Analyze the product.
- Improve the product.

After the problem has been defined and clarified by the potential customers, a variety of alternative solutions need to be developed using the structured and unstructured critical problem-solving process. Different idea generation techniques can be used during the idea generation process. There is never one right answer, but always aspectrum of acceptable solutions. It is necessary to generate as many acceptable solutions as possible as well as generate as many alternative design concepts as possible. It is important to make smart choices and take responsibility for those choices. The next step in the design process is to evaluate each design concept. The evaluation needs to be conducted by using the established evaluation criteria. [14.3], [14.4]. The evaluation criteria should be defined after listening to the customer's perspective. If none of the proposed solutions satisfy the evaluation criteria, there is a need to iterate the idea generation process or even to the beginning and redefine the problem. Sometimes there is a need to repeat the process a number of times until the proposed solutions meet the evaluation criteria. There are many evaluation techniques which can be used. After selecting the solution meeting all the evaluation criteria, the design can be implemented. An application for a provisional

patent (patent-pending status) needs to be submitted. A prototype of the selected design needs to be built and tested. If the testing of the prototype does not fully match the consumer's expectations, it is necessary to iterate to the stage of idea generation or even to the stage of identifying the problem. The cycle needs to be repeated until the results of testing the prototype are fully satisfactory. The last step is the commercialization of the invention. The commercialization process is not a smooth and resistance-free journey. We need to overcome our own resistance as well as the resistance of others. [14.5]. [14.6], [14.7], [14.8]

15. Application of Methods Stimulating Creativity in Designing Innovations

15.1. Case 1 – a company from the carpentry industry

▪ Introduction

The company operates on the market of window joiners. It was established in Tarnów Opole in 1983. The company relies on reliable and multi-generational traditions and craftsmanship. It developed at a rapid pace despite the destruction of the production hall due to fire in 2001 and the need to transfer the plant to a new location. Over the past two decades, the company has transformed into a modern company employing dozens of workers and cooperating with many well-known and valued contractors and professional assembly companies.

The company mainly carries out production and commercial activities related to the sale of its own products. At present, the offer of includes:
- wooden windows,
- aluminum windows,
- wooden doors,
- wooden shutters,
- blinds,
- windowsills and decorative strips,
- PVC windows,
- buildings and Winter Gardens,
- elevations, terraces, floors.

Use of inventic methods in designing an innovative product

The research included three stages:
- creativity tests,
- in-depth interv iews,
- creative sessions.

Studying the level of cre ativity of employees

Before attempting a creative problem-solving session, employees completed psychological tests that defined their level of creativity. The study involved from 44 to 48 employees (production and office workers). The tests did not include the persons on leave and exemptions.

A maximum of 81 points could be obtained on the test. The limit values for each group are as follows:
- 27–45 – creativity dormant,
- 46–63 – unrealized creative potential,
- 64-81 – innovators

Depending on the number of points earned, employees were assigned to one of three groups:
1. People whose creative potential is dormant
2. People who do not fully exploit their creative abilities
3. Innovators

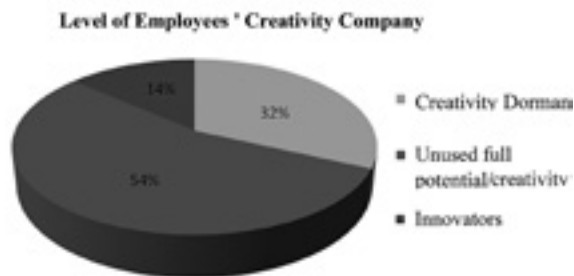Results for employees of the company are presented in figure 15.1

Fig. 15.1. Employees' level of creativity.(%)
Source: Own development.

Most of the subjects are not fully utilizing their creative abilities. They have, therefore, been offered exercises for developing creativity (Appendix 2).

▪ Barriers to creativity in the company

The next step in the research was to familiarize employees with the idea of a creative organization, fundamentals of creativity psychology and innovative methods.

Interviews with employees have been conducted to familiarize them with barriers that block creativity in the organization. The interviews involved from forty-four to forty-eight production and office workers. The interviews were not conducted with persons on leave or exempt for any reason.

The workers pointed to the following barriers. (Barriers are arranged from the most frequently to the least frequently mentioned during the interviews):
1. Unwillingness to change,
2. Lack of motivation system to generate new solutions,
3. Lack of faith in their own abilities,
4. Commitment of management to tradition,
5. Emphasis on control,
6. Lack of time to develop innovations,
7. Criticisms among employees.

The owner and the company manager agreed to take the following actions to overcome the existing barriers:
1. The owner and manager along with employees will develop a system to reward new valuable ideas.
2. Creative sessions will be organized (at least monthly),
3. More time will be allowed for creative thinking and deciding on the most innovative solutions.
4. Owner, manager and employees will work together to build an atmosphere conducive to creativity, organizing integration meetings

as well as developing, conducting and organizing courses/training sessions to increase the level of creativity.

▪ Session for Creative Problem-solving

The next step in the company's research was to design a new product with the help of innovative methods. The creativity session was attended by twelve employees selected by the owner of the company. The employees represented all departments.

The following methods were proposed to workers:
- New look
- Analogous transfer
- Brainstorming
- Fish diagram

The session started with taking a new look the existing problem. The workers were supposed to imagine how houses will be built over the next 50 years. The following statements were considered:
- Houses will be energy efficient, intelligent, passive.
- All devices in your home can be controlled from your computer or phone.
- Houses will have unusual, strange shapes.
- Houses will be resistant to disaster (hail, hurricane, floods).
- Houses will have state-of-the-art/advanced anti-burglary devices.

The wording had to be standardized with the mission and vision statements of the company.

The method did not give a specific solution, but it indicated the direction that the company should follow. Employees decided to focus on modern technologies, ecological trends in combination with the tradition of the company, namely wooden windows. Then, the creative session used the analogue transfer method.

The basic problem was defined as the *development of an innovative product for the window joiner company"*. Then, by contrast, an analogous problem, *baking a cake,* was identified.

The creative search for solving the problem could be divided into two successive stages.

- **Step 1.**

The employees started looking for solutions to the analogous problem. (What to do to bake a delicious cake?) The following answers were suggested:

1. Buy good ingredients.
2. Order the cake in the bakery.
3. Buy ready-made semi-finished products.
4. Search for a delicious recipe (e.g., on the Internet).
5. Use appropriate culinary technique and instruments.

The solutions were provided by experienced bakery workers.

- **Step 2.**

Try to resolve the basic problem by using solutions to the analogous problem (Fig. 15.2).
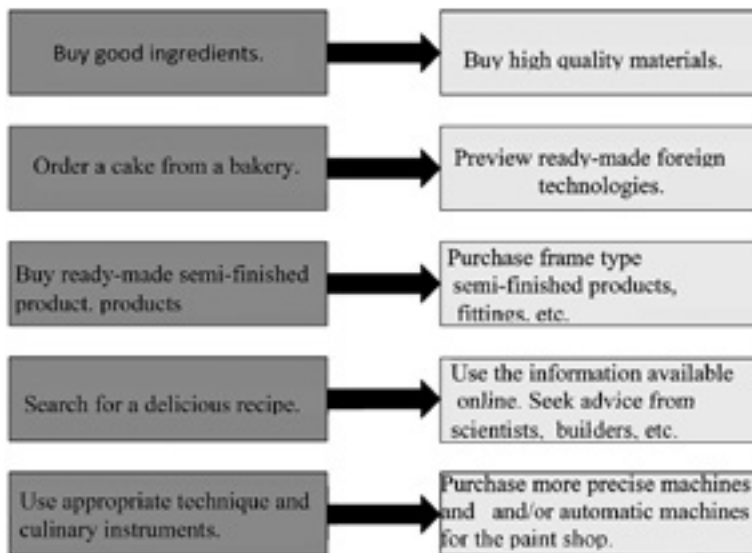

Fig. 15.2. Resolution of the problem by means of transfer analogous.
Source: Own development.

The method of analogue transfer resulted in a strong resistance among the workers. The types of resistance were as follows:
- employees were reluctant to attend the session.
- employees did not understand the meaning of the method used.
- the problem seemed too trivial.

It can be said that the analogue transfer method should be used by people who have previously used similar methods. The ideas generated were written and forwarded for further analysis. Unfortunately, the method has only identified general wording (improving the properties of all products). It did not encourage employees to develop an innovative product, which has also been used by one of the most popular techniques – brainstorming. The solution generated by this method has been applied at the enterprise.

The process for creating an innovative product project consisted of three successive stages.

▪ Step 1.

The company's employees are presented with the rules of the method (shown on a board visible to all employees). The rules of the method are as follows:
- Principle of Deferment of Assessment
  (Any assessment during a brainstorming session is prohibited.),
- Principle of Fantafication
  (It is desirable to come up with even the most unlikely, fantastic, absurd ideas.),
- Principle of moving from Quantity to Quality
  (There is a greater chance of finding the optimum solution when a higher number of ideas are generated.),
- Principle of Modification
  ideas of others in inventing their own.)

▪ Step 2.

An idea gathering session was started. The training was attended by employees from vario us(It is advisable to improve and modify the ideas of other people.)

- Principle of Suggestion

(It is advisable for workers to include the positions, with different knowledge and skills. Ideas for both the consumer and the producer were emerging. All ideas were saved in a prominent place (on the board). Already at this stage it was noted that the new product of the company, will be characterized by high quality, multifunctionality and energy efficiency. The ideas at this stage clearly showed the creativity of employees. Now another tool (list of Osborn questions) was used.

When deciding to apply the Osborn question list, it was imperative to ensure that the necessary prerequisites were fulfilled:
- The problem has identified a multitude of possible solutions.
- The questions were clear and simple.
- The solutions are real and achievable.

The product (windows) has fulfilled all the conditions, so the following questions are displayed on the media board.
- Apply differently?
- Adapt?
- Modify?
  (Give a new form? Change destiny, movement, hue, sound, shape, smell? Make other changes?)
- Enlarge?
- (Add something? Increase the frequency? Why should you spend more time? Make a narrower? More? Thicker? Longer? Double? Add a new value? Multiply? Enlarge the number of ingredients? Redo it?
- Reduce?
  (Should I do it smaller? Less? Miniature? Lighter? Less? What can be taken away/removed ? Skipped? How to divide into parts? Redo it?)
- Replace?
  (What? Who? Other materials, processes, energy sources, place? Other possible changes?)

- Reorganize?

  (Accept other models? Change the components/materials? Change the order of production.? Change the production sequence? Change the look? Effect? Sequence?)

- Reverse?

  (Turn? Reverse roles? Place upside down? Consider the opposite? Add a new step to the process?)

- Combine?

  (Try a mixture of alloy, harvesting, connection? Create a combination of ideas, goals?)

▪ Stage 3

After gathering ideas (no more than 70), a break was proposed. A break was allowed for distancing from the problem. Then the workers began the stage of evaluation and verification of ideas, while also considering the pros and cons of each idea. The principles of prudence, tolerance, mental openness and distance were guided. Undeliverable ideas and those in opposition to the fundamental problem were eliminated from the board.

Product assumptions included high quality, energy efficiency, environmental concerns/issues and modernity). Other ideas were grouped using the Ishicoff diagram.
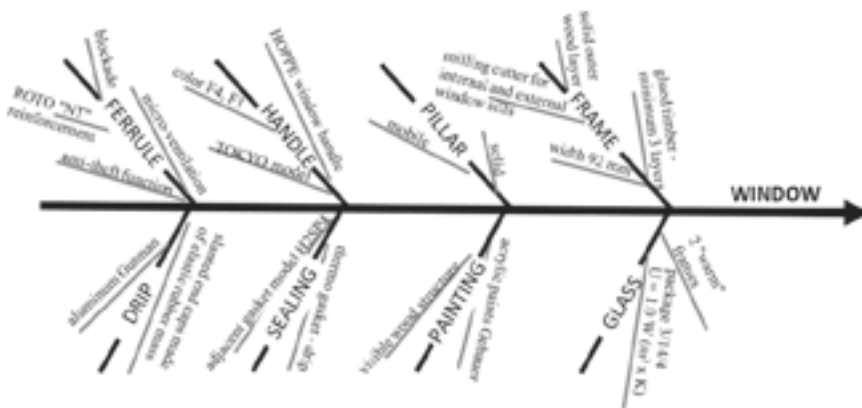

Fig. 15.3. Innovative window design.
Source: Own development.

The diagram was built in the following order:
- Step 1: Establish the main components of the innovative product.
- Step 2: Designate the secondary components and elements which are organized according to key factors related to the production of the product.
- Step 3: Select the determinants, i.e., the choice of ingredients that affect the product, its quality, appearance, consumer perception.

The solution obtained by the creative thinking training sessions is a modern popular market product, Window Passive LUX 92. This new product generates nearly $700,000 per year in company revenue. (This represents almost 10% of all revenues.).

▪ Summary

The creative session was successful. The session was developed and resulted in the implementation of a new product. The knowledge and experience of employees and experts were necessary for the creative session. People employed in the company were excited to participate in this research and the creative problem-solving. In addition, the effects obtained from the individual innovative methods differed from each other. The methods of *new look* and *analogies* outlined the overall vision of the project, but were "too fuzzy" for the workers. (This term was used by the employees themselves). The brainstorming method combined with the Osborn question list allowed for the largest number of solutions. In contrast, the Ishi Espresso diagram has been a great idea in grouping ideas.

Some employees ' options regarding methods are as follows:
- The *Method of Analogy* required the greatest possible creativity.
- The Method of a *New Look* gives general solutions.
- *The Brainstorming Method* collects the most ideas.
- The *Ishi Espresso Diagram* is good for preparing a version of the final product.

In addition, the company has developed and implemented a motivational system supporting the creativity of employees. Company employees organize creative sessions (once a month), participate in numerous courses and trainings (often co-financed by the European Union). The company has undertaken permanent cooperation with the Opole University of Technology.

The ideas were generated without disrupting the company's production and the marketing of the product. The product was offered mainly on the Polish and German markets. It brings the company a consistent profit, which is usually difficult in the window joiner/carpentry industry (because of the seasonality of sales).

15.2. Case 2 – Machine Tool Factory

▪ Introduction

The beginnings of the foundry date back to the 19th century, when a foundry was built in an existing rolling mill, Bushings for wagon axles were cast . The development of the foundry (machine-casting for mining and agricultural machinery) came after World War I. The development of the foundry took place between 1922 and 1928. It was modernized from 1956 to 1960. At that time a warehouse was built, the Cuticans were replaced, the processing of the moulding masses began and the foundry treatment was put into operation. In 1963, production was started in a second foundry and a warehouse of models and wood dryers were put into service.

Between 2001 and 2009, an automated line was installed for the regeneration of molding masses, the production of the shock grilles and the cupolas.

Currently, the company is struggling with problems caused by huge increases in the prices of metal raw materials and competition from China.

The company specializes in the production of the following cast iron grades.

- grey cast iron (200, 250 and 300 according to industry standards 1561:2000),
- size range (100 – 30000kg),
- nodular cast iron (500-7 and 600-3 in accordance to industry standards 1563:2000),
- size range (100 – 5000 kg).

The predominating part of the production is the casting for the machine tool industry. The company produces the components used in the shipbuilding, energy and machinery industries.

▪ Use of Innovative Methods in Designing Innovative Solutions

Studying the Degree of Creativity of Employees in the Company

Before proceeding with the development of a solution for the problem, the company's employees completed a survey to determine their degree of creativity. The study involved 209 out of 211 employees. It was not attended by persons who were sick. Depending on the number of points earned, employees were assigned to one of three groups.

1. People whose creative potential is dormant
2. People who do not fully develop and use their creative capabilities
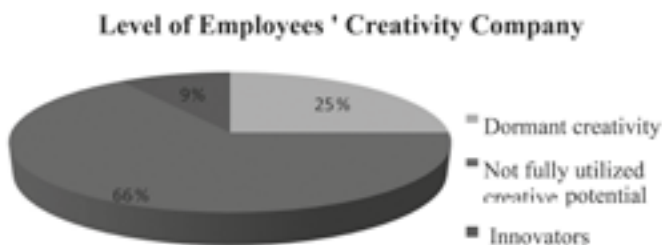3. Innovators

Fig. 15.4. Level of employee creativity
Source: Own development.

Most of the subjects are not fully developing and using their creative abilities. They have, therefore, been offered exercises for developing creativity.

Barriers to Creativity at the Enterprise Foundry Team

Interviews were conducted with the staff (intelligence structure – Appendix 3) to familiarize them with barriers to creativity in the organization. The study involved 209 out of 211 employees. It was not attended by persons who were sick.

The workers pointed to five barriers which are arranged from the most frequent response (1) to the least frequent response (5):
1. Unwillingness to change
2. Lack of motivation (especially financial)
3. Criticisms from among employees and management staff
4. Lack of opportunity (appropriate place and time) to propose changes
5. Attachment to tradition

To overcome the existing barriers, the employees proposed the following solutions:
- Implement an "ideas box".
  (An "idea box" is a tool that allows employees to propose changes.)
- Organize creative sessions on a regular basis.
- Organize trips to other foundry (industry leaders) to exchange knowledge and experiences.

Creative Problem-solving Session at the Enterprise Foundry Team

The President of the company proposed to design an organizational or technological innovation that will contribute to reducing the amount of production waste. Production waste is currently at 11% to 12%. For the creative session, the President chose twenty employees for the creative problem-solving session. The selected employees represented all departments (except solicitor). It was also necessary to analyze the company's documents. The documents identified the reasons for production gaps and the type of shortcomings.

The types of deficiencies identified include the following:
- deficiencies associated with shape defects,
- gaps related to continuity, and
- deficiencies related to internal defects.

The most common causes of defects during production at the company included the following:
- incomplete filling of the mold with liquid metal, caused by too low metal temperature,
- poorly calculated or poorly placed filling system,
- uneven weight of the mass (tumor),
- bad assembly of mold half (repositing),
- low HWS or core mass, inadequate casting design (Appearance of cracks),
- gases in metal or the penetration of gases from molds into metal (internal and external blisters),
- metal contamination.

To identify the location of the deficiencies, the session started by grouping the factors influencing the quality of the castings. The Lotus Flower Method was applied. The stages of the session and the results of the Lotus Flower Method are presented in Fig. 15.5.

Fig. 15.5. Main factors influencing the quality of casts.
Source: Own development.

In the next step, each of the petals became the center of the flower. This helped in finding detailed information about the problems and factors in the casting process.

The staff involved in the session was to indicate which of these factors (petal on subsequent flowers) negatively affected the quality of the casts. The following items were listed:
- positioning and cross-sections aeration in the form,
- employee motivation (or lack of motivation),
- current physical and psychological disposition,
- technological degree of compinging of casters and duration of the foundry process technology cycle

In the remainder of the study, an attempt was made to seek solutions that would compensate for the negative impact of the aforementioned factors. The factors were divided into two groups: elements closely related to workers and elements related to the casting process.

To find a source of problems related to employee motivation, the 5 WHY Method has been used.
1. Why are employees poorly motivated to work?
   – *They are not appreciated.*
2. Why are employees not appreciated?
   – *There is no company policy for showing appreciation to employees.*
3. Why don't you have a predetermined way of valuing them?
   – A predetermined way of valuing employees has not been developed.
4. Why wasn't it developed?
   – Nobody was obliged to develop a way of showing appreciation to employees.
5. Why has no one been obliged to develop it?
   – The President has not seen the need to assign someone to the task of developing an employee appreciation policy.

The President noticed that the incentive system is not functioning properly in the company. Therefore, there was low morale among the

employees. The President's lack of knowledge stems from the fact that he took the position recently. The President has not had experience with the development of employee incentive methods. The company is also struggling with financial difficulties, so its attention has been concentrated on other activities.

A similar pattern of conduct was adopted in the study of workers ' physical and psychological condition.

1. Why are workers in poor mental and physical condition?
   − *They are tired.*
2. Why are they tired?
   − *They work in a physically demanding, stressful and harsh environment.*
3. Why do employees work in harsh environments?
   − *There are extreme temperatures.*
4. Why are there extreme temperatures?
   − *It is hot during the melting process and the winter is cold.*
5. Why is it hot during the melting time and cold in the winter?
   − *The hall has poor insulation and workers are not dressed appropriately for the cold temperatures.*

The solution to the problem is replacing the insulation of the hall (Unfortunately, this is very costly) and/or buying for the employees clothing appropriate for the temperatures in the work environment.

Another part of the study was the solution to the problems of the distribution of aeration in the forming and the duration of the process. (However, the technological complexity of the casters is dependent on the specification of the customer.) Employees have called for these problems to be solved at the same time as they both relate to the design stage of the casting process. The solutions should be coordinated, or a common solution should be generated.

A Teratological Method was selected for the search of solutions. Production of casters with deficiencies was considered as the main problem to be solved. The next stage of the method was to write down hypotheses that could find the solution to this extreme problem.

The staff wrote the following wording on the board:
- *There are smart machines that set the casting parameters themselves.*
- *It is possible to predict the casting process*
- *Employees do not make mistakes.*
- *All errors committed during the casting process can be repaired.*
- *The same components are constantly cast.*
- *The employee was hired by an eminent foundry expert.*

The hypotheses were analyzed and plotted. The unrealistic ideas (cast constantly the same elements and all errors committed during the casting process can be repaired) were eliminated. Then a different interpretation of the other hypotheses was attempted. In this way, solutions to the basic problem, namely the production of deficiencies, were generated as follows:
- Control the foundry process by the computer.
- Purchase a program to simulate the casting process.
- Train staff.
- Consult with experts on casting projects.

The generated solutions were forwarded to the President for further analysis, verification and approval. There is currently a procedure for buying a program to simulate the casting process, which is intended to reduce production gaps to 3% – 4%. In addition, two employees of the company received funding for training to broaden their knowledge of the techniques of improving the quality of casters. The use of innovative methods has benefited the innovation of the company. The programs purchased will allow future production of new products without the need for costly testing.

Summary

The studies made it possible to identify and bridge the creative barriers of the organization, which allowed them to build a creative team and a friendly working atmosphere. During the creative session three methods were used. Those methods were the following:

- Lotus Flower Method,
- 5 Why Method, and
- Teratologic Method.

These three methods helped to solve the problems identified by the President of the company. The President saw too many production gaps. The Lotus Flower Method has identified the main causes of deficiencies. Those causes were as follows:

- distribution and cross-sections of the aeration in the form,
- motivation of employees (or lack thereof),
- current physical and psychological disposition,
- technological degree of the complication of casts.

These causes affected the production process cycle at the foundry. However, no specific solution was identified. The Lotus Flower Method (and the graphics used), aroused the interest of the employees, and therefore they willingly participated in the creative session(s).

The 5 Why Method was used to develop solutions relating to low motivation among workers and their physical and psychological facilities. The generated solutions are as follows:

- development of a new motivation system,
- greater involvement of the manager in contacts with employees, and
- insulation of the hall.

The 5 Why Method has allowed for a thorough examination of the causes of the problem. The employees found it easy to use.

The Teratological Method has been used to develop technological production process solutions. The identification of an extreme situation and zero production gaps allowed workers to fantasize and encouraged positive feelings. The generated solution, the purchase of a casting simulation program, has met with the general approval of all employees. Employee feedback on the methods used was as follows:
−*The Lotus Flower Method put all the elements together.*

- *Thanks to the Lotus Flower Method, we have gathered all the factors, even those about which we had no idea, or about which we wondered.*
- *The 5 Why Method is the topic drilldown.*
- *The 5 Why Method is looking for details and a second bottom.*
- *The Teratologic Method required the greatest creativity, and it was the most interesting.*

An expert participated in the creative session. This expert pointed out what methods should be applied and in what order. In addition, the characteristics and stages of each method were presented by expert. Today, employees are willing to try to improve their jobs and technological process by putting written proposals into the "idea box". Creative problem-solving has become a stimulus for changes in the company. This is necessary for the company's further competitiveness in the market.

The purchase of the "VOLCANO" program contributed to the reduction of casting defects by more than 4%. The reduction of casting defects favorably influenced the quality and cost of production.

Currently, the company's financial situation is stable. Sales of products in foreign markets (Germany and China) have increased considerably. However, the recipient of more than 80% of manufactured products is still the company.

15.3. Case 3 – Dairy Cooperative

▪ Introduction

The history of the Dairy Cooperative dates to the 20th century. At that time a private dairy buying milk from surrounding farmers was founded. After the end of World War II (1945), a dairy cooperative was created from a private German dairy. The cooperative consisted of fifty-two members. At the beginning of the 20th century, the cooperative was in its peak period. It had two thousand members who benefited from

ongoing subsidies and developed its production potential intensively. In 1995, thanks to be being qualified as a preferential enterprise, the company received credit to modernize the production facility, and tank trucks were purchased to start picking up milk directly from the farms. In 2004, a building was purchased. The building was configured for cottage cheese production. In 2006, the packaging machines for dairy products were purchased. In 2008, Dairy Cooperative modernized the apparatus and launched the packaging system in buckets of 0.5 kg and 1 kg. The company also built a new production and warehouse structures and launched the production of granular cheese and mozzarella. In October 2014, the company was sold to the German market giant. The company is a producer of fresh dairy products, with a special focus on the production of cottage cheese, sour cream, cream cheese, kefir, butter and mozzarella-type cheese.

▪ Use of Innovative Methods in Designing a New Product

Studying the Employees' Level of Creativity

Before proceeding with the problem(s), the company's employees completed a survey to determine their degree of creativity. The study involved thirty-six employees. (All participants were employed in the company.) Based on points earned for replies, they could be assigned to one of three groups.
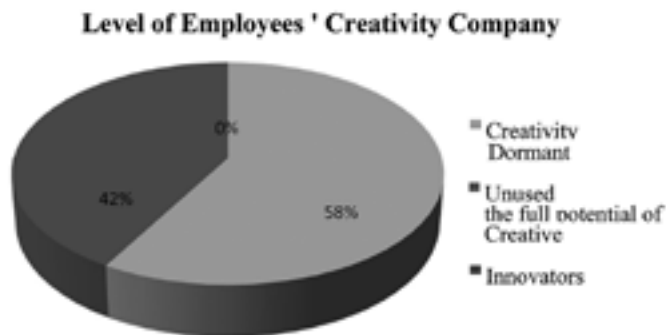

Fig. 15.6. Creativity level of Dairy Cooperative employees.
Source: Own development.

The creativity of the workforce proved to be at a disturbing level, none of the employees showed the skills of a typical innovator. Employees who do not benefit from their creative abilities, do not engage in their work and are not motivated to act. To investigate the reasons for this situation, in-depth interviews were conducted.

Barriers to Creativity in Dairy Cooperative

Interviews were conducted with thirty-six employees who were all employed in the company. Workers have pointed to the following barriers blocking creativity. (Barriers are listed from the most frequently response (1) to the least frequent response (5)):
1. lack of motivation to act,
2. criticisms among employees and management staff,
3. poor working atmosphere due to rumors about the poor financial condition of the company,
4. employment uncertainty,
5. lack of opportunity (appropriate place and time) to propose changes.

To overcome the existing barriers, the staff proposed the following solutions:
- inform employees about planned activities,
- organize information meetings and creative sessions,
- sign new contracts giving employment guarantees ,
- show appreciation of ideas and employee engagement, such as through financial bonuses.

Work on building a creative atmosphere in the enterprise/workplace needed be taken immediately. Employees, who feel undervalued and unconfident in employment, are less efficient, uncreative and unproductive. A set of exercises was therefore provided to stimulate employee creativity. In addition, workshops were organized under the motto, "We build the spirit of the team", Games and psychological fun activities were used to integrate employees and create a creative atmosphere in the workplace.

Session of Creative Problem-solving in Dairy Company

A troubleshooting session for designing a new product was developed. For this purpose, the Crushing Method and Six-thoughtless Hats de Bono Method were used. The session was attended by twelve employees representing the commercial, quality control of production, buying, and transporting departments.

The Board of Cooperatives pointed out that because of the financial situation of the company, it is not necessary to introduce drastic changes (requiring excessive reorganization of workstations, purchase of expensive machinery or instrumentation) when considering the introduction of an innovative dairy product. After using the Crushing Method, a dense natural yogurt was adopted. This product is already offered in the assortment of cooperatives. It was decided to modify the yogurt product to make a new and different product with unique characteristics.

On a board in the conference room, the leader of the creative team entered the word "natural yogurt". The participants were asked to provide a sequence of questions related to the word "natural yogurt". The task was to modify the proposed product to obtain an innovative milk-based product for the members of the cooperatives. The questions that the participants of the creative session provided are the following.
1. Can you connect it with something?
2. Can I use it for other purposes?
3. Can I extend its scope of use?
4. What can I do?
5. What can you add?
6. What ingredient/ingredients can you add?
7. Can you change its character?
8. What should I do to be more valuable?
9. Can you change the smell?
10. Can you change the color?
11. Can you change the quality?
12. What other changes are possible?
13. Can I combine mixtures?

After writing the most important suggestions on the sheets of paper, a 30-minute discussion began. Everyone could deliver their ideas and visions regarding all possible combinations. Summaries of the standard product (natural yogurt) were discussed to try to create of a new unique product for the plant. All the above questions were answered according to a predetermined sequence. All proposals were written on the board (irrespective of how trivial or unrealistic), so that the ideas were easier to remember. Finally, the participants developed a solution through a thorough analysis of all the options and possibilities reported. The answers were as follows:

What to combine?
- coconut chips,
- chocolate pieces (less yogurt),
- cereals,
- sweet cocoa (to make a chocolate delight),
- caramel (obtaining a caramelized dessert),
- pieces of fruit,
- fruit syrup (composed of velvet yogurt)
- dense jam of selected flavor.

Use for other purposes? Extend its scope of use.

The traditional yogurt which has been modified by adding one or more of the items listed can be used as:
- component of sauces, cakes and more complex desserts,
- stuffer for pancakes (crepes/nalesniki), etc.
- sweet dishes,
- dessert for self-consumption.

What can I do?
- Change the existing current technology, adding only the selected ingredient(s) (additive(s)) in the final stage of manufacture.
- Identify new labor resources,
- Identify knowledge, competence of the workers, procedure carried out, modified recipe of other products.

What can you add? What ingredient/ingredients?
- additives, e.g., vanilla, cocoa, strawberry, banana, etc.,
- new flax-free/gluten-free ingredients, i.e., fruit syrups, dye, chocolate, coconut chips, caramel, cereals, etc.,
- pieces of fruit: peaches, raspberries, berries, cherries or forest fruits.

Can you change the product's character? What should I do to make the product more valuable?
- use additives to be richer in nutritional values, valuable vitamins and minerals necessary for the healthy functioning of the consumer,
- improve taste qualities,
- lower the sugar content only by using the selected ingredient,
- change the packaging (design a bucket with a rich graphics, eye-catching for potential customer).

Can you change the smell? Can you change the color? Can you change the quality?

The smell, color and quality of the basic, dense natural yogurt can be changed using the following:
- dyes with the corresponding flavor qualities,
- pieces of fruit, and/or
- additives (chocolate, cereals, vanilla, cocoa, caramel, etc.).

What other changes are possible?
- thickening of yogurt to the form of a natural sandwich cheese,
- season with herbs, chives, garlic or onions to enrich the flavor and achieve greater variety.

All other possible changes using the base, natural yogurt, have already been proposed in the earlier sub-sections/questions. At this stage, the participants in the session did not have many proposals.

Can I combine mixtures?

The ability to combine blends has inspired the team members to generate the following options.

- Addition of vanilla, cocoa or caramel to the natural yogurt.
- Enrichment of the base with pieces of fruit, flavor syrups or mixtures of dyes.
- Combination of dry components e.g., chocolate chips, coconut or cereals to produce a natural dessert.

After the time provided for the collection of ideas, the possible options for modifying natural yogurt were developed. The result was an original new product. The participants selected chocolate chips as the additive. The working name for the product was "A Dessert Lost". To begin production, it would only be necessary to buy chocolate chips. No additional costs in the form of buying new machines and devices, reorganizing work, etc. would be incurred.

The creative session also used the Six Colorful Hats de Bono Method. For this method, the employees were given six different kinds of headgear. (This session was recommended for those who had not previously participated in creative sessions). With the help of the hat, each team member could adopt a certain attitude and style of thinking about an idea for an innovative dairy product. Keywords reflecting the ideas of each hat were printed on a board.

Fig. 15.7. Board with colored hats de Bono.
Source: Own development.

A white hat (representing an objective style/information) was distributed at the beginning of the creative troubleshooting session. Employees sitting in a circle and passing the white hat to one another gave their views and insights. The problem required focusing on facts and avoiding judging and emotions. The employees made an objective review of the current situation in the cooperative, using the prompt associated with the color of the hat. The most frequent recurring observations were as follows:

1. *The company from the beginning of existence produces products for everyday consumption, such as cottage cheese, milk, butter, buttermilk, kefir, sour cream. These products differ only in the size of the packages available.*
2. *The products of the plant are sold in local markets.*
3. *Products distributed through a warehouse were completely excluded, because of the short shelf-life of dairy products. The single production cycle of the product is within one thousand pieces per day.*
4. *The main recipients of the manufactured assortment are the following:*
   - *schools ("Glass of Milk" program orders the milk for the pupils),*
   - *grocery stores, LIDL, Biedronka, or smaller establishments (where the cottage cheese, butter, milk, cream, kefir and butterfat are delivered)*
   - *cafes, confectioners and similar businesses (approximately four hundred such establishments).*
5. *New products are rarely introduced. From the outset, the company did not initiate and introduce any new dairy products. It was only in the last ten years that new products solutions were added into the current assortment, i.e,, natural yogurt, flavored milk and Greek yogurt.*

The Red Hat (intuition and feelings) was then used so that each participant in the session could express their emotions about the current assortment of cooperatives. As before, the members of the training session were assisted by a "pull" on the board who answered the questions about the aspect of feelings. The facilitator handed the red hat to one of the employees, after which he handed it over to him, etc. The following statements were placed on the answer board:

- *The range of products is too poor.*
- *The offered range of dairy products became common, nothing surprising.*
- *The quality of the products is reliable and proven among consumers.*
- *The products are common, average, "backward".*
- *The dairy does not follow the current trends.*

The participants noticed the need for changes in the assortment. They pointed out the need to create an innovative dairy product that could be produced by the cooperative.

Next the black hat (caution, risks, problems) was used to adopt a critical style of thinking. The purpose of this task was to detect all defects and imperfections in the existing solutions. To adopt a specific direction of deduction, an outline of the risks arising from the continuous production of only current dairy products, without introducing any novelty was discussed.

The following wording was the most common.
- *The products offered have a very short shelf-life.*
- *The products must be refrigerated.*
- *A poor graphic design causes new customers not to pay attention to products.*
- *Customers can be bored of consuming constantly the same dairy products. Moreover, they can begin to look for new flavors and solutions in competing companies that offer their consumers a much broader range of products.*

After the black hat, the operator handed the participants a yellow hat (benefits and feasibility) to comment on the constructive, positive issues of the current range of dairy products. The answers to the support questions in that sphere of thought were stated as follows:
- *A positive aspect of the products of Dairy Cooperative is their long tradition, recognition in the industry, products famous for being prepared according to their own proven recipes, specific reputation and prestige on the market.*

- *Numerous awards, e.g., "Company of the Year" and "Product of the Year".*
- *Milk and its byproducts are a source of well-digested calcium.*

Next, the green hat (alternatives and creative ideas) contributed to the generation of new ideas and concepts concerning an innovative dairy product that could become a product of the Dairy Company. Employees have reported the following comments.

1. *Production of yogurt with pieces of fruit is tailor-made by Jogobelii of Zott. (This product was a creamy cheese with extra-large pieces of fruit, in various flavors (strawberry, banana, peach, raspberry, berry, cherry or forest fruit). This idea had long been a personal vision of employees of the company and the customers of the company. They had increasingly asked this type of product and they were willing to purchase it.*

2. *To avoid additional costs associated with the purchase of new machines and the hiring of additional persons, it is necessary to produce yogurt with pieces of fruit to yogurt already produced. In the final stage, the factory added only pieces of selected fruit.*

3. *It is necessary to create new cups of different capacities, with a rich graphic design, to properly advertise the product on the local market.*

Finally, a blue hat (managing the thinking process) was used. The following statements appeared.

1. *The process of thinking was turbulent. There were times when there were several solutions and ideas at once. Each solution seemed good and possible to implement. However, after a moment of thought and deeper analysis, the most important answers were chosen. Then the most important thoughts and insights were clarified.*

2. *The most ideas came during the white hat discussions where the facts were analyzed and the green hat discussions, which explored new possibilities and solutions.*

3. *The most fears and blockages appeared during the realization of the black hat issues because it is difficult to criticize something that we produce ourselves. In addition, the presence of colleagues and supervisors was also not comfortable.*

4. *The idea of making a new fruit yogurt could meet with appreciation among customers.*

The workers pointed to yogurt with pieces of fruit as a potentially innovative product to implement.

▪ Summary

Dairy Cooperative's creative sessions used two innovative methods (Crushing Method and Six Hats de Bono Method). The Crushing Method has generated less-radical solutions (based on the existing assortment). For employees who did not use innovative methods before, the Crushing Method was understandable and convenient. The solution generated by the Crushing Method was a chocolate chip dessert based on the natural yogurt which is already available in the company's assortment.

Using the Six Colored Hats de Bono Method resulted in a delicate yogurt with large pieces of fruit. This method also made it possible to draw constructive conclusions about the company's activities and the products offered to date.

Opinions of Dairy Cooperative's employees on the methods are as follows:
- *Crushing Method has proved to be the beginning.*
- *Methods have forced the participants to come up with new solutions.*
- *Six Hats de Bono Method allows and even forces the participants to take on different roles, so they notice new things.*
- *In the Six Hats de Bono Method, ideas were more innovative than during the other methods.*

In both cases, the expert's knowledge was necessary. The expert pointed out which methods should be applied and in what order. The expert also presented a summary of the proceedings.

The session, concerning the emergence of a novel product, should contribute to the initiation of the changes. The goals were:

- to enrich the portfolio of the Dairy Cooperative's products.
- to have customers enjoy and purchase the product domestically.
- to lead to a positive change in the perception of the establishment.
- to increase the sales of manufactured dairy products.
- to intensify the sentiment of the purchasers to the Cooperative's dairy products (both current and new ones).

This is not an easy task, because the management board of the company did not show any enthusiasm for any change. The participants of the meeting deeply believed that the idea to create, implement and broaden the range of products offered on the market would create the opportunity to improve the competitiveness and image of the company. The effects of creative problem-solving were seen almost immediately and resulted in improving the process of developing a novel product. In addition, the level of knowledge of the creative process participant has increased in terms of creative problem- solving.

The arguments in favor of producing a new product were as follows:

- strengthen the portfolio with new, attractive products,
- enrich the knowledge and experience of new collaborators
- appreciated the creativity that workers developed in creative sessions.

16. Innovations in 4.0 conditions

Today, industrial production is driven by global competition and the need to quickly adapt to ever-changing market requirements [16.1, 16.2]. Modern production was built on the experiences of the first industrial revolution, streamlining the operations of manufacturing plants; the second revolution, introducing electricity to industry; and the third revolution, automating uniform tasks for production workers [16.2; 16.3; 16.4]. The fourth industrial revolution – Industry 4.0 – differs from its predecessors in that it applies to all areas of life [16.5], including the dangerous phenomenon of an aging population and the consequent decline in the workforce [16.6; 16.32]. This revolution is also connected with the fact that the opportunities for increasing the profit of industrial production are exhausted despite the use of the "lean" manufacturing concept and outsourcing [16.7, 16.8]. Industry 4.0 determines changes in production – from mass production to personalized production – which make the production processes more flexible and provide the means to meet the individual needs of different customers more effectively.

The concept of Industry 4.0, although initialized in Germany [16.9, 16.10], is spreading around the world, and the countries implementing the idea define it differently. In the United States and English-speaking countries, it is called the industrial Internet. In others, it is called the Internet of Things or a smart factory [16.11]. Apart from the non-uniform term, the terminology used for Industry 4.0 is not consistent either. The variations depend on how individual business circles interpret this term. In the United States, it is seen as the integration of people with things and things among themselves, combining the analysis of large data sets with the Inte rnet of Things [16.12, 16.13; 16.33].

In France, the concept of "Industrie du futur" is based on the cooperation between industry and science. It is built on five pillars, namely:

(i) state-of-the-art technologies, including additive manufacturing, virtual factories, the Internet of Things, and augmented reality; (ii) support to French companies to adapt to the implementation of new technologies; (iii) intensive training of workers; (iv) strengthening international cooperation on industrial standards; and (v) promoting the French industry of the future [16.14]. In China, on the other hand, the concept consists of a comprehensive modernization of the Chinese industry, taking direct inspiration from the German concept of Industry 4.0 and adapting it to its own needs [16.15].

In the digital age, an organization should adjust their production and logistics systems to meet new technologies. Business has evolved to improve in effectiveness and cost-efficiency. Production systems should be customer-centric and should drive agility within the business. To meet these objectives, the implementation of Industry 4.0 is needed. We can distinguish the following reasons for why the conception of Industry 4.0 is so important [16.16, 16.17]:

- Cost efficiency;
- Agility and flexibility of the production system;
- Customer-centric production systems, with customization of products.

In the Industry 4.0 environment, producers should better understand the patterns of consumption and based on that, be able to adjust the product to the specified requirements of the end-users [16.18]. We can distinguish many technologies used in the Industry 4.0 concept. They may affect the methods of projecting, manufacturing, and delivering products to customers. The main technological conceptions supporting digitalization and servitization in Industry 4.0 are the following [16.19; 16.34]:

- adaptive robotics;
- cyber-physical infrastructure embedded systems;
- additive manufacturing;
- cloud technologies;
- visualization technologies, such as virtual reality and augmented reality;
- simulations;

- data analytics and artificial intelligence;
- industrial internet – communication and networking;
- RFID (Radio-frequency identification) and RTLS (Real-time locating system) technologies;
- cybersecurity;
- sensors and actuators;
- mobile technologies.

The main objective of Industry 4.0 is to increase automation so as to contribute to the operational efficiency and effectiveness of the company [16.20]. Industry 4.0 is based on the integration of new technical solutions. Particularly important, in this case, is the process of combining smart machines and systems, as well as changes in the production processes [16.20].

Industry 4.0 is not only a technological revolution. It is also now connected with the problem of linking different devices together for achieving traceability and trackability. We can distinguish the following dimensions of the Industry 4.0 concept [16.22, 16.23]:

- Internet of Things – the ability to conveniently access data from anywhere and exchange data between devices. All production systems become interconnected. There are real-time flows between all elements of the supply chain.
- Common digitalization – the process of ensuring digitized, constant communication between all people and all devices and between people and devices themselves.
- Autonomous manufacturing systems – creating intelligent factories that organize production processes autonomously and can react flexibly to changes to the requirements of the manufacturing processes. Smart factories perform virtually the entire production processes themselves with minimal human input.
- Customization of the product – delivering a customized product to the customer, precisely according to their orders.
- Robotization—implementation of flexible production sockets, based on industrial robots, using robots adapted to cooperate with humans.

- Implementation of architecture based on cyber physical systems.
- Widespread use of disruptive innovations - these can allow a rapid increase in the efficiency and effectiveness of the socioeconomic and operation system in an organization.

Technical structures are flexible and open, they permit autonomy to the employees and can help organize a structure with fuzzy boundaries. The likelihood that innovations will emerge in such an open and flexible organizing structure is high. We are dealing with this kind of situation in the Industry 4.0 conditions.

For example the widespread of Industry of Things can have a positive effect on innovativeness. Using this method organizations can gain access to new sources of data and new information which can be used for decision-making in a more comprehensive way. Such data systems may contribute to detection of new patterns of behavior or machine interactions. The access to those data can enable managers at the strategic level of researchers to create new innovations. The development of new Industry 4.0 applications and novel business models change from pure production to customer-oriented and personalized services for special solutions possible [16.24].

Innovation ecosystems are collaborative networks focused on the cocreation of value [16.25].

The structure of the innovation ecosystem can be self-organized or managerially designed with multilayer networks of actors with different attributes to provide a system of innovative product and services [16.26]. As in other innovation ecosystems, the Industry 4.0 innovation ecosystem will also need to deal with lifecycle stages. The regional consolidation process while many technologies emerge and different economic aspects of the ecosystem ten to consolidate in the condition of industry 4.0. The capability dimension of the innovative ecosystem in industry 4.0 conditions reflects the organization's capability to organize itself to provide value and foster growth in the ecosystem [16.27].

According to international research it can be distinguished from the list of Top 10 Industry 4.0 Trends and innovations in the year 2021. The authors of this research analyzed a sample of 770 global start-ups and scaleups. The result of the research was data-driven innovation intelligence that improves strategic decision-making by giving an overview of emerging technologies in Industry 4.0 [16.28]. The Top 10 Industry 4.0 innovative trends in 2021 are described in the table 16.1.

Table 16.1. Top 10 Industry 4.0 innovative trends in 2021.

Trend	Explanation
Cyber Security, Transparency & Privacy	The flow of information due to the connectedness in Industry 4.0 is raising concerns about security, transparency, and privacy. As the manufacturing practices are increasingly becoming personal and customizable, the data management practices done outside and within the shop floor will hugely influence the appeal of the company. The transmission and processing of sensitive industrial data need to be done securely to avoid cyberattacks on critical industrial facilities. Digital ethics and privacy, privacy-enhancing technologies, self-adaptive security, zero-trust security, end-to-end communication security, blockchain are some of the new developments in this front. The focus on cybersecurity needs to be balanced with transparency and privacy.
Edge, Fog & Cloud Computing	The immense amount of data being generated by the industrial internet of things (IIoT) is propelling the adoption of edge, fog, and cloud computing capabilities in Industry 4.0. Custom hardware and software solutions like connected clouds, distributed clouds, distributed compute and storage, hybrid computing, low code development platforms, microservices, mobile computing, and multi-access edge computing are shaping up this industry 4.0 trend.
Artificial Intelligence	AI and machine learning are driving innovations across industries and functional areas. AI-specific hardware and new algorithms are being developed to optimize the existing systems and tackle new challenges facing manufacturing. Factories are beginning to integrate AI across their production systems and processes. Advanced AI makes it possible to conduct predictive maintenance, cognitive computing, swarm intelligence, context-aware computing, smart machines, hardware accelerators, and generative design. All of these technologies propel manufacturing facilities to move towards complete lights-out manufacturing.
Human Augmentation & Extended Reality	The physical and cognitive augmentation of humans forms another major industry 4.0 trend. The limitations in humans are being augmented with the help of technologies such as wearables and exoskeletons. Further, industrial mobile devices, natural and intuitive UI, and portable machine control screens enhance the ease of using such technology. XR technologies like mixed reality (MR), augmented reality (AR), and virtual reality (VR) are already in use in Industry 4.0 from the research and development (R&D) to full-scale production and post-production processes. This multi-experience paradigm is changing the way industrial manufacturing systems function. The nature of human-machine interaction is aligning more toward machine-enabled workers.

Trend	Explanation
Network & Connectivity	Network and connectivity are among the main driving forces in enabling Industry 4.0. A number of technology developments such as edge-to-cloud, gigabit ethernet time-sensitive networks, low-power wide-area network (LPWAN), 5G, machine-to-machine communication (M2M), real-time deterministic ethernet, time-sensitive networking (TSN), ubiquitous radio access, unified IoT framework, and zero-touch networks nudge factories to implement IIoT to transform into Industry 4.0 facilities.
Advanced Robotics	Advancements in robotics make the processes in industry 4.0 faster, efficient, and safer. The most prominent robotic technologies impacting manufacturing include autonomous robots, collaborative robots (cobots), collaborative autonomous mobile robots, humanoid, mobile robots, cloud robotics, APIs, pick and place robots, and robot swarms. The use of robots offers higher precision and agility while improving the capability of rapidly developing customizable robots. Robots also free up time for the human workforce to focus on other non-repetitive or high-value tasks.
Internet of Everything	The machine-machine, human-machine, and human-human real-time connectedness together comprise the internet of everything in manufacturing. It includes IIoT, internet of skills, internet of services, internet of systems, and shop floor IoT. The internet of everything combines together real-time data, machine intelligence, and human skills, resulting in faster, efficient, and cost-effective manufacturing processes. Interoperability and a unified internet of things framework are crucial for the smooth implementation of industry 4.0 facilities.
Digital Twin	Digital twin technology creates virtual models of industrial assets by combining dynamic real-time sensing and visualization data. Some of the promising use cases of digital twins include model-driven design, virtual prototyping, virtual system validation, throughput optimization, and evolutionary design. The use of digital twins is propelling industry 4.0 manufacturing towards hyper-automation. Digital twins provide valuable insights into all steps of the manufacturing process.
Additive Manufacturing	Manufacturers constantly search for new technologies to cater to all aspects of the growing market demand. Additive manufacturing, which started out as a prototyping technique, is revolutionizing and decentralizing production. Hybrid manufacturing aims to integrate both additive manufacturing and subtractive manufacturing. The advancement in material science and techniques such as stereolithography and metal 3D printing enables simpler fabrication of intricate structures and complex components. Additive manufacturing is making highly-customizable and sustainable cloud-based production a reality.
Big Data & Analytics	The scale of industrial data collection eventually enables factories to make the transition into industry 4.0 facilities. Big data is complex and is valuable only when it is captured, stored, and analyzed in a quick and cost-effective manner. Advancements to utilize data for gaining valuable insights into the manufacturing systems, along with the availability of immediate and real-time data, open up opportunities for prescriptive, predictive, and augmented analytics at different levels of a company's manufacturing facilities.

Source: On basis. [16.28].

Disruptive Industry 4.0 innovative startups in the world include [16.29]:

- Israeli startup Augury allows "machines to talk". By "listening" to machines the startup anticipates malfunction or failure and currently further develops the machine diagnostics backend of the Internet of Things (IoT).
- Waylay masterminds an intelligent SaaS decision-making platform. The Belgian startup generates a compact logic for easy maintenance – dynamic processes in the cloud, for the cloud.
- German Additive Works makes additive manufacturing less costly. The startup's solution entails a four-step system called the ASAP Principle (Assessment, Simulation, Adaption, Process), on which their software solution "Amphion" is built.
- UK-based SQR Systems bridge the secure communications gap between mobile & IoT by enabling companies to protect their data and build secure products by taking away the pain of regulatory compliance and security assurance.
- Netherland-based Semiotic Labs works with Artificial Intelligence (AI), specifically machine learning algorithms and sensors, to optimize the process of predictive maintenance in smart factories.

We can find the definition of Industry 4.0 where an attention on innovativeness is taken place. For example, the Working Group prepared the following definition of Industry 40: Industry 4.0 regards it as a series of disruptive innovations in production and leaps in industrial processes resulting in significantly higher productivity. It is viewed as the fourth time such a disruption took place [16.30].

In the time of Industry 4.0 we can invent not only technical innovation but also invent and use social innovations. In table 16.2 we put some examples of emerging social innovations which are strictly connected with the fourth industrial revolution.

Table 16.2. Main social innovations connected with Industry 4.0.

Innovation	Characteristic
Universal basic income	To a varying degree, this proposal seems to be supported by both liberals and conservatives. As early as in 1979, Friedrich Hayek referred to this concept in his work Law, Legislation and Liberty. . In general, it is assumed that the value of such income should correspond to an existential minimum. This idea is very controversial however, nowadays it seems to be a robust, even though not perfect, social solution which can combat the negative effects of technological unemployment and make "life financing" possible.
Education	It is significant encouragement to create forms of supported structurally lifelong learning, which do not concentrate on professional qualifications, but rather on the development of skills as "something that whatever job you're in there's something that you can do about. And if you invest the right skills, you can leave yourself in a better place to benefit from the opportunities of the future". Modernization of education systems should also be accompanied by innovative support programmes for grassroots forms of learning. An example can be the Fab Labs/ FabLearn Labs, the essence of which is knowledge and skills sharing on the basis of coaching or Internet mentoring. Voluntary organizations or education crowdfunding can also be considered the grassroots forms of learning in both cases, digital communication technologies (DCT) are used to share knowledge.
New forms of employment	It is mostly about sharing economy solutions that need to be identified both with the concept of sharing various resources with other members of the community to use them better and of sharing new models of business practice that use Internet platforms. We can also consider crowdfunding to be a new form of work – it is about putting own project into action, which is financed by the community that believes in its meaning and chance of success based on donation culture that fully implements existential dimensions of work; similarly as "community entrepreneurship" based on benefit corporations, the profit from such ventures is the result of implementation of e.g. social and environmental goals, that is goals that improve the quality of life.
Development of socially useful activities	Currently, the traditional forms of voluntary service, such as participation in social life, were extended with all open source forms, the flagship example of which can be Wikipedia. It is crucial to notice that communication platforms and IoT created completely new possibilities in this scope, starting from sharing computing power of one's devices through search for new drugs to predicting climate change in searching for new planets, etc.
Establishing a culture of "new" values	Creating social initiatives, the goal of which is to boost creativity and develop community cooperation, as the sources of high quality of life. In the economic paradigm, work was a source of wealth that not only conditioned survival, but also expressed one's social position and defined one's identity, etc. Nowadays, this simple correlation is not so obvious anymore. This is due to several factors, including the sense of wealth in developed countries as well as research on the sense of life satisfaction, proving that material values are not able to ensure our well-being, therefore, work or other activities we undertake should also refer to other values.

Source: On basis. [16.31]

17. Design thinking and its use to boost innovativeness

Design can be defined as both noon and a verb in the context of any creative activity. As a verb, design is the process of originating and developing a plan for an aesthetic and functional product or service, which usually requires a considerable amount of research, thought, modeling, iterative adjustment and re-designing. At noon it is both for the final plan of action or the result of the following plan of action. The industrial design process and methods are in part based around innovation and creativity and guides projects through a fuzzy and chaotic reality while keeping a close touch with the end user [17.17].

Design thinking is an activity that is implicit in the process of design. As a concept, Design Thinking emerged in the latter part of the twentieth century. The discourse on design and design thinking is grounded in traditional disciplines such as industrial and graphic design as well as engineering and architecture. We can define design as the principal mark that distinguishes the profession from science. [17.1] Design thinking refers to creative strategies that designers utilize during the process of designing. [17.2] Design thinking is also an approach which can be used to consider issues and resolve problems more broadly than within professional design practice and has been applied in business and to social issues. [17.3] Design thinking in business uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity. [17.4] The qualities of design thinking are affected by variables such as fixation, creativity, process strategy, and generation of alternatives. A significant part of the problem-solving process in design thinking involves the ability to synthesize knowledge from a variety of sources. [17.5, 17.6] For this reason, design thinking has a multidisciplinary character. Attempts have been also made to distinguish design thinking as a form of abductive thought which has the capacity to generate novel ideas. [17.7].

Table 17.1. Rules of design thinking.

Rules	Explanation
Human rule	All innovator activity is ultimately social in nature. Human rule is based on individuals, but teamwork is also necessary to invent new and challenging innovations. The team should be diverse and agile to do the process of creating innovations best. People are the most valued asset in the design process.
Ambiguity rule	Innovators must preserve ambiguity. (Never go home with just one idea.) Innovation demands experimentation at the limits of knowledge, at the limits of the ability to control events and with the freedom to see things differently. The innovation must always be in a rebuilding mode. The process of creating innovation can be long and the ambiguity may be frustrating, but it is necessary to create alternative futures.
Redesign rule	All innovation is re-innovation. When looking to the future, it is always helpful to look to the past. Try to understand the previous solution of the problem and learn from them. [12] Because technology and social circumstances change constantly, it is imperative to understand how needs have been addressed in the past and by whom. Then we can more easily apply the foresight method to estimate basic social and technical conditions that we could encounter 5, 10 or more years from now.
Tangible rule	Make innovation tangible. Being tangible is essential because we need to learn rapidly in order to produce well. Conceptual prototyping has been a central activity in design thinking in all cases.

Source: On basis. [17.9; 17.10]

Also design and design thinking is an integral part to the production of things or artifacts. Indeed, design thinking is implicated in all aspects of the manmade world from physical artifacts to symbolic and conceptual objects. Design thinking should involve all forms of cognitive activities including remembering, understanding, applying, analyzing, evaluating and creating. [17.8] Design thinking is mainly about building innovators who can use the design thinking paradigm to transform ideas into reality, to transform organization, and to transform all aspects of life. There are four rules of design thinking to be fulfilled in the process. The rules are described in the Table [17.1]

Design Thinking consists of five successive stages. All stages are indispensable and should be done sequentially without leaving out any of them. We can distinguish five stages of Design Thinking as follows: (Figure 17.1; Table 17.2)

- empathize,
- define,
- ideate,

- prototype, and
- test.

Figure 17.1. Five steps of Design Thinking.
Source: [17.11].

Table 18.6 shows in greater detail the characteristics of the Design Thinking stages.

Design thinking process realization in the company should consider following steps [17.14]:

- Design Thinking starts with empathy, a deep human focus to gain insights which may reveal new and unexplored ways of seeing, and courses of action to follow in bringing about preferred situations for business and society.
- It involves reframing the perceived problem or challenge at hand, and gaining perspectives, which allow a more holistic look at the path towards these preferred situations.
- It encourages collaborative, multidisciplinary teamwork to leverage the skills, personalities and thinking styles of many in order to solve multifaceted problems.
- It initially employs divergent styles of thinking to explore as many possibilities, deferring judgment and creating an open ideation

space to allow for the maximum number of ideas and points of view to surface.

- It later employs convergent styles of thinking to isolate potential solution streams, combining and refining insights and more mature ideas, which pave a path forward.
- It engages in early exploration of selected ideas, rapidly modeling potential solutions to encourage learning while doing, and allow for gaining additional insights into the viability of solutions before too much time or money has been spent
- It tests the prototypes which survive the processes further to remove any potential issues.
- It iterates through the various stages, revisiting empathetic frames of mind and then redefining the challenge as new knowledge and insight is gained along the way.
- It starts off chaotic and cloudy steamrolling towards points of clarity until a desirable, feasible and viable solution emerges.

Table 17.2. Five stages of Design Thinking

Stage	Characteristic
Empathize	Stage is used to determine the characteristics of the audience for which the product is designed through detailed observations, interviews or surveys. This way you can find detailed information about the product users and their needs. Innovation always starts with a thorough diagnosis of the needs and expectations of users and potential users of the product while also understanding the technical conditions and market conditions of the product.
Define	In this step the team should specify the user needs. The interdisciplinary team should carry out a synthesis of the information which was collected during the previous phase of the process to determine the extent of the problem. A design brief should present the client's requirements for a job. These may be verbal or written, simple or complex. A brief should contain a specific goal to be met by the design. During the analysis standard frame of mind and habits should be rejected, in order to design the most creative and customer-oriented solutions. This stage is relatively difficult, because people naturally will work on specific solutions, which are known to them, and do not move in the uncertainty of many possible directions. Note, however, that too rapid concretization of solutions can lead to a situation in which a solution will not sufficiently satisfy the needs of the customer. Example questions: • Do you understand what the client is asking for? • Does the client understand what they are asking for? • Do you agree on the definition of terms? • Does the brief have any flaws? • Can you manage client expectations?

Stage	Characteristic
Ideate	At this stage, using tools such as brainstorming, we should generate as many creative ideas as possible. Please note that, in accordance with the rules of brainstorming, even the most improbable ideas and solutions should be considered. Generating good ideas requires not only technical knowledge on the topic, but also ingenuity, courage and creativity. In order to facilitate this process everyone should refrain from criticism of ideas generated by other team members. This phase should be completed by evaluating and selecting the best idea. Then a prototype of the solution should be created. At this stage, a design team might also choose to harness one of the multitudes of art and design movements as a paradigm. As the ideate stage progresses, it will become clear whether there are any misunderstandings or shortcomings in the definition stage and whether enough research was done. Feedback can be sought through the design process to clarify points with the client and to address aspects which were ill-defined during the definition stage. Example questions: • Do you understand the brief? • Do you have enough research information? • Which methods will be used for idea generation?
Prototype	In this step, it is necessary to build one (or in some cases several solutions), assemble and test the prototype(s) prior to the presentation. During the building phase the prototype is created as a physical representation of a solution to the problem. The basic function of the prototype is the ability to present visual solutions for users and fast feedback on its operation. This way you can check whether the project complies with the requirements set by the customer or if changes are made. A prototype gives the design team and client the ability to visualize and handle a design concept, to get an idea of its physical presence and tactile qualities. You can never be entirely sure that the final product will be a success, even if you have previously conducted tests using prototype solutions, Frequent building, improvement and testing of prototypes may be necessary. This approach ensures that the client's expectations have been fulfilled and the risk of potential failure has been minimized. The aim of the prototype is to test various aspects of a design solution. To do this all aspects of the design solution should be effectively evaluated. To convey the idea of what the design solution might look like, a prototype does not need to be made with the final materials. Example questions: • Do all potential solutions require prototyping? • What elements will the prototype test? • What functionality will the prototype have?
Test	In the last stage the prototype should be presented as a solution to the original client in order to obtain their opinion on the generated product. In this way, you can test its functioning. At this stage, the aim is to check the functioning of the designed solution in a real environment in which the product will be used. Specify the necessary parameters and their values, so you can clearly determine the results of the test. In this step you should involve many people in the testing process. Omission of this step in the design process can lead to a situation that the proposed solution does not quite meet the required assumptions and expectations of customers. Example questions: • Has the client signed off on the design(s)? • Have printers or other production professionals been booked? • Has the artwork been delivered to production professionals? • Has the job been proofed against the design? • Has the finished job been delivered?

On base: [17.12; 17.13].

Sometimes authors distinguish seven steps of design thinking, such as define, research, ideate, prototyping, selection, implementation and learning as shown in Table 17.3. [17.4]

Table 17.3. Seven stages of Design Thinking.

Stage	Characteristic
Define	A precise understanding of the problem and its constraints which allow a more exact solution to be developed.
Research	The stage reviews information, such as the history of the design problem, end-user research and opinion-led interviews. In this stage we can identify potential obstacles.
Ideate	In this stage end-user motivations and needs are identified and ideas are generated to meet these, for example through brainstorming.
Prototyping	In this stage we should resolve ideas, which are presented for user-group and stakeholder review, prior to being presented to the client.
Selection	In this stage the proposed solution is reviewed against the design brief objective. Some solutions might be practical but may not be the best ones.
Implementation	In this stage we should finalize the design for the purpose of delivery to the client.
Learning	The stage helps the designer(s) to improve their performance and, for this reason, designers should seek client and target audience feedback and determine if the solution meets the goals of the brief. This may identify improvements that can be made in the future.

Source: On base: [17.12].

The method of design thinking can be used to resolve many problems connected with innovativeness. For example following issues can be resolved using described method [17.14]:
- redefining value,
- human-centered innovation,
- quality of life,
- problems affecting diverse groups of people,
- involving multiple systems,
- shifting markets and behaviors,
- coping with rapid social or market changes,
- issues relating to corporate culture,
- issues relating to new technology,
- re-inventing business models,
- addressing rapid changes in society,
- complex unsolved societal challenges,

- scenarios involving multidisciplinary teams,
- entrepreneurial initiatives,
- educational advances,
- medical breakthroughs,
- inspiration is needed,
- problems that data can't solve.

Design thinking is an approach to collaboration, learning, problem solving and innovation. In practice the whole design process is a structured framework for identifying challenges, gathering information, generating potential innovations, refining ideas and testing new solutions. The main reason why companies strive for innovation is to be more flexible and adaptable to the new and dynamic business environment on the market. In this situation new adaptive instruments are needed to initiate these new ideas. This opportunity is provided by the design thinking method because it can be a strategic and a key tool facilitating the combination of internal processes in an organization and take them to a new level by focusing on the customer and its needs. Practice in many organizations shows that when managers perceive the framework of design thinking ad an approach in their every activity and such of their companies (new products, new services and experiences, marketing, human resources, innovation, etc.) the result is reaching desirable market solutions with an added value for the user and also secure realization and profit for the organization [17.16].

According to the research carried out by D. Markowską, the relationship between design thinking and organizational innovativeness. Design Thinking began its important role especially when start-ups were starting to increase in the global market. Nowadays this method plays an important role as a part of dynamic, agile action on the world stage and in various sectors of business from teaching to building IT systems. Because of that method it can be used as a boost in innovative activities in many sectors.

According to the type of analysis we can achieve various effects using design thinking methods. In the table 17.3 we distinguished some

typical varieties of Design thinking. Each of them can have various impacts on the innovations. There are also many typical common Design thinking tools. We describe them in the table 17.4.

Table 17.4. Types of Design thinking.

Type	Characteristic
Design Thinking	Also known as Meta Design Thinking, Strategic Design Thinking, and Transformation by Design. Method starts upstream with no outcome assumptions, and results in diverse outcomes.
Product Design Thinking	Starts downstream with product creation assumptions and results in product outcomes.
Service Design Thinking	Starts downstream with service creation assumptions and results in service outcomes
Experience Design Thinking	Starts downstream with experience creation assumptions and results in experience outcomes.

Source: On base: [17.14].

Table 17.5. Design thinking tools.

Tool	Characteristic
Visualization	Tools involve the use of imagery, either visual or narrative. In addition to traditional charts and graphs, it can take the form of storytelling and the use of metaphor and analogies, or capturing individual ideas on post-it notes and whiteboards so they can be shared and developed jointly.
Ethnography	It encompasses a variety of qualitative research methods that focus on developing a deep understanding of users by observing and interacting with them in their native habitat. Techniques here would include participant observation, interviewing, journey mapping, and job-to-be-done analysis
Structured collaborative sense-making techniques	Tools like mind mapping facilitate team-based processes for drawing insights from ethnographic data and create a "common mind" across team members. Collaborative ideation, using brainstorming and concept development techniques, assists in generating hypotheses about potential opportunities. These tools leverage difference by encouraging a set of behaviors around withholding judgment, avoiding debates, and paying particular attention to the tensions difference creates in the process of seeking higher-order thinking and creating more innovative solutions.
Assumption surfacing	Tool focuses on identifying assumptions around value creation, execution, scalability, and defensibility that underlie the attractiveness of a new idea
Prototyping	Its techniques facilitate making abstract ideas tangible. These include approaches such as storyboarding, user scenarios, metaphor, experience journeys, and business concept illustrations. Prototypes aim to enhance the accuracy of feedback conversations by providing a mechanism to allow decision-makers to create more vivid manifestations of the future.

Tool	Characteristic
Co Creation	Toll incorporates techniques that engage users in generating, developing, and testing new ideas.
Field experiments	Tolls are designed to test the key underlying and value-generating assumptions of a hypothesis in the field. Conducting these experiments involves field testing the identified assumptions using prototypes with external stakeholders, with attention to disconfirming data.

Source: On base: [17.18].

18. Seeking Opportunities to Innovate

Periodically in our personal and professional lives, we encounter different types of problems and setbacks and challenges. There are different methods and approaches of coping with those challenges. Those methods are shaped by our attitudes towards life.

- Negative attitude
  (Why is it me again? How am I going to live through that? This cannot be solved., etc.)
- Positive attitude
  — Assess where you are,
  — Determine where you want to be.,
  — Develop a plan to get where you want to be.

Every challenge that we encounter in our professional and personal lives is an opportunity and chance to develop something bigger and better. *Every end is a new beginning.*

Very often in our professional and personal daily activities, we have innovative ideas, but by the end of the day those ideas are forgotten and we never had a chance to explore them further. Very often also we are in a daydreaming mode with many ideas crossing our mind. When the daydreaming mode is over, those ideas disappear. It is extremely important to capture those ideas as soon as they are born. The important part is to capture as many ideas as we can ,considering the fact that only one-in-a-thousand ideas lead to success. A very important part of the innovation process is keeping and daily updating an ideas journal. The ideas in the journal need to be reviewed periodically because new ideas may be born by combining some of the existing ideas. Spend at least ten-minutes-a-day dreaming. Look out the window or lay in bed and daydream. In your daily activities, try something new or do something old in a new way. (Try a different

exotic food or take a different route on the way home.) Routine is an enemy of the process of innovation. [18.1, 18.2, 18.3] Adaptability and routine make you comfortable with the status quo. Challenge people around you (e.g., teachers, parents, work supervisors, etc.) instead of listening to them. In addition to this do the following: [18.3, 18.4]

- Add new people to your circle of friends and support network.
- Surround yourself with eclectic energetic individuals.
- Spend at least half-an-hour daily discussing with them different ideas and dreams.
- Listen to them, but also provide feedback to them as well as welcome their feedback.
- Life is richer by interacting with people by giving and taking.
- Listen to the opposite points of view.
- Do not censor yourself and do not do everything according to what is expected of you.
- Rebel periodically and take bold steps of action. "People who listen do not make history."
- Specify the driving forces carrying you toward your dreams.
- Always believe in yourself and your potential.
- Be tolerant, accepting and respectful.
- Stay away from individuals having a negative *poisonous* effect on your life and performance.
- Allow time to relax and regroup your thoughts.
- Work hard and play hard.
- Do not try to *find yourself* because you are not there to be found.

(You need to create the person that you want to be.)

Innovative people need other innovative individuals, so that they can *feed off each other* and exchange innovative ideas. Try to create this kind of simulating environment. At least twice-a-week, go to a different exciting workshop or presentation to meet new energetic innovative individuals. Interact with them and do not be afraid to ask for help. In addition to that: [18.3, 18.5, 18.6]

Write your wild important dreams periodically and create roadmaps toward those dreams. (Fig. 18.1).

- Try to develop hard and soft skills to pursue your dreams.
- Make your surroundings beautiful and eccentric.
- Do not be afraid of failures.
- Apply an **intelligent control failure method**. (Chapter 13)

Failure is a part of the innovation process. Einstein said, "Genius is making all possible mistakes in the shortest period of time."

Fig.18.1.   Development stages of life goals. Source: Authors' compilation.

Create and constantly update your *rings of life* biographical sketch. (Fig. 18.2.)

A life preserver is a ring shape flotation device that is thrown into the water when someone is drowning. It helps to keep a person float.

We each have our own life ring(s) around us as we try to keep afloat in the waters of life.

In this activity imagine that the inner circle is representing you. Around that circle there are different rings. We will label those rings with what helps you "stay afloat" and aid in your success.
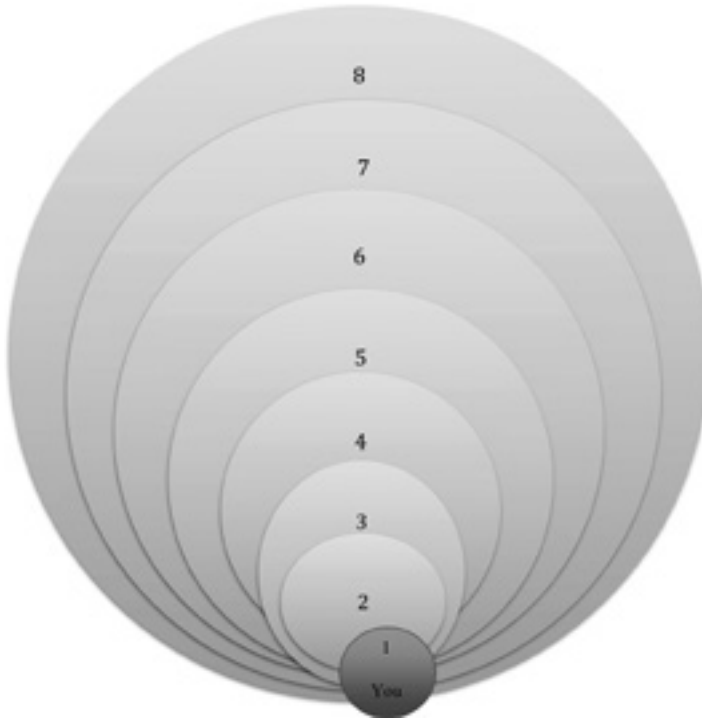

Fig.18.2.   Rings of life. Source: Authors' compilation based on [18.1, 18.2, 18.3, 18.7, 18.8].

Now that you have created your life ring, use it to complete Part 2.

We all have a resume. Resumes tend to focus solely on our academic and professional accomplishments. However, in our life we have many accomplishments that do not fit into our resume. That does not mean these accomplishments are unimportant for our growth.[18.3, 18.7, 18.8, 18.9, 18.10]

▪ Part 2

Create a life-resume with all your accomplishments that do not fit onto your resume.

How has your life ring been a support for these accomplishments?

How have these accomplishments helped you with the accomplishments
you already have listed on your resume?

1. **Center of the circle**
   Your life goals are what you are trying to accomplish in your life.
   Life goals and dreams are changing as we go through the life
   transformation process.
   The life goals and dreams need to be updated periodically (in the
   same way as we update our curriculum vitae CV). Studying the
   evolution of our life goals and dreams helps us to understand the
   ongoing life transformations to which we are subject. Observing
   the transformations allows us to better understand ourselves.

2. **Second circle**
   Internal driving forces motivating your actions
   The internal forces and motivations to pursue our goals are
   constantly changing. Therefore, the biographical profile needs to
   be periodically updated because of our life transformations. The
   pattern of changes of our internal driving forces and motivations
   is important to understand ourselves better and the process of
   constant transformation.

3. **Third circle**
   Your strengths and special skills
   Our strengths and special skills are changing based on our
   work experiences as well as life experiences. They need to be
   periodically updated. The pattern of changes can be valuable to
   understanding our transformation process.

4. **Fourth circle**
   Your education
   Education is another constantly changing factor needed to be
   periodically updated. Updating the formal education is one of the
   easiest parts of updating the biographical circle.

5. **Fifth circle**
   Your work experie nces
   Your work experiences are also changing and need to be updated. Similar
   to education, updating this part does not usually create a problem.

6. **Sixth circle**

   Your support system

   Our support system changes with age and the family situation. Understanding the changes in the support system allows us to understand the transformation process better.

7. **Seventh circle**

   People relying on your support

   The list of people relying on us is also changing with age and family situation. It needs to be periodically updated.

8. **Eighth circle**

   Your weaknesses and shortcomings

   Your weaknesses and shortcomings are also changing. Some weaknesses may disappear or even become a strength. Other weaknesses may appear.

19. Innovativeness in Everyday Life

"Every day, we use language to speak sentences that have never been spoken before. We express thoughts that have never been expressed. All of this is so deeply ingrained that we don't notice how creative it is."

<div align="right">

Art Markman
(co-editor of the book *Tools for Innovation*) [19.1]

</div>

The phrase 'everyday creativity' can be defined as creativity that is used in everyday life. We may not even realize these thoughts or actions are part of a creative process. It can be as simple as wearing or modifying an old article of clothing that has been passed down. But it goes beyond this.

"It's too bad that when considering what endeavors may be creative, people immediately think of the arts. – It's the problem-solving processes they exhibit rather than the content or craft that make them so. Just about anything we do can be addressed in a creative manner, from housecleaning to personal hobbies to work." [19.1]

Michele Root-Bernstein, co-author with Robert Root-*Bernstein of Sparks of Genius*

Creativity and its innovativeness can be more than about someone who writes fantasy novels or paints paintings. Everyday creativity can enrich our life and make it better. [19.1]

There is a term "Life Hacks" that is being used more and more on the internet. This term is meant to describe a simple invention that can be made easily. This invention solves everyday problems. Creating and using *life hacks* is an example of being innovative in everyday life.

Creativity can lead to innovativeness. There are many ways people can learn to become more creative in their everyday lives. This learning process requires tasks supporting creative thought that a person can perform.

Examples of these tasks are as follows:

- Solve Puzzles
- Combine Random Words
- Try to Understand Opposing Views
- Take A Shower/Meditation
- Free Writing
- Finish Projects Later
- Use A Different Method of Transportation
- View Random Images

Work is a large part of many people's everyday life. Being creative at work is sometimes not an option. Work environment and limitations may hinder creativity. But this does not mean a single individual cannot bring creativity to their own work individually or to the work environment. It takes a person to start a movement. If you are comfortable being a leader and speaking with management, change is possible.

There are small ways that you can be innovative in your work environment. Specifics vary from job to job but some core ways an individual can, on a personal level, bring innovation to their work are as follows: [19.1, 19.2, 19.3, 19.4, 19.5, 19.6]

- Make sure you love what you do.
  (It is hard to be innovative if you do not love your work. Without passion the drive may not be there to be creative.)
- Surround yourself with innovation and inspiration
- Look at your work from a different perspective.
- Work out-of-the-office

If you are in a management position, you may want to promote innovativeness in your employees. Again, there are any ways to do so and there may be variations based on the field in which you work or supervise. Some ideas to promote innovativeness are as follows:

- Give your workers more freedom.
- Let your employees fail.
- Provide your employees the resources to implement innovative ideas.

- Be a model for innovativeness.
- Acknowledge the contribution of your employees.
- Celebrate diversity in your workforce.
- Celebrate success and tolerate failures.
- Provide incentives for suggestions that are implemented.

As you may have noticed, many of these strategies promoting innovativeness are also the same characteristic of being an effective leader. This is not a coincidence. A "*good leader*" is one who is creative and promotes a creative work environment. They do this because they see the benefits to the employees as well as the work itself.

20. Innovativeness as a Power to Make a Positive Contribution to the World (Bildung)

Bildung is a theory created in Germany in the 18th century (between 1793and 1794) by Wilhelm von Humboldt ("The Theorie der Bildung des Menschen"). Bildung theory reflected the social and political conditions in Germany during the 18th century. During that time there was an increasing division of labor and increasing specialization of knowledge.[20.1]. *Bildung* theory promotes the link between human development and specialized knowledge. *Bildung* is focusing on the development of humanity and our contribution to humanity by everything that we do during our lifetime. [20.2]

Humanism is a higher value placed above the social bodies, religious beliefs, and national belongings. According to *bildung,* the most important part of human existence is to give as much as possible to humanity during our lifetime. By doing that our life will make an everlasting impact and contribution to the world. [20.3]

Bildung has historically lost and gained popularity as a result of the political, social, and religious climate. Nationalism as well as strong religious influence have been undermining the humanity aspect of *bildung*. In the early 21st century the concept of bildung became very appealing to many people. [20.4]

Equity and equality in the education systems is also an important facet of bildung.
- A good education is the right of every individual. The concept of *bildung* was promoting a good education for every individual regardless of social and financial status.
- Education in the new society will no longer depend on birth privileges but on individual merit and talent.

- Education will awaken the inner forces of creativity.
- Education needs to be a broad general form of education appropriate to a vocation.
- Education supports free development of individual personality.
- Education will transfer people into autonomous responsible citizens.
- An educated society has creative judgment.
- Educated individuals will transform the world and humanity.
- Education adapts individuals to the world

According to *bildung* theory, the task of education is to adapt individuals to the world and awaken the inner forces of creativity and creative judgment to transform the world and humanity.

Bildung theory was supposed to modernize German society by transferring people into autonomous responsible citizens.

In the 21st century bildung continues to be a dynamic theory. Presently this concept has become a reality in most developed countries.

In 21-st century most people believe that the success of their life can be measurement by the contribution that they made to humanity and the world. *Bildung* does not promote passive contemplation. To the contrary, bildung promotes an active lifestyle with good communication with others, and a full commitment of all the energy to the contribution to humanity and society.

It is not easy to quantify the philosophy of bildung. Innovativeness and creativity which result from this theory are more important than ever. Catastrophes of the 20th and early 21st century (e.g., climate changes and COVID-19) have resulted in rapid technological changes (e.g., Industry 4.0 and the Digital Age).

Bildung is still an important model for thinking about the role and purpose of education as well as the role and purpose of our lives. The philosophy of *bildung* applies to modern society even though it

cannot be measured or quantified. Innovativeness, creativity, protecting the planet and benefiting humanities is more important than ever before. [20.5]

Bildung is a constant process that never ends and responds to the current civilizational challenges. *Bildung* promotes ecological and social interdependence.[20.6] Promoting Bildung today is about helping each other, so we are better prepared for the challenges of tomorrow. *Bildung* encourages individuals to take upon themselves ever bigger personal responsibility towards family, friends, fellow citizens, society, humanity, and our planet.

21. Innovativenes
as a Positive Outlook for the Future

The psychological safety of team members promotes the free exchange of ideas and enhances creativity and innovativeness. Psychological safety is a non-threatening environment with all members of the team functioning without the fear of being criticized. The discussion between team members (including management) needs to have a positive and constructive tone. All the ideas provided by team members need to be considered and carefully evaluated. None of the ideas can be criticized including those not selected for implementation. Psychological safety needs to be implemented as a process for changing the company's culture. The company culture needs to provide nurturing stress-free environments for all the employees. This requires a commitment by management and possibly new management styles. The environment of psychological safety cannot be implemented overnight. It requires time, commitment and continuous quality improvement (CQI). A climate of psychological safety benefits the company in many ways. The main benefits are creativity, innovativeness, high work ethic, employees' job satisfaction and better retention.

Very often in our personal and professional lives, we encounter different types of problems, difficulties and setbacks. There are different methods and approaches of coping with those challenges. Those methods are shaped by our attitudes towards life.

- Negative attitude
  (Why is it me again?How am I going to live through that? This cannot be solved., etc.)
- Positive attitude
  — Assess where you are.,
  — Determine where you want to be.,
  — Develop a plan to get where you want to be.

Every problem that we encounter in our professional and personal lives is an opportunity and chance to develop something bigger and better. *Every end is a new beginning.* A positive attitude to life allows us to view the following:

- Problem as an opportunity
- End of the status quo as the beginning of a bigger and brighter future
- Closing the door as the opening of other doors

A positive attitude in facing challenges and setbacks in our professional and personal lives leads to innovative solutions and a brighter future. This is the main objective and message of this monograph. There is no alternative to a positive attitude. A negative attitude in dealing with personal and professional challenges leads to frustration and can be self-destructive.

Innovation always impacts the future. Those with an innovative mindset are usually future oriented individuals. Innovation has positive connotations for the future because it seeks to make the future better. Those who are innovative must also have an optimistic look for the future. Innovation in itself is something that promotes progress, changing what is outdated or ineffective into something new and beneficial for the future.

Many have noted a positive outlook for the future as being a part of creativity. "Creativity is increasingly vital to competitive advantage. Leaders are under growing pressure to generate a creative output from themselves and their teams, and human capital managers and consultants are increasingly called to facilitate and build a climate that promotes innovation." [21.1] To do this, innovative people must look to the future and be positive about the future and all that can be achieved. Because of this, positive emotions and feelings are important for seeing this bigger picture and for innovative mindset and attitude.

Positive emotions are beneficial for big picture and innovative thinking. Positive emotions and attitude from managers and mentors can

also aid in the process of innovative lateral thinking. [21.2][21.3] [21.4] Innovation is a way to take the future into our own hands and change the status quo. A desire to change that status quo requires a positive mindset and attitude that things can be changed and hope that the future will be better. If someone has a negative mindset they can become stuck in the past. This can be associated with depression and feelings of hopelessness, feelings of being stuck in the past or the current situation. [21.5]

Negative emotions and fear of the future may lead to stagnation. Stagnation is when something is not moving. Often stagnation is referred to as water. When water does not move it can become stagnant. Stagnant water can become the perfect habitat for insects to breed and bacteria to congregate and as a result of this the water begins to smell and is unhealthy. People and society can also become stagnant, having the same unpleasant effects. One potential reason for stagnation is fear of the unknown.

Fear is an emotion that can keep us safe from dangers, but it can also limit our behavior in many ways. If someone is fearful of the future, they will be less likely to take the risk of change. To those individuals it is more comfortable to keep doing what they always did, because they want the result they are familiar with. This result may not be in their best interest, but at the very least it is a result that they know. This makes the status quo safe and predictable. Life conditions are constantly changing, and sometimes what we have always done in the past no longer works or does not produce the desirable results.

In this situation, we have an option, we can keep doing what we have always done in the past or we can begin the process of change.

The process of change and innovation is progress may sometimes require trial and error to reach an effective and desirable solution meeting the changing demands of our environment. The driving force for innovation must be the desire to create a better future.

The reality is that life changes. Fear of the future and comfort in the status quo can be signs that an individual is not positive or hopeful about the future. It takes positive emotions and outlook on life to be innovative and try to create a better future.

Within the organization the role of the effective leader is to set up a positive outlook on the future. A positive outlook energizes the employees. Only happy employees with a positive optimistic outlook can be creative and innovative. A good leader can have profound influence on their employees, allowing them to reach full innovative potential.

22. Transformation

Throughout life we undergo many transformations. These transformations change us in a variety of ways during different times in our lives. No matter where a person is around the world, we have a shared development. Though we share aspects of our development, development is influenced by a variety of factors including culture. We can look at our development in three different ways, as: physical development, cognitive development, and social development. (In Chapter 23 we will explore how social and cultural influences creativity and innovation.)

There are many theories of human development proposed by developmental psychologists. Some researchers view our development as contiguous, while others view development as something that can be better described in stages. Stages are time periods in our lives where people generally experience a certain aspect of development. Often these stage theories focus on cognitive (Piaget) [22.1] or psychosocial (Erikson) development [22.2]. When focusing on creativity we must look at a wide variety of transformations we undergo in our lives. During the different stages we face various life-changing transformations. Every change can promote or hinder the development of creativity. The most changes in our development occur in the beginning and end of life. In this chapter we will break down human life stages into three categories: Childhood, Adolescence and Emerging Adulthood, and Adulthood.

▪ Childhood

The stage of childhood ranges from birth to puberty. Transformations that we undergo in childhood can be long lasting and set a pattern of behavior in later life. It is difficult to change ingrained behaviors, but

it is easiest to develop positive patterns early on in life. [22.3] Some common features of development during childhood are as follows:

- Language development
- Cognitive development
- Physical development
- Social development

There is a great deal of physical development that occurs in childhood. This physical development allows for a wide array of movements that allow children to explore their world. This exploration and trial and error allows for mistakes to be made and learning to take place.

During this childhood period there are also cognitive and social changes. In the child's cognitive world, much is changing. The child is able to develop logic to a certain degree and begins to play. Play is a large part of our human development, and we see it in other animals as well. Play helps us understand social rules and helps us develop within the culture we are living. Through play we learn not to cheat, but also we learn to craft and to be creative. Play occurs around the world in much the same way. We learn during this time what is socially accepted and how we move though society with our peers, what they and we have learned. Depending on the country and region in which you live can also influence this. Does the city promote innovation or adaptation? There are various ways this creativity or adaptation can appear. Adaptation is fitting yourself into the current environment, where adaptation is taking that current environment and making it new. A single person or movement can be a spark for this change towards innovation.

Much of what we know moving forward in our development is set during childhood. It is important that a culture that values creativity and innovation also promotes skills that foster creativity during early childhood education.

▪ Adolescence to the Emerging Adult

This stage begins at puberty and ends at young adulthood. Emerging Adulthood is currently a term used most commonly to describe the

time between adolescent and adulthood. The stage was first defined and studied by Jeffrey Arnett. He noticed that around the world there was a change that had occurred. In the recent past, after high school or even earlier, adolescent individuals would become adults in society. This would mean that many would find employment, get married, move away from parents and become more self-sufficient. However, Arnett noticed that the age of marriage and first child was becoming later. He noticed that financial challenges (including college) were pushing the time young adults moved away from parents. He called this stage as:

- Age of identity exploration
- Age of instability
- Age of self-focus
- Age of feeling in between
- Age of possibilities [22.4]

There are a lot of transformations that occur during this time in our lives. Though relatively short, adolescence is a time that is full of change. These transformations impact the development of our creativity in the following ways:

- Cognitive development
- Physical development (puberty)
- Social development

During adolescence and emerging adulthood we are making our own path. During this time, we are developing our own sense of identity. This time is a second opportunity for developing creativity skills. In adolescence and emerging adulthood we are likely to challenge the status quo, this includes cultural norms. During this time, we are also developing more abstract reasoning and becoming more engaged socially and politically. This leaves many opportunities to implement creativity to create new innovations. [22.5], [22.6], [22.7], [22.8], [22.9]

Emerging adulthood causes further growth as an adolescent is now faced with more instability and more opportunity for creativity to manifest. During this time it is important for guidance but also freedom to explore new environments and situations. During this time there is

more instability and lack of financial resources which might cause the need for creativity and innovation. Based on learning we have developed an understanding for the items around us, a set function for those items we see in everyday life. This can lead to functional fixedness. Functional fixedness can hinder our problem-solving. For example, a sewing needle can be used for sewing, but for what else can a sewing needle be used? Perhaps a sewing needle can be an item to hand a photo or small art piece on the wall. During adolescence and emerging adulthood, the lack of most resources and the cognitive capacity may lead to a breakdown of functional fixedness, especially if the hard and soft skills have been ingrained in childhood.

During this time in our development, society is also pushing us to decide what we want to pursue in our lives, which creates stress and opportunity. In some civilizations there may not be that push, sometimes paths are decided for the individual. This can limit a person's creativity and the utilization of that person's strengths.

▪ Adulthood

Adulthood is from young adulthood until the end of life. During adulthood an individual's personality is more stable. In adulthood, oftentimes an individual has gained insight into their field. This insight can mean the habits that have formed by adulthood are more difficult to change. That said, there is still a great deal of transformation that occurs during this stage. The transformations that occur can also impact creativity and innovation.
- Cognitive development
- Physical development
- Social development

This stage is much more stable, but that in and of itself brings about wisdom, which is part of creativity and innovation. Wisdom can also harm innovation as it creates a framework that may lead to cause and effect thinking, where one problem has one solution. In adulthood there

should be a foundation for creativity laid for the individual. At the same time, the individual may have more freedom to experiment and create with the knowledge they have accumulated.

Transformations across the lifespan are important for understanding our development of creativity and innovativeness skills. There can be changes in a person's development from birth and up until death. Some of these changes in development can help and hinder innovation.

23. Social and Cultural Aspects of Creativity and Innovation

Life changes and transformations we experience are important for understanding the development of creativity and innovation. One of the most influential parts of our development is society and by extension culture. Creativity and innovation are influenced by society in many ways. Culture is both visible and invisible. Culture is a difficult thing for a single individual to notice until they encounter something that goes against cultural norms and expectations. Culture is influenced by society and is ever changing. Culture is a mixture of everything around us: the language we speak, what we eat, and what we do for leisure. Those around us teach us culture at a young age and we continue to be influenced by culture. Culture can provide us with opportunities or even hinder the nurturing of creativity and innovation. Cultural practices and society that enforces these practices, can lead to more creativity or less creative freedom.

"The impact of culture on creativity is typically manifested in three ways:
- People from different cultures or settings have distinct implicit and/or explicit conceptions of creativity.
- Individuals from different cultures, particularly those from individualist and collectivist cultures, show differences in preferred creative processes and creative processing modes (e.g., usefulness seems more important than novelty in the East, whereas novelty seems equally important as usefulness, if not more so, in the West) when they are engaged in creative endeavors.
- Creativity may be assessed using different measures based on culture-related contents or materials, and findings accurate only when culturally appropriate or culturally fair measures are used." [23.1]

We can see this reflected in the differences of innovation between certain countries. Levels of innovation within a country can be measured in a variety of ways, one of these ways is in the number of patents within a certain country.

A country's culture may be categorized as: Collectivistic and Individualistic. Collectivistic cultures value selflessness and teamwork. These cultures place a focus more so on the group and conformity, adapting to the group and not standing out unless it is of benefit to the group. Individualistic cultures are on the opposite end of the binary. Individualistic cultures value individuality and place less emphasis on the group. Individualism focuses on a person succeeding rather than the group moving forward.

Of course, no single country is entirely collectivistic or individualistic. Even if a country leans toward a certain category it does not necessarily mean that a person themselves who lives within that cultural environment will follow those same traits. In fact, a person who goes against their country's social norms (personality traits that are praised) may be more likely to have a more creative mindset by being able to think outside of the culture's proscribed way of solving problems and handling situations.

Collectivistic and individualistic cultures still have a large influence on the development of an individual's social behaviors and even personality traits. Personality is a consistent way in which we interact with the world around us. There are many perspectives within psychology that attempt to explain personality and its development that range from the genetic to humanistic. One of the ways psychologists attempt to assess an individual's personality is through trait theories. Trait theories focus on the identification of certain traits of an individual. Gordon Allport made a list of close to 4,000 personality traits. Raymond Cattell later narrowed this down to 16 personality factors. Hans Eysenck's three-factor theory is also an attempt to identify personality traits. A widely supported trait theory is The Big Five. [23.2]

The Big Five traits are: openness, conscientiousness, extraversion, agreeableness, and neuroticism. Each of these personality traits are a part of a person's personality to varying degrees. For example, after taking the assessment, every individual will be given a high or low score on openness. If a person scores high on openness this suggests that the person will be more adventurous and curious. Someone who scored low on openness may be more conservative and less open to new experiences. [23.2]

Cultures both intentionally and unintentionally shape certain traits and behaviors in its citizens. If a certain trait is deemed desirable by the culture it will be passed down through various social interactions. The way this occurs is by a process known as *conditioning*. Conditioning of social norms and the development of certain personality traits can occur through interactions with others.

■ Classical Conditioning

Classical conditioning takes place when a neutral stimulus is paired with an unconditioned stimulus. This was first identified by Ivan Pavlov when working on his Nobel Prize winning research regarding digestion. The physiologist has become a well-known name among behavioral psychologists. In classical conditioning there are a few terms to take note of: unconditioned stimulus, unconditioned response, neutral stimulus, conditioned response, and conditioned stimulus. Unconditioned stimulus and response do not require learning . Many dog owners will notice that when eating around a dog, the dog will want to eat too. When shown food a dog will salivate naturally. As humans, we follow the same biological rules as dogs do. When we are presented with food that entices us, our mouths begin to salivate. This is unlearned, unconditioned. Pavlov noticed that sometimes neutral stimuli get associated with this unconditioned behavior.

John B. Watson followed this research with another famous experiment, Little Albert. The example that follows is similar to the example of the

Little Albert experiment: For example, when you were a child you saw a flash of light in the sky and then moments after heard a loud noise. As an adult you know this as thunder and lighting, but as a child you responded on instinct to the loud sound and were potentially afraid. By the time you are reading this as an adult, this interaction of thunder and lightning has happened multiple times in your life. A neutral stimulus of a flash of light in the sky is now paired with an unconditioned stimulus of a loud sound. This continued pairing has changed your neutral stimulus of a light in the sky into a conditioned on as you paired it to the loud noise. This may have created the conditioned response to the lightning in the sky. As an adult, whenever you see lightning, you may be expecting to hear something.

Something similar occurs socially and culturally as we grow. We begin to pair certain biological drives with other things. Aspects of creativity can be learned in a very similar way. Classical conditioning can change throughout life.

■ Operant Conditioning

Operant conditioning is learning that takes place through rewards and punishments. There are positive and negative rewards and punishments. Positive only means that something is added, whereas negative means that something is taken away. A reward is meant to increase a behavior, while punishment is used to decrease behavior.

Operant conditioning is often how we learn in social environments. Whenever you say something and it is met with a frown, you decide not to say it again. This is a type of learning. We are always learning through operant conditioning. We learn creativity and innovation (both hard and soft skills) in this way. Getting a high grade on an exam is positive reinforcement. A friend's smile when they see how you solved a problem for them is also an example of positive reinforcement. Society can also play a role in the shaping of our behavior. If we are punished or looked down upon for a behavior, it will act as a punishment that

decreases our behavior (For example, a young woman who is deciding a major. If her fellow classmates make a negative comment towards her choice of major, she may decide to change it.) This and the following few aspects of sociocultural learning are one of the reasons women are underrepresented in STEM feeds. Similarly for men, men are underrepresented in psychology, early childhood education, and nursing. The reason for this is not biological (though biology may play a small role) but social and cultural expectations.

▪ Operant Conditioning by Proxy

Operant conditioning by proxy can also occur. This type of learning is based on observation alone. We do not personally need to be rewarded or punished for our behavior for our behaviors to be shaped by society. (For example, there may be a young girl who enjoys building small inventions. On a television show she may see a girl being bullied (positive punishment) by peers for the same hobby.) Seeing the bullying occur, the young girl does not want to be bullied herself (positive punishment) and so the behavior decreases. This can also tie in with observational social learning and modeling first proposed by Albert Bandura.

▪ Observational Learning/Modeling

Albert Bandura's famous experiment of the Bobo Doll highlighted observational learning/modeling. In 1961 Albert Bandura conducted an experiment where he placed a clown doll (one he named the Bobo Doll) in a room with other toys. He allowed young children access to all of the toys in the room and recorded their behavior. Any interaction with the Bobo Doll was minimal. The children would inspect it, push it gently to watch it rock back and forth, or move it. Bandura then showed the children a video of adults punching and kicking the doll without repercussion. After the children were placed back in the room with the doll, they shockingly did similar things to the doll. The behaviors

ranged from a slight interaction to a child picking up a toy gun to press it against the doll. This created fear, in regards to what children were exposed to in their everyday life. In the early 21st century, when discussing creativity, if a child is exposed to creative behaviors they may be more likely to repeat these behaviors even if there is no reward or punishment. This is because a child often has little to no reference for new situations, and so they will look to a model for help.

24. Protecting Intellectual Property

Innovativeness and creativity are processes of generating intellectual property. Protecting intellectual property is an important component of the innovation process. One of the roles of governments in modern society is "to promote the progress of science and useful arts by securing for a limited time the exclusive rights to respective writing and discoveries" as stated in Article 1 Section 8 of the United States Constitution. [24.1, 24.2] Intellectual property can be bought, sold or inherited. [24.7, 24.9] Innovativeness and creativity can be highly profitable activities fueling the knowledge-based economy. There are four methods of protecting intellectual property.

1. Maintaining a company secret
2. Applying for patent protection
3. Applying for trademark protection
4. Applying for copyright protection

▪ Maintaining a Company Secret

Only a limited number of employees have access to the information. Each employee who has access to the company secret signs a confidentiality agreement obligating them to maintain the company secret even after retirement or termination of employment. COCA- COLA ingredients are successfully protected by a company secret agreement for over fifty years. If the company would have applied for a patent fifty-years ago and renewed it periodically, the patent would have already expired thirty years ago and the ingredients for COCA-COLA would be in the public domain.

■ Applying for Patent Protection

A patent is a form of property rights given to the inventor. A patent can be sold as a form of intellectual property. Patent protection is only valid in the country where the patent was issued. Therefore, often there is a need to apply for a patent in more than one country. There is a substantial fee associated in applying for a patent as well as for maintaining the patent protection. There are three types of patents. [24.5, 24.7]

1. Utility patent
   (This type of patent is technical and applies to new products, new or improved processes for a machine.)
2. Design patent
   (This patent protects a new ornamental design to be produced. It is usually related to art.)
3. Plant patent
   (This type of patent protects a new variety of plants and is related to agriculture.)

■ Applying for Trademark Protection

Trademark protection protects the company's symbol, e.g., COCA-COLA symbol. Trademark protection prevents others from using a similar symbol. Trademark protection does not prevent others from selling the same product under a different symbol.[24.3 , 24.4]

■ Applying for Copyright Protection

A copyright protects the authorship by providing the author with exclusive rights to reproduce the work. A copyright can apply to music, writings or dramatic works (published or unpublished). [24.5, 24.6, 24.7]

Most inventions are being protected by utility patents. There are five conditions that an invention would need to meet to be eligible for a utility patent. Those conditions are as follows:

- New invention
  (Not being used presently)
- Not obvious
  (For someone familiar with current technology)
- Suitable for practical industrial applications
- Not published previously
- Not patented previously

Ownership of the patent is granted as follows: [24.10, 24.11, 24.12, 24.13]

- Author of the invention
  (If the invention was not part of the employment responsibility.)
- Company employing the inventor
  (If the invention was done as part of the employment responsibility.)

Most employers and universities (public and private) are requiring their employees to sign an agreement giving the employer the right to intellectual property development during the duration of employment. In that case, the company can market the patent, but the employee (inventor) is entitled to 50% of the profit.

The procedure to apply for a patent allows the inventor to prepare their own application or hire a patent attorney. Preparing a patent application requires an understanding of patent law as well as technical merit. The patent application needs to include the following:[24.7. 24.9]

- Patent application form
- Description of the invention
- Summary of the invention description
- Drawing(s) or sketch(es)
- Patent search and examination fee
  (The patent office is conducting a patent search to verify the originality of the invention.)

- Claim and oath of originality signed in front of a government official

Within eighteen months the patent office publishes a description of the invention. After that the patent is being issued. (This is approximately 2.5 years after the patent application was submitted.)[24.9] The cost associated with applying for a patent can be significant especially if a patent attorney is hired. That cost is in the range of $5,000 to $15,000.

A significant part of the expense associated with applying for a patent is the cost of the patent search and writing a description. If the inventor chooses to conduct the patent search and write the patent description, there will be a significant saving. This requires, however, technical and some legal skills. There is a seven-step procedure for contacting a patent search.

Seven Steps in a Preliminary Search of United States Patents and a Published Patent Applications

During the process of writing a description of the invention, there is always a need to conduct a patent search to identify if any similar solution already exists. If similar solutions already exist, the inventor can either abandon the idea or explain how the invention is different. The procedure for a patent search is as follows: [24.10, 24.11, 24.12, 24.13]
1. Brainstorm terms.
2. Find relevant "Cooperative Patent Classification" (CPC). (www.uspto.gov)
3. Review the CPC definition.
4. Retrieve U.S. patent documents with the CPC that you selected. (Patents Full-Text and Image) using a government database (http://patft.uspto.gov)
5. Review relevant patent publications for similarity to your own invention.
6. Retrieve U.S. published patent applications with the CPC selected in Step 3 in the "Applications Full-Text and Image" (AppFT). (Refer to http://appft.uspto.gov).

7. Find additional U.S. patent publications by searching PatFT or AppFT databases, European Patent Office's patent database (http://worldwide.espacenet.com) and the nearest Patent and Trademark Resource Center (http://www.uspto.gov/ptrc).

Patent searches conducted by the inventor lead to a significant saving in patent attorney or patent agent fees.

Citizens of any country can apply for a patent in the United States. United States citizens applying for a foreign patent need one of the following prior to applying for an international patent.[24.12, 24.13]

- To apply for a United States patent.
  (This application needs to be done up to 12 months prior to applying for the foreign patent.)
- To secure written permission from the United States Patent Office to apply for the foreign patent without applying for the United State patent.

Polish citizens living in Poland must apply for a patent in Poland before applying for a patent in any other countries.[24.2]

- **Provisional Patent Protection
  as a Low-cost Valuable Alternative**

Since June 8, 1995, the United States Patent Office has offered inventors the option of filing a provisional application for a patent. This was done to provide low-cost patent filing.[24.10, 24.11, 24.12, 24.13] A provisional application allows the patent office to establish an early effective filing date for a patent application. It also allows the term "patent pending" to be used with the invention. A provisional application can only be filed for a utility patent. The filing date of the provisional application is the date on which the written description of the invention (and drawings) are received by the United States Patent Office. The provisional application needs to include a $260 filing fee and a cover sheet indicating that the application is provisional. Then the

applicant has twelve months to file a non-provisional application. The filing date of the non-provisional application is retroactive and matches the filing date for the provisional patent. If a non-provisional application is not filed within twelve months, the provisional patent expires. A provisional patent application is not being checked for merit and can be filed in any language. A provisional patent application is a very valuable option for new entrepreneurs and small companies in the incubation stage. A provisional patent provides them with twelve months protection for a $260 fee. Companies at the beginning stage of operation can start to market the product based on the invention. They can also check the market value of the patent by being able to disclose the idea to prospective buyers. If the business venture based on the invention is demonstrating sufficient growth, the profit which is generated can be used to apply for a non-provisional patent. If the invention does not generate any profit, the inventor can abandon the idea before investing more financial resources to pay for a non-provisional patent.[24.12]

The concept of provisional patents is a very effective way of helping the inventors and start-up companies. They can protect their innovative idea for one year without a costly and lengthy process of applying for a utility patent. One year protection is enough to develop a product based on the invention or negotiate the sale of the invention. There is no provisional patent concept in Poland. The timeframe for the procedure for getting a utility patent in Poland is longer than in the United States, that is 4.5 years in Poland and 2.5 years in the United States. Therefore, inventors in Poland are at a disadvantage.

25. Students' Weekly Assignments

The student weekly assignments are an example of thirteen assignments (corresponding with a fifteen-week semester). This list of assignments needs to be expanded, supplemented or changed as needed.

1. Trash-to-Treasure Project
   (Use *trash* that you can find in your house and create something useful or a piece of artwork.)
2. Make something from an old/used car tire.
3. List the five biggest failures which took place in your lifetime.
4. List the ten biggest successes which took place in your lifetime.
   (Look for the correlations between your successes and failures.)
5. Use a sheet of paper (8.5" x 11") and build a bridge between two paper cups (apart).
   (Measure the load capacity of that bridge by counting how many washers (provided by the instructor) can be put in the middle of the bridge before it will collapse.)
6. Build the tallest tower using 30 paper cups provided by the instructor.
7. Write the five most innovative ideas that you had in your lifetime.
   (Describe them in as much detail as possible.)
8. Write the five entrepreneurial opportunities that you have had in your lifetime.
   (Describe them in as much detail as possible.)
9. Describe any bold act of defiance that you took in your lifetime.
10. Reflect on your life and identify different phases through which you went.
    (What was the turning point of each phase?)
11. Write five ideas that can be implemented in your community which will enhance the quality of life in your community.
12. Write five innovative ideas to lower your carbon footprint.
13. Write three innovative ideas to lower your energy consumption.

26. Ideas for Students' Team Projects

- ■ *Improve Your Community and the World* Innovative Projects

This is a group project to be completed during the first twelve weeks of classes.

The class will be divided into multidisciplinary diverse teams. Each team will contain approximately five students. Teams can select one of the projects suggested by the instructor or can develop their own project.

The idea of *improving the world* must be developed and described in great detail.

Improving the world is being interpreted as making something better, more positive or human friendly. Making something better means something goes smoother, faster, less expensive, less labor-intensive, more functional and user-friendly, less energy-intensive, safer, etc.

Students will be allowed twelve weeks to complete the project, prepare a written report and make a twenty-minute oral presentation.

Students will report not only outcomes, but also the process and procedure, intelligent fast-failure methodology is recommended.

Students will be graded based on applying creativity and innovative behavior rather than just the project outcome. Project will be peer-reviewed by other students.

This is a list of eleven potential topics for the "improve your community and world projects". This list needs to be supplemented and expanded as needed.

- **List of Proposed Topics**

1. Energy efficient people transportation device for the future
2. Energy efficient low-cost housing
3. Harvesting and storing solar energy
4. Lowering the carbon footprint to prevent global warming
5. Water filtration system for underdeveloped countries
6. Futuristic healthcare and health monitoring system
7. Futuristic marketing and shopping
8. Futuristic mental healthcare and mental health monitoring system
9. Futuristic farming method
10. Food production for the 22nd century
11. Energy generation and storage

Students may add their own topic into the list after discussing it with the instructor.

27. Guideline to Providing Feedback to Innovative Colleagues

Most of the innovative projects are being evaluated by others from the perspective of assessing feasibility, making suggestions for improvement, etc. The evaluation can happen multiple times. Usually, the evaluation process takes place at the following:

- Entrepreneurial centers
  (peer-review, professional staff or volunteers)
- Business incubator centers
  (professional staff or volunteers)
- Financial institutions (for potential funding of the project)
- Venture capitalist (to secure potential funding)
- Universities or state sponsored agencies (promoting economic development)
- Private discussion with family, friends and other innovative individuals
- It is critical for the success of innovative projects to conduct the evaluation in an objective, but positive manner. The feedback provided to the inventor needs to be constructive and encouraging. Every "improve your community and world innovative project" completed by students will be evaluated by other students as well as by the instructor. Guidelines or peer-review of those projects are listed below.

Criticism and feedback provided to other students need to have the following components. [27.1], [27.2], [27.3]

- Positive spin
  (Describe the strengths of the project. Do this in a positive and constructive tone.)
- Assessment of uniqueness
  (Comment on the unique aspects of the project.)
- Suggestions for improvement
  (Be constructive and positive.)

- Assessment of educational values
  (Describe what you learned from the project. Use a positive tone)

Use encouraging approach in provided giving feedback: [27.1] [27.2][27.3]

<u>Positive</u>: First, highlight the strengths of the submission – what was done well? Give "happy comments" right away, and be considerate and constructive

<u>Unique</u>: Next, comment on interesting and unique aspects of the submission – what did you find interesting about it?

<u>Revision</u>: Third, be a "critical friend" – what suggestions do you have for improvement or revision. The purpose is not so much "to grade" as to interact and suggest.

<u>Education</u>: Close by reflecting on what you learned and how you were educated from the submission as a feedback provider.

Based on the experience from "improve your community and world innovative project" (doing the project as well as peer reviewing other student projects) ,in class s discussion and weekly homework students will gain the following learning and attitude outcomes.

Expected Learning Outcomes:

After the completion of the course, students will be able to.
- To describe the characteristics of innovative behavior in individuals.
- To describe the characteristics of innovative teams.
- To describe the characteristics of innovative organizations.
- To describe analysis and research methods for studying innovative behavior at different levels of the organization.
- To analyze different levels of innovative behavior at different levels of an organization.
- To state the factors influencing behavior at different levels of opportunities.

- To create an innovative solution to a given problem.
- To use a systematic approach for moving from a problem to a proposed solution and to commercialization.
- To work effectively on multidisciplinary diverse innovative teams.
- To state the differences between adaptive style and creative style.
- To identify their own creative style.
- Know how to manage the resistance.
- Demonstrate self-determination , codetermination and solidarity.
- Have problem solving ability.
- Know how to apply Intelligent Controlled Failure Method
- Know Ideation Methods
- Apply Design Thinking
- Know how to Evaluate Ideas.

Expected Attitude Outcomes:

At the end of the course, the student expected to
- View every new problem as a new opportunity.
- Seek opportunities to innovate.
- Apply creative thinking in everyday life.
- Be aware of their creative talent(s).
- Have a higher confidence level.
- Feel the sense of power.
  (I am in the driver's seat.)
- Feel capable of making positive contributions to the world.
- Have a positive outlook for the future.
- Feel that creativity is fun.
  (Creativity is not work.)
- Appreciate diversity and teamwork.
- Know how to keep Idea Journal.
- Appreciate creative diversity.
- Have the ability to make choices.
- Know how to talk to customers .
- Know yourself.
- Understand life phases and transformation

28. Student Resources

During the semester students can seek additional help and assistance from the following resources.

1. Regional Entrepreneurial Center
   a. Attend a workshop related to starting a business venture.
   b. Participate in an annual business plan competition.
2. Regional Business Incubator Center
   a. Attend a workshop on protecting intellectual property.
   b. Attend a workshop on seeking funding.
   c. Meet with venture capitalists to secure funding.
3. Engineering Faculty at a Local University
4. Business Faculty at a Local University
5. Psychology Faculty at a Local University
6. Other Students and Classmates
7. Regional and State-Sponsored Agencies Responsible for Economic Development
   a. Information about protecting intellectual property
   b. Conducting patent search
   c. Grant information

29. Ethics of Innovations

The term "innovation" comes from the Latin noun innovatio (renewal) and the verb innovare (to renew) and is defined as the introduction of something new; thing newly introduced; novelty; reform [29.10]. The approach to innovation from a management perspective has changed over time. Currently, innovation can be defined as the process of "transforming existing possibilities into new ideas and putting them into practical application" [29.24]. However, not all innovations meet the criteria of ethics. Innovations, by definition, should serve people and improve their quality of life according to the concept of sustainable development. Successively various activities are undertaken to achieve this goal. Nevertheless, apart from those innovations that serve people, there are also those that harm them by creating different types of risk.

Issues relating to the ethics of innovation should be considered in relation to various specific ethics, normative and applied. The review may begin with ethics of technology. Technological innovation will be the subject of an overview in the field of ethics of technology as well as development of science and technology and the problems they can generate. Innovative technologies can have two aspects: they can serve people in various aspects of their lives, but they can also generate negative effects. Successive industrial revolutions (age of steam, age of electricity, age of computers, age of the Internet and the disappearance of the border between man and machine) led to the facilitation and improvement of people's quality of life. These serious changes in the human psychological environment may lead to human dependence on technological products and has a negative influence on his psyche [29.14]. It leads to the atrophy of feelings, boredom and purposelessness of human existence. Currently, the ethics of technology is facing new challenges in connection with the development of information and communication technologies, Industry 4.0, cognitive

technologies, artificial intelligence, automation and robotization. In this context, new challenges related to the issue of responsibility appeared [29.13]. Thus, innovation in ethical terms should be considered in the context of responsibility as the basic ethical category.

Technological innovation is now opening up new perspectives for ethical reflection. They do not only concern mankind, but also products. This problem clearly manifested itself in the era of automation and robotization related to the development of Industry 4.0, the development of modern information and communication technologies (ICT), cognitive technologies and artificial intelligence. There was a problem regarding the ethicality of robots, i.e. equipping these products with human intellect with moral values on the one hand, and on the other hand, ethical control over their functioning. The rapid development of artificial intelligence(AI) and cognitive technologies has made modern intelligent robots/AI able to act in many respects just like humans. Intellectually they are often equal to or even better than man. However, the moral sphere has not been demonstrated by robots yet. It is debatable whether it is good or bad. Morality is the element that distinguishes a human being from a robot. The morality issue is still unresolved.

Traditionally, the ethical dimension concerns mankind and moral actions based on responsibility. The development of modern technologies, including intelligent robots, meant that the ongoing discussion concerning whether intelligent robots can, like humans, also be assigned subjectivity and thus be granted the status of ethical entities. The ethicality of subjects is considered from the point of view of intentionality. Robots with the capability of specific instrumental actions are certainly the representatives of their designer and/or controller. The scope of robots' instrumentality is determined by the designer. In the case of intentionality, we enter the area of normativity, and this is an area traditionally assigned exclusively to man. One cannot exclude the possibility of equipping the robots with a specific resource of normativity. The work of programmers in this area is being developed. If it was possible to equip robots with ethical values and link efficiency with intentionality, then some kind of subjectivity could be ascribed to

robots [29.9, 29.8, 29.13]. Whether it is needed is a separate problem. Certainly, ethical regulations regarding the human-intelligent robot relationship are needed. Humanity has been addressing these issues for a long time. Isaac Asimov formulated the laws of robots, which were to regulate the relationship between robots and humans, specifying three main laws:

1. A robot cannot harm a person, nor allow a person to suffer harm by failure to act.
2. The robot must obey human commands unless they conflict with the first law.
3. The robot must protect itself, as long as it does not contradict the first or second law

Overriding those laws is Law "0", which says that: The robot cannot harm humanity, or cause harm to humanity by failure to act [29.1]. These four formulated laws show the anthropomorphizing of the world of robots and the ascription of human characteristics and decision-making abilities to them. From the perspective of contemporary experiences, this is no longer so unrealistic. Intelligent algorithms successfully take over functions that have so far been associated only with humans. Consequently, it will be necessary to introduce a regulatory framework wherever there are intelligent solutions that affect the sphere of the human, social and natural environment [29.13]. In the European Union(EU), work on the framework for the functioning of "ethical artificial intelligence" was started in 2018. The *White Paper on Artificial Intelligence: A European Approach to Excellence and Trust"* [29.2] specifies the term "ecosystem of trust" based on a regulatory framework for the protection of fundamental and consumer rights which guides citizens through their use of artificial intelligence. To create a trustworthy artificial intelligence framework, seven key requirements have been identified. Some of the key requirements are as follows:

1. Guiding and supervisory role of humans must be guaranteed.
2. Stability and security.
3. Privacy and data protection.
4. Clarity.
5. Diversity, non-discrimination and justice.

6. Social and environmental well-being.
7. Responsibility.

The document also indicates the opportunities and threats related to the development of artificial intelligence. Opportunities include improving health care (e.g., more accurate diagnostics, better disease prevention), increasing agricultural productivity, contributing to climate change adaptation and mitigation, improving the efficiency of production systems, and increasing safety. Threats include non-transparent decision-making, discrimination on the basis of sex or other factors, interference in our private life or use for criminal purposes [29.13]. Innovations in this area (as in any other) must be responsible innovations, which modern people are well aware of, although they do not always take them into account in their actions. With regard to innovative technologies and research, programs are created to focus on multilateral cooperation. Such an idea developed within the European Union is RRI (Research, Responsibility and Innovation - responsible research and innovation). RRI is a process that considers the potential environmental and social impacts and impacts of research and innovation. Responsible research and innovation are processes undertaken with and for society. RRI should be a transparent and interactive process where different members of society (scientists, citizens, politicians, entrepreneurs, NGOs, etc.) work together throughout the research and innovation process to determine the ethicality, purposefulness and durability of embedding scientific and technological achievements in society [29.3]. RRI can be understood as a process of fundamental changes in responsibility. Responsibility is no longer seen in individualistic and consequential terms, but in terms of responsibility in which all social actors are involved (collective responsibility)[29.12]. For this reason, ethical education is necessary not only for engineers [29.16], as the main entities creating technological innovations, but also for politicians, decision makers and the whole society. RRI should integrate four dimensions: anticipation (anticipating future changes and effects), reflectivity, inclusion (a wide range of stakeholders), mutual reaction (regarding this knowledge, perspectives, views, norms, etc.). Moreover, in the RRI process, diversity, openness (transparency) and adaptive

changes are important [29.4]. Despite the short history of RRI, many studies have already been produced on the subject, and various projects have also developed RRI tools for politics, business and industry, citizens, civic organizations, social education and research. In RRI, as in the concept of sustainable development, responsibility is the central ethical value[29.12]. The conceptual assumptions of sustainable development indicate three main dimensions: economic, social and ecological. Each of these levels is assigned a specific catalog of values, and the values that connect them are human and its individual responsibilities.

These issues are discussed in the field of technology ethics, which focuses on the regulation of activities within the development of technology and modern technologies. The task is to ethically manage internal changes in science and technology and on the other hand, to influence the direction of political and social management of the processes of disseminating the results of the development of science and technology as related to technology assessment [29.8]. The ethics of technology as the subject of considerations is in the development of science and technology, the effects (positive and negative) of technical advances on individuals as well as social and organizational life. The risks related to the development of technology, its scale and level of acceptability, and the analysis of the possibility of social conflicts arising in connection with development (e.g., the problem of technological unemployment) [29.15] and the availability of modern technologies defines the levels and subjects of responsibility (individual, collective, institutional) [29.13]. In such an understanding, the ethics of innovation falls within the ethics of technology and is based on responsibility in all of the above-mentioned dimensions. The ethics of innovation should also be considered in relation to social innovation. In professional ethics, primarily engineering ethics, there is no one profession of engineering, but all engineering has one common denominator of responsibility. There are, therefore, many engineering professions, but one ethos for an engineer that focuses on the traditional individual subject of responsibility. In traditional ethics, an instance of responsibility may be the engineer's conscience, which should be the guide towards developing their engineering passions that will benefit human and non-

human communities. The professional ethics of an engineer is the ethic of an innovator, creator, constructor, human being. It should be noted that not every engineer has to be an innovator. High social expectations are set for people working in the engineering profession. Engineering activity results in the practical use of their products and the related safety of operation of various work environments, reliability of products and technologies, harmlessness of products to the health of individuals and the whole society, as well as the natural environment. These results are the opportunities which direct engineering activities towards innovation. Therefore, each time a new idea arises, engineers should ask themselves whether the prototype, construction, technology, finished product created on the basis of this idea, will bring good to society and its individuals. If not, stop developing such ideas and look for other solutions. Engineers face the requirement and the obligation, at the same time, that their activities in their professional practice provide benefits and minimize social harm. Therefore, ethical standards play an important role in engineering practice. They provide guidelines for moral behavior within the profession. However, as a consequence, the professional ethics of an engineer depends on his individual morality, acquired mainly in the phase of primary socialization, but also in the phase of secondary socialization. Therefore, teaching professional ethics will be an important aspect in shaping engineers' consciousness [29.13]. Ethical standards for engineers are contained in codes of ethics and focus on safety, health, social welfare and all engineering activities that are to serve these purposes [29.25]. In the process of ethical education, the engineer's character traits should be shaped, such as prudence, caution and responsibility, as well-established human inclinations to act in accordance with the ethical good [29.21]. In the era of the development of modern information and communication technologies, Industry 4.0, artificial intelligence and cognitive technologies, the ethics of innovation, including engineering ethics, is of particular importance. The latest trends in technology development are the subject of numerous scientific studies [29.18, 29.23, 29.11, 29.17, 29.19.], Modern technologies are a permanent element of people's everyday life and often generate a number of ethical problems. Engineers - creator, constructor, innovator - in their work are faced with ethical dilemmas, the resolution of which

is not easy at all, hence the need for ethical education. Thus, it can be said that character virtues are important in any given profession. In this case, reflection on this subject should be rooted in the ethics of virtue. Virtue ethics is also strengthened by engineering deontology (moral obligation, commitment, ethics). Organizations associating engineers formulate codes of ethics, which define the duties of the engineering profession [29.13].

The issue of innovation and ethics of innovation are also closely related to business ethics, including business innovations based on, technological, organizational and financial innovations. They do not always take an ethical perspective. For example, financial innovations were supposed to help "run a business, facilitate trade and economic turnover between distant places in the world, and improve the functioning of people in everyday life, but the high rates of return that they began to bring meant that financial institutions and their managers are focused on their earnings. The ease and speed with which it is possible to make a profit, to earn some extra money by trading financial instruments or creating new ones, turned out to be an insurmountable temptation for many financial market participants."[29.5]. As a result, a type of financier emerged with such characteristics as: "inclination to count, unlimited lust for possession, strong desire for power, attitude of radical technocratic rationalism, extreme individualism, inability to emotion, lack of feeling and need for community, moral indifferentism, exaggerated propensity to risk" [29.5]. The lack of ethical reflection led to extreme pathological behavior (disorders in behavior). Modern blockchain technologies are currently developing to improve financial and accounting processes [29.22]. Blockchain is a system of recording information in a way that makes it difficult or impossible to change, hack, or cheat the system.

Similar situations occur with modern solutions in administration [29.20] or information and communication technologies [29.17; 29.19]. However, if innovative solutions are to serve people, they must be applied in an ethical manner. So again, there is a need for ethical education, or even forming people's character by using the latest

technological solutions. When it comes to innovation, ethical reflection is essential at every innovative stage (creation, application and use). There is no doubt, however, the world is everchanging and innovation is an integral part of development. The ethics of innovation allows you to become aware of the complexity of human behavior in the light of the development of innovation and the creation of ethical innovation.

30. Innovation management

The term "innovations" was introduced to the economy by J. Schumpeter, who in his model of the emergence of innovations drew attention to the internal management mechanisms that determine their formation [30.37]. Explaining the concept of "creative destruction" accompanying the emergence of innovation, Schumpeter refers to the Kondratieff cycles, explaining the importance of innovation in economic development [30.38]. Schumpeter considered innovations:

1. Creation of a new product.
2. Application of a new method of production and organization of the industry.
3. A new market.
4. New sources of raw materials and new raw materials.
5. New organizational solutions [30.37].

Innovation is particularly important in managing sustainable development in all its dimensions: economic, ecological, social and cultural. The concept of sustainable development has been present in the strategies and plans for the development of cities, villages and enterprises for several decades. Although the translation of the principles of sustainable development into practical activities still does not bring satisfactory results. Humanity on a global, regional and local level continues to struggle with the progressive degradation of the natural environment and deepening ecological, economic and social crises. Nevertheless, innovation is an important element in implementing the principles of sustainable development. They are indicated as an important element of the implementation of the assumptions and goals in the concept of sustainable development. They are recognized as an instrumental value and a tool for shaping better living, work, rest and environmental protection conditions [30.12]. In Agenda 21, the terms 'innovation' and 'innovative' appear almost fifty times in different contexts

and cover both technological and social issues. They are considered in relation to innovation in teaching, social innovations related to the processes of social inclusion, economic and financial innovations, various types of innovations in enterprises and entrepreneurship, and the aforementioned technological innovations, both in relation to the economy (development of enterprises, including green technologies), and the development of the information society. Innovation is about programs, approaches, processes, products, methods, experiences, research [30.1.]. The innovation trend is maintained in subsequent documents constituting the concept of sustainable development, i.e. in the implementation plan from Johannesburg (2002), in the final document of the RIO + 20 conference "Future We Want" (2012), in the new 2030 Agenda for Sustainable Development (2015) [30.14]. In the concept of sustainable development, innovations are aimed at improving the quality of life in its various dimensions. What is important, however, is a properly prepared innovation management process, skillfully integrated into strategic management [30.4, 30.6, 30.14, 30.28].

The etymology of the term "innovation" refers to the Latin root words innovatio (renewal) and innovare (renew) and is defined as introducing something new; thing newly introduced; novelty; reform [30.11]. There are many definitions of the concept of innovation [30.15], although they change slightly over time. In the past, innovation was viewed as a linear or ladder process - (unidirectional) - from scientific research to practical application. Currently, more attention is paid to the interactive nature of the process, in which feedback is an important element [30.14]. This understanding of the innovation process best characterizes the so-called Kline and Rosenberg's chain-link model [30.35]. E. Okoń-Horodyńska (2008) defines innovation as a process consisting in "transforming existing possibilities into new ideas and introducing them to practical application" [30.36].

Managing innovations requires great managerial skills and the decision-making courage of managers, because the innovation process is associated with investment uncertainty. It is impossible to predict with 100% certainty that a new product or service will interest potential

recipients. Investments in innovation are often loss-making and there is no way to get back the invested capital. You should analyze whether the risk is at an acceptable level. When making important management decisions, one should be objective in order to properly define the optimal time for the development and use of innovation, the effectiveness of the capital involved while taking into account the progressive approach to innovation [30.27, 30.14].

The innovation management process should be complemented by effective innovation marketing. Marketing of innovation is defined as a management process supporting the transfer of research solutions to practice and the implementation of these solutions in specific products and services. The main goal of innovation marketing is to lead to the application of knowledge, innovative solutions and the results of scientific works to practical applications, i.e. from a concept to its implementation and commercialization [30.2.]. In this approach, innovation management should also be placed in the context of knowledge management [30.20, 30.16.].

Recently, we have been observing a significant technological acceleration, mainly in the areas of the development of Industry 4.0, artificial intelligence and cognitive technologies [30.13, 30.22, 30.30, 30.31, 30.32, 30.44]. Well-planned innovation marketing supports the rapid transfer of modern technologies to practical solutions. Cognitive technologies are used in various areas of enterprise functioning, both in the technological, organizational and management spheres.

Innovation management is also included in the context of game theory and reflective management [30.21, 30.29]. An important aspect of innovation management is the skillful management of human resources and talent management. Appropriate organizational support and the use of effective motivational tools lead to the emergence of new ideas [30.8, 30.9]. What is also important in innovation management is cooperation with universities and research institutes, involvement of business in the educational process and a real impact on educational innovations in the field of creating innovative education programs [30.10, 30.18].

In the context of the implementation of the assumptions of sustainable development, ecological innovations (technological, social and educational) are important. Since the announcement of Agenda 21, many green technologies have been used in industry, in particular in green sectors of the economy, e.g. renewable energy, increasing energy efficiency [30.3, 30.23, 30.25, 30.17]. Examples of good practices in this area are described, inter alia, in "The Business Case for the Green Economy: Sustainable Return on Investment "(2012) [30.43]. The conclusion resulting from the report is as follows: the green economy is an opportunity for business, and environmental investments not only pay off, but also to allow for success in the market. The report contains examples of positive rates of return on investments in the green economy and shows that green investments are not only financially profitable, but also strengthen the brand value and influence the formation of a positive reputation of the company, which in turn translates into financial profits and extends the time of selling a given product or services. However, the vision of the development of a green enterprise requires courage and taking into account a number of different factors, such as the specificity of the industry, location, access to resources, etc. [30.14].

Almost a decade of investments in the green economy showed measurable benefits, both economic and ecological, which can be traced in scientific studies on these issues [30.5, 30.7, 30.33]. Green smart marketing tools [30.24] can be used to promote green economy, combined with shaping a positive image of enterprises, cities and countries, not only from the perspective of environmental safety, but also economic growth [30.34, 30.31], social and public factors [30.41, 30.42]. These issues can also be viewed from the perspective of cooperation [30.39, 30.40].

There are many examples of the application of innovative technologies for environmental protection. Innovative solutions are used to improve safety, shape better living conditions, develop tools to facilitate communication and communication, etc. In many cases, managerial decisions related to innovation management have brought tangible

economic results and serve the good of people and society and the protection of the natural environment. It should be emphasized, however, that not all innovations can be classified as such. There are also many examples of "harmful" innovations. That is why it is very important to educate engineers ethically in order to shape their attitudes of responsibility and prudence [30.26, 30.19].

31. The Role of a Leadership in Management Based-on Creativity and Innovation

31.1. Organizational Leadership (Predisposition, Characteristics/ /Attributes, Competence)

Are leaders are predisposed by nature (genetics) or by steadfast determination, experience, environmental circumstances (nurture) to develop leadership abilities

Klemens Ścierski Minister for Industry and Trade (Poland) who participated in coordinating the change from socialism to capitalism (mid-1990s), used to say: "It is not difficult to work hard just to do a job. Achieving the set goal is what counts." He implemented this principle not only in the public life in Poland during the time of political transformation, but also in the field of his professional activities. For nearly 30 years he managed a large coal power plant. When he set a personal goal of reducing the nuisance of the plant to the natural environment, he was able to install expensive denitrification and desulphurization systems, and the power plant was awarded the prestigious title of "Ecology Leader". Wanting to encourage employees to look for innovation, he introduced incentive systems, which resulted in the fact that the company had completed many innovative projects in the entire energy industry. Ścierski is the holder of forty-six patents. He achieved this by skillfully dividing his time into being a minister, deputy, senator and director.

This example shows how important a leader's role can be. Time management skills of a leader may have a direct impact on the implementation of the mission of the organization understood as the meaning of its existence, as well as the vision perceived as the

long-term goals to be achieved. The leader has a special role in the field of management as related to change within the organization. The leader's role includes the implementation of procedures and methods, promoting the perception of the need to search for innovations and their application on many levels of the organization's operation.

A Classical Approach of the Study of Leaders

In the classical approach, the leader has to set goals, define the methods of achieving them, decide on the gathering and allocation of resources necessary for the implementation of this process as well as coordinating the actions to be taken and supervising them. A leader can have characteristics including, but not limited to ambition, self-discipline, determination, decisiveness, assertiveness. An archetypal leader can also have characteristics such as creativity, openness and responsibility.

Leadership is defined as the ability to influence a group or to exercise power. Power means any change within an organization will be forced through, even despite resistance, no matter what the change relates to [31.9]. Power in an administration, institution, company or service can be characterized as formal because it results from specific provisions, e.g., election law, regulations or statutes. The authority is ensured by the existing organizational hierarchy, which specifies the scope of competences and responsibilities in a given position. Related to this is the power of rewarding, i.e., using a system of incentives, a strategy leading to an innovative behavior. Moreover, power allows for the distribution of limited resources or goods. Another form of power is also expert power built on the knowledge and competences of certain members of the organization [31.7].

31.2. Leaders from the Perspective of Charismatic Leader(s) and Talent Hunter(s)

A sports team coach, commander of a military unit or director of a department in a corporation is responsible for success measured by

triumph during a competition, victory in an armed clash or the result of market activity. These goals can be achieved using a variety of leadership models. There is a fundamental difference between leadership and management [31.3]. According to some scientists, they are similar in the tools used, such as raising awareness of the organization's goals, teamwork, and the use of techniques influencing team behavior, but they differ in the effects of functioning. Management usually tends to stabilize, while leadership (especially by charismatic leader) tries to change reality. This concept of management was strongly emphasized by Max Weber. Hence, the synergy of leadership and management needed to be at an optimal level for the sustainable development of the organization. The criteria is weakened when leadership is perceived as a management function of a narrower significance than management. The leadership directly linked with management is then "a set of processes used to guide the members of the organization to cooperate with each other in the interest of the organization" [31.2]. This link does not change the beneficial effects of the synergy within the organization.

Leadership from the process perspective is a situation where "an individual influences a group of people to achieve a common goal" [31.6]. This author has formulated theories related to effective adjustment of the leader's style to the situation, orientation to motivation and interaction between the leader and subordinates. The author also suggested servant leadership, where the leader puts the welfare of his subordinates above other criteria. This last solution refers to idealism rather than reality. Organizational leadership depends on a person having formal authority. The leader also gains personal authority. Then the leader trusted by the team because of his knowledge, experience and competencies. These characteristics are understood as qualifications completed, if necessary, with formal entitlements and are able to charismatically support the implementation of the organization's strategy. These characteristics do not depend on whether the leader prefers a directive style (leadership by issuing orders), relational, normative, authoritarian or democratic style. Leadership skills may be innate (born leader) or simply learned through exercising power to achieve the planned goals. The leader seems to be extremely important for the success or failure of the organization.

The charismatic leader (visionary), who takes decisions that change the fate of the entire organization individually and autonomously, is a management legend (Edison, Westinghouse, Goodyer, Iaccoa, Jobs, etc. . At the same time, their model is less and less adequate to reality. A modern leader should be open to innovation. A leader's role in internal relations should be to discover new leaders in the organization rather than just showing directions, motivating and supervising. In this way, a leader who is a "talent hunter" for the organization's team, identifies management competences by delegating powers and responsibility. In this context, the essence of the role of a leader is to ask the team the right questions instead of providing ready-made answers. What matters is releasing the creative potential of the team [31.1]. In this way a balance is achieved. The number of committed, motivated and ambitious "reserve leaders" at various stages of the project implementation creates an atmosphere conducive to improving efficiency and introducing innovation. Those leaders holding the highest positions are responsible not only for the current activity, but above all for the long-term strategy of the organization (related to social and economic changes). Those leaders also need to consider individuals' needs and environmental aspects [31.4].

31.3. Communication Skills
in the Process of Implementing Changes

Communication is a two-way process of transmitting information between the sender and the recipient to establish and maintain a relationship in the form of contact, understanding or influencing. Three years after the end of World War II, Harold Lasswell of the University of Chicago [31.5] briefly described the process using the categories expressed by the following questions: (1) the sender (who is speaking?), (2) the message (what is he saying?), (3) the communication channel (by what means?), (4) the recipient (who is he talking to?) and (5) the results achieved (with what effect?). It is also worth recalling the completely independently created, although at the same time - in 1948, transmission model developed by the electronics engineer and

mathematician Claude Shannon and his associate Warren Weaver [31.8], who by analyzing the mathematical structure of the flow of signals introduced additional categories such as: channel capacity, term of code, since the signal is encoded during transmission and decoded at the time of reception, or information noise being the source of the interference. Of course, not only in the technical sense, but also in the semantic, contextual and substantive sense.

Communication allows for the transfer of information and interaction also in the aspect of persuasion. Therefore, communication is a strategic field of activity for a leader. It requires all management functions, from planning, through organizing and coordinating activities, to their implementation and evaluation. Communication management is a basic challenge for people responsible for the functioning and development of an organization and for introducing innovations.

Communication relationships have to be created both within the supervised structures as well as with external recipients. This applies to all stakeholders of a given entity - constantly and directly influencing the conditions and effects of operations or only incidentally and indirectly. Of course, this requires the creation of a communication strategy, the basic components of which may be the items specified in the cited Lasswell model, because usually the purpose of these relations will be persuasive. Communicating the organization with its social, economic and political environment is not, however, the same as promotion. Building a position, consolidating a planned reputation, shaping an opinion, although long-lasting and often also tedious, bring long-term effects. The product result measured by the increase in sales in the case of advertising campaigns cannot be easily translated into image-building activities. Building and strengthening a brand is an investment. Reaching the assumed level facilitates expansion: a candidate that inspires confidence of voters wins the elections, a popular sports team is a dream come true for ambitious players, and buyers convinced of high quality of services are more likely to use the offer of a specific company, etc.

31.4. Informing, Motivating and Awakening enthusiasm

Communication in the organization fulfills an informative, motivating and control function. It also gives the opportunity to express emotions. Focusing on improving the quality of internal communication is a task not only for global corporations which, due to the dispersion of their branches all around the world, have to deal with the effects of multiculturalism among employees. In a small family business, it is necessary to talk and listen with understanding. The distances to be covered, the scope of contracts to be analyzed or, ultimately, the profits achieved result from the scale and type of activity. On the other hand, the nature of the communication relationships remains unchanged. A leader who wants to achieve the set goals has to communicate them skillfully. The best situation is when he is able to involve subordinates in the creation of plans, who should be aware of the challenges taken. Convincing the team that results in approval for the set goals, and sometimes even enthusiasm, gives additional chances of success.

The multilateral communication in the organization allows superiors and managers to convey orders, express expectations, provide information about systems of evaluation or verification of work performance, data on performed activities or scopes of duties, motivating, advising, etc. It allows subordinates, for example, to report the effects, raise questions, signal needs, indicate the ways to improve work or rationalize the conducted processes. Proper supervision over communication activities, as well as over the availability of message distribution channels for employees, allows not only for the effective implementation of the information policy, but also contributes to the integration, mobilization and activation of employees around the values important for the organization.

However, an effective leader must be aware of the consequences of the aforementioned information noise or interference as a consequence of coding and decoding errors. In this aspect, the leader's responsibility

for the opinions expressed is important. The cases when bosses with their innocent remark about the weather started investment processes in supervised companies are known. For example, after the mechanically spoken by the leader, visiting the branch of the company, words about the pouring rain, huge roofs of industrial areas were built. On a subsequent visit, proud lower-level management reported to the surprised leader that they had removed the inconvenience he had recently been paying attention to. Instead of unnecessarily investing in building redundant infrastructure, one could simply buy an umbrella. Meanwhile, however, it is the leader who must be aware of the importance that his statements may have for subordinates.

It is similar in relations with the external environment. The disseminated messages always have their cultural, political and historical context. Mutually beneficial contacts can be easily lost due to a lack of knowledge, interest or experience in the field of communication.

31.5. Communication
in Creating an Atmosphere Friendly to Innovation

Proper communication management in an organization shapes the corporate culture, increases the sense of approval towards its internal value system and stimulates the creativity of employees, improves interpersonal relations, prevents resistance to the introduced changes, and at the same time facilitates the creation of an atmosphere conducive to the implementation of innovations. Hence, it is so important to define goals for communication activities at the planning stage. Referring again to the Lasswell model, where the initiative is assigned to the sender and its purpose has a persuasive dimension, it is also necessary to specify the nature of information activity in the organization, specify the message distribution channel, segment the audience and plan the schedule of activities. The possibilities of modern means of communication, the formula of feedback should be planned. Thanks to modern content carriers, the phenomenon of convergence also applies to the principles of interaction between the sender and the recipient. The recipient,

thanks to the editing, commenting and sharing functions, activates his subjective role, being both the addressee and becoming a co-author of subsequent versions of the message distributed using a given medium or other communication tools.

The reference to Lasswell's formula is sometimes useful also after the end of a given stage of activities to carry out the process of their evaluation. If some of the assumed tasks have not been completed, the reason must be determined. It may be searched, among others, in the sphere of the sender's responsibility, the functioning of the channel, the formulation of the message, the recipient's reaction or the definition of goals. Leaving the process without intervention causes the displacement of reliable news by rumors, manipulations and gossip, and disinformation disseminated within an organization can have fatal consequences for its future.

Proper communication management in an organization is a condition necessary for ensuring its proper functioning, development opportunities and creating an atmosphere conducive to discovering and implementing innovations.

Bibliography

1.1. Oxford English Dictionary (2012). Oxford University Press: USA. ISBN-13: 9780198611868

1.2. Kim, Suyeon (2006). Can We Trust Creativity Tests? A Review of the Torrance Tests of Creative Thinking (TTCT). Creativity Research Journal, 18(1), 3–14. https://www.researchgate.net/publication/237792387. DOA: 11.05.2021.

1.3. Torrance, E. Paul (1995). Why Fly?: A Philosophy of Creativity (Panel Answer Book Series). Psychology Press Ltd: Hove, East Sussex, UK. ISBN-13: 978-1567501728.

1.4. De Angelis (2003). The Dream Canvas: Are dreams a muse to the creative? Monitor: American Psychological Association, 34(10), 44. https://www.apa.org/monitor/nov03/canvas. DOA: 11.05.2021.

1.5. Dorner, Dietrich and Joachim Funke (2017). Complex Problem Solving: What It Is and What It Is Not. Frontiers in Psychology, 8:1153. https://www.frontiersin.org/articles/10.3389/fpsyg.2017.01153/full. DOA: 11.05.2021.

1.6. Resnick, Mitchel (2017). Lifelong Kindergarten: Cultivating Creativity through Projects, Passion, Peers, and Play. MIT Press: Cambridge, MA. ISBN13: 9780262037297.

1.7. Aguilar, David and Manoli Pifarre Turmo (2019). Promoting Social Creativity in Science Education with Digital Technology to Overcome Inequalities: A Scoping Review. Frontiers in Psychology, 10: 1474. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6614193/. DOA: 11.05.2021.

1.8. Conti, Regina, Heather Coon and Teresa M. Amabile (1996). Evidence to Support the Componential Model of Creativity: Secondary Analyses of Three Studies. Creativity Research Journal, 9(4), 385-389. https://www.tanfonline.com/doi/abs/10.1207/s15326934-crj0904; https://www.hbs.edu/ris/Publication%20Files/12-096.pdf_. DOA: 11.05.2021.

1.9. Amabile, Teresa M. (1988). A Model of Creativity and Innovation in Organizations. Research in Organizational Behavior, JAI Press Inc., 10, 123-167. ISBN: 0-089232-748-0. http://emotrab.ufba.br/wp-content/uploads/2019/06/AMABILE-Teresa-A-model-of-creativity-and-innovation-in-organizations.pdf. DOA: 11.05.2021.

1.10. Davis, Ben (2020). What Are the 5 Components of Creativity MV Organizing. https://www.mvorganizing.org/what-are-the-5-components-of-creativity/#What_are_the_5_components_of_creativity. DOA: 11.05.2021.

1.11. Sternberg, Robert J. and T.I. Lubart (1998). The Concept of Creativity: Prospects and Paradigms. [in] Handbook of Creativity. Sternberg, R.J. (Ed.) Cambridge University Press: Cambridge, England, 3-15. ISBN: 978-0521-57285-9.

1.12. Sternberg, Robert J. (2006). Creativity Research Journal, 18(1), 87–98. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.294.3558&rep=rep1&type=pdf. DOA: 11.05.2021.

1.13. Williams, Rich, Mark A. Runco and Eric Berlow (2016). Mapping the Themes, Impact, and Cohesion of Creativity Research over the Last 25 Year. Creativity Research Journal, 28(4), 385-394. https://www.tandfonline.com/doi/full/10.1080/10400419.2016.1230358. DOA: 11.05.2021.

1.14. Guilford, Joy Paul (1950). Creativity. *American Psychologist, 5*(9), 444–454.

1.15.. Guilford, Joy Paul. (1956). The structure of intellect. *Psychological Bulletin, 53*(4), 267–293.

1.16. Namia, Yaghoob, Hossein Marsooli and Maral Ashouri (2014). The Relationship between Creativity and Academic Achievement. 4th World Conference on Psychology, Counselling and Guidance WCPCG-2013. Procedia – Social and Behavioral Sciences 114, 36 – 39. https://pdf.sciencedirectassets.com/277811/1-s2.0-S1877042814X0008X/1-s2.0-S1877042813052919/main.pdf. DOA: 11.05.2021.

1.17. Fisher, Tamara (2011). Creative Thinking. Education Week. https://www.edweek.org/education/opinion-creative-thinking/2011/07. DOA: 11.05.2021.

1.18. Baer, John (2016). Implications of Domain Specificity for Creativity Theory* [in] Domain Specificity of Creativity. Academic Press: London, United Kingdom. ISBN: 978-0-12-799962-3.

1.19. Sitorus, Jonni (2016). Students' Creative Thinking Process Stages: Implementation of Realistic Mathematics Education. Thinking Skills and Creativity, 22, 111-120. https://www.science direct.com/science/article/abs/pii/S1871187116301183. DOA: 11.06.2021.

2.1. Hartman, Patrick (2016). Innovation in Horizon 2020: Innovation Concepts and Innovation Policy.http://www.ncpacademy.eu/wp.content/uploads/2016/12/20161018_Presentation_Innovation_PH.pdf. DOA: 11.05.2021.

2.2. Singh, Sanjay and Yogita Aggarwal (2021). In search of a consensus definition of innovation: a qualitative synthesis of 208 definitions using grounded theory approach. Innovation: The European Journal of Social Science Research. https://www.tandfonline.com/doi/abs/10.1080/1351 1610.2021.1925526. DOA: 11.05.2021.

2.3. Moss, Frank, et.al. (2011). Innovation: Perspectives for the 21st Century. BBVA Foundation: Madrid, Spain. ISBN: 9788492441488.

2.4. Castaneda, Delio Ignacio and Sergio Cuellar (2020). Knowledge Sharing and Innovation: A Systematic Review. Knowledge and Process

Management: The Journal of Corporate Transformation, 27(3), 159–173. https://onlinelibrary.wiley.com/doi/10.1002/kpm.1637. DOA: 11.06.2021.

2.5. Chan, C.S. Richard and Annaleena Parhankangas (2016). Crowdfunding Innovative Ideas: How Incremental and Radical Innovativeness Influence Funding Outcomes. Entrepreneurship Theory and Practice, 41(2), 237–263. https://journals.sagepub.com/doi/full/10.1111/etap.12268. DOA: 11.06.2021.

2.6. Myhren, Per, Lars Witell, Anders Gustafsson and Heiko Gebauer (2017). Incremental and Radical Open Service Innovation. Journal of Services Marketing, 32(4), 101–112. ISSN: 0887-6045. https://www.emerald.com/insight/content/doi/10.1108/JSM-04-2016-0161/full/html. DOA: 11.06.2021.

2.7. Marshall, Guillermo and Alvaro Parra (2019). Innovation and Competition: The Role of the Product Market. International Journal of Industrial Organization, 65, 221–247. https://www.sciencedirect.com/science/article/pii/S0167718719300207. DOA: 11.06.2021.

2.8. OECD Directorate of Science, Technology and Industry (2012), Innovation for Development: A Discussion of the Issues and an Overview of Work of the OECD Directorate for Science, Technology and Industry. Organisation for Economic Co-operation and Development (OECD): Paris, France. https://www.oecd.org/innovation/inno/50586251.pdf. DOA: 11.06. 2021.

2.9. Schumpeter, Peter J. (1934). The Theory of Economic Development: An Inquiry into Profits,

Capital, Credit, Interest, and the Business Cycle (Harvard Economic Studies 46). Harvard University Press: Cambridge, MA. ISBN: 9780674879904

2.10. Sorescu, Alina B., Rajesh K. Chandy and Jaideep C. Prabhu (2003). Sources and Financial Consequences of Radical Innovation: Insights from

Pharmaceuticals. Journal of Marketing, 67(4), 82–102. https://journals. sagepub.com/doi/10.1509/jmkg.67.4.82.18687. DOA: 11.06.2021.

2.11. Stilgoe, Jack, Richard Owen and Phil Mac Naghten (2013). Developing a Framework for Responsible Innovation. Research Policy, 42(9), 1568–1580. https://www.sciencedirect.com/science/article/pii/ S0048733313000930. DOA: 11.06.2021.

2.12. Peterson, Christopher, Nansook Park and Patrick J. Sweeney (2008). Group Well-Being: Morale from a Positive Psychology Perspective. Applied Psychology, 57(1), 19–36. https://iaap-journals. onlinelibrary.wiley.com/doi/full/10.1111/j.1464-0597.2008.00352.x. DOA: 11.06.2021.

2.13. Lee, Michael T. and Robyn L Raschke (2016). Understanding Employee Motivation and Organizational Performance: Arguments for a Set-Theoretic Approach. Journal of Innovation & Knowledge, (3), 162–169. https://www.sciencedirect.com/science/article/pii/ S2444569X16000068. DOA: 11.06.2021.

2.14. Farson, Richard and Ralph Keyes (2002). The Failure-Tolerant Leader. Harvard Business Review. https://hbr.org/2002/08/the-failure-tolerant-leader. DOA: 11.06.2021.

2.15. Neto, Jose Chavaglia, Jose Antonio Filipe and Antonio Bento Caleiro (2019). Creativity and Innovation: A Contribution of Behavioral Economics. International Journal of Innovation Studies, 3(1), 12–21. https://www.sciencedirect.com/science/article/pii/ S209624871930013X. DOA: 11.06.2021.

2.16. Dorow, Patricia Fernanda, Guillermo Antonio Davila, Gregorio Varvakis and Rolano Vargas Vallejos (2015). Generation of Ideas, Ideation and Idea Management. Navus Revista de Gestao-e-Tecnologia,5(2), 51. https://www.researchgate.net/ publication/275023006_Generation_of_Ideas_Ideation_and_Idea_ Management. DOA: 11.06.2021.

2.17. Novotney, Amy (2009). The Science of Creativity: Use These Empirically Backed Tips to Capture Your Next Big Idea. Grad Psych Magazine, 14. https://www.apa.org/gradpsych/2009/01/creativity. DOA:11.06.2021.

2.18. Ali-Tirmizi, Syed Muhammad, Ali- Malik, Qaisar Ali Malik and Syeda Sheeba Hussain (2020). Journal of Open Innovation: Technology, Market, and Complexity Concept Paper Invention and Open Innovation Processes, and Linkages: A Conceptual Framework. Journal of Open Innovation: Technology, Market, and Complexity, 6, 159. www.mdpi.com/2199-8531/6/4/159/pdf. DOA: 11.06.2021.

2.19. Technopolis Group & MIOIR (2012): Evaluation of Innovation Activities. Guidance on methods and practices. European Commission, Directorate for Regional Policy: Brussels, Belgium.https://ec.europa.eu/regional_policy/sources/docgener/evaluation/pdf/eval2007/innovation_activities/inno_activities_guidance_en.pdf. DOA: 11.06.2021.

2.20. Dorner, Madin, Sebastian Gurtner and Michael Schefczyk (2009). Overcoming Resistance to Innovations: An Approach for the Use of Communication Tools within the Innovation Process. International Journal of Technology Marketing, 4,(2/3), 199–216. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.629.2643&rep=rep1&type=pdf. DOA: 11.06.2021.

2.21. Burger, Thomas, Peter Hottum and R. Lorenz (2012). Barriers to Service Innovation - Perspectives from Research and Practice. Conference: Management of Innovation and Technology (ICMIT), 2012 IEEE International Conference on Management of Innovation and Technology, Sanur, Bali. https://www.researchgate.net/publication/241632915_Barriers_to_service_innovation_-_Perspectives_from_research_and_practice. DOA: 11.06.2021.

2.22. Anthony, Scott D., Paul Cobban, Rahul Nair and Natalie Painchaud (2019). Breaking Down the Barriers to Innovation: Build the Habits and Routines that Lead to Growth. Harvard Business Review: Cambridge, MA.

3.1. Porter, Christopher, O.L.H., Ryan Outlaw, Jake P. Gale and T.S. Cho (2019). The Use of Online Panel Data in Management Research: A Review and Recommendations. Journal of Management, 45(1), 319––344. https://journals.sagepub.com/doi/10.1177/0149206318811569. DOA: 11.07.2021.

3.2. https://pennstate.qualtrics.com/jfe/form/SV_6nkD8leIM4UI9HD). DOA: 11.07.2021.

3.3. Kirton, M.J. and M.E. Tefft (2020).The Reliability and Use of Kirton Adaption-Innovation Inventory with Teenagers. KAI Centre: Herts, United Kingdom. https://kaicentre.com/reliability-use-kirton-adaption-innovation-inventory-teenagers/. DOA: 11.07.2021.

3.4. von Wittch, Daniel and John Antonakis (2011). The KAI Cognitive Style Inventory: Was It Personality All Along? [in press] Personality and Individual Differences. https://serval.unil.ch/resource/serval:BIB_8020064BDBA2.P001/REF. DOA: 11.07.2021.

3.5. Sim, Edward R. and George Wright (2002). A Comparison of Adaption-Innovation Styles between Information Systems Majors and Computer Science Majors. Journal of Information SystemsEducation,13(1),29-35. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.203.3510&rep=rep1&type=pdf. DOA: 11.07.2021.

3.6. Stum, Jake (2009). Kirton's Adaption-Innovation Theory: Managing Cognitive Styles in Times of Diversity and Change. Emerging Leadership Journeys, 2(1), 66-78. ISSN 1930-806X. https://www.regent.edu/acad/global/publications/elj/vol2iss1/Stum_Jake_Final.pdf. DOA: 11.07.2021.

3.7. http.TestMyCreativity.com. DOA: 11.07.2021.

3.8. von Rueden, Christopher R., Aaron W. Lukaszewski and Michael Gurven (20150. Adaptive Personality Calibration in a Human Society: Effects of Embodied Capital on Prosocial Traits. BehavioralEcology,

26(4),1071–1082. https://academic.oup.com/beheco/article/26/4/1071/210310. DOA: 11.07.2021.

3.9. Blagov, Pavel S. (2021). Adaptive and Dark Personality in the COVID-19 Pandemic: Predicting Health-Behavior Endorsement and the Appeal of Public-Health Messages. Social Psychological and Personality Science, 12(5), 697–707. https://journals.sagepub.com/doi/10.1177/1948550620936439. DOA: 11.07.2021.

3.10. Ali Imran (2019). Personality Traits, Individual Innovativeness and Satisfaction with Life. Journal of Innovation and Knowledge, 4(1), 38–46. https://www.sciencedirect.com/science/article/pii/S2444569X18300167. DOA: 11.07.2021.

3.11. Amar, A.D. and Kevin Mullaney (2017). Employee Ability to Innovate: How Can Organizations Recognize It. Procedia Computer Science, 122, 494–501. https://www.sciencedirect.com/science/article/pii/S1877050917326431. DOA: 11.07.2021.

3.12. Giaccone, Sonia C. and Mats Magnusson (2021). Unveiling the Role of Risk-Taking in Innovation: Antecedents and Effects. R & D Management. https://onlinelibrary.wiley.com/doi/full/10.1111/radm.12477. DOA: 11.07.2021.

3.13. https://www.ou.edu/deptcomm/dodjcc/groups/99A2/theories.htm. DOA: 11.07.2021.

3.14. Rogers, Everett M., Una E. Medina, Mario A. Rivera and Cody J. Wiley (2005) Complex Adaptive Systems and the Diffusion of Innovations. The Innovation Journal: The Public Sector Innovation Journal, Volume 10(3), article 30, 1–26. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.130.8047&rep=rep1&type=pdf. DOA: 11.07.2021.

3.15. Grosul, Maya (2010). In Search of the Creative Scientific Personality. SJSU ScholarWorks (Master's Theses). San Jose State University. https://scholarworks.sjsu.edu/cgi/viewcontent.

cgi?referer=&httpsredir=1&article=4860&context=etd_theses. DOA: 11.07.2021.

3.16. Kirton, M.J. (2011). Adaption-Innovation in the Context of Diversity and Change. Routledge: London, England. ISBN: 978-0-415-29850-6.

3.17. Jordanous, Anna and Bill Keller (2016). Modelling Creativity: Identifying Key Components through a Corpus-Based Approach. PLoS One., 11(10), e0162959. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5051932/. DOA: 11.07.2021.

3.18. Herrmann, Daniel and Jorg Felfe (2013).Moderators of the Relationship Between Leadership Style and Employee Creativity: The Role of Task Novelty and Personal Initiative. Creativity Research Journal, 25(2), 172–181. https://www.researchgate.net/publication/271901066_Moderators_of_the_Relationship_Between_Leadership_Style_and_Employee_Creativity_The_Role_of_Task_Novelty_and_Personal_Initiative. DOA: 11.07.2021.

3.19. Shao, Yong, Chenchen Zhang, Jing Zhou, Ting Gu and Yuan (2019). How Does Culture Shape Creativity? A Mini-Review. Frontiers in Psychology, 10. https://www.frontiersin.org/articles/10.3389/fpsyg.2019.01219/full. DOA: 11.07.2021.

3.20. McCarthy Marina, Chen Chao.C, McNamee Robert C. (2018). Novelty and Usefulness Trade-Off: Cultural Cognitive Differences and Creative Idea Evaluation. *Journal of Cross-Cultural Psychology*, 49(2), 171–198. https://journals.sagepub.com/doi/abs/10.1177/0022022116680479. DOA: 11.07.2021.

3.21. Ee, Jessie, Seng, Tan Oon, Ng Aik Kwang (2007). Styles of Creativity: Adaptors and Innovators in a Singapore Context. Asia Pacific Education Review, 8(3) 364–373. http https://www.frontiersin.org/articles/10.3389/fncir.2019.00018/fulls://files.eric.ed.gov/fulltext/EJ811071.pdf. DOA: 11.07.2021.

3.22. Okada, Takeshi and Kentaro Ishibashi (2016).Imitation, Inspiration, and Creation: Cognitive Process of Creative Drawing by Copying Others' Artworks. Cognitive Science: A Multidisciplinary Journal, 41(7), 1804–1837. ISSN: 0364-0213. https://onlinelibrary. wiley.com/doi/full/10.1111/cogs.12442. DOA: 11.07.2021.

3.23. Khalil Radwa,Khalil, Ben Godde, Godde Ben, Ahmed A. Karim (2019). The Link Between Creativity, Cognition, and Creative Drives and Underlying Neural Mechanisms. Frontiers in Neural Circuits, Social Psychology and Personal 13, Article 18. ISSN: 1662-5110. https://www. frontiersin.org/articles/10.3389/fncir.2019.00018/full. DOA: 11.07.2021.

4.1. Sellier, Anne-Laure and Darren W. Dahl (2011). *Focus! Creative Success is Enjoyed through Restricted Choice*. American Marketing Journal, 48(6), 996-1007. https://journals.sagepub.com/doi/full/10.1509/ jmr.10.0407.

4.2.Tiefenbacher, Wanda (2020). *Innovation Potential: Why and How to Strengthen Traits that Predict Unique Thought*. CQ Net. https://www.ckju. net/en/dossier/innovation-potential-why-and-how-to-strengthen-traits- that-predict-unique-thought.

4.3. Chamorro-Premuzic, Tomas, Seymour Adler and Robert R. Kaiser (2017). *What Science Says About Identifying High-Potential Employees: Employee Performance Management*. Harvard Business Review. https:// hbr.org/2017/10/what-science-says-about-identifying-high-potential- employees.

4.4. Renkema, Maarten, Jeroen Meijerink and Tanya Bondarouk (2021). *Routes for Employee-Driven Innovation: How HRM Supports the Emergence of Innovation in a Formalized Context*. The International Journal of Human Resource Management, https://www.tandfonline.com/doi/full/ 10.1080/09585192.2021.1913625.

4.5. Laguna, Mariola, Karolina Walchowska, Marian J. Gorgievski- Duijvesteijn and Juan A. Moriano (2019). *Authentic Leadership and*

Employees' Innovative Behaviour: A Multilevel Investigation in Three Countries. International Journal of Environmental Research and Public Health, 16(21), 4201. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6861954/.

4.6. Awang, Abd Hair, Noorsafiza Mohd Sapie, Mohd Yusof Hussain, Suraiya Ishak and Rozman Md Yusof (2019). *Nurturing Innovative Employees: Effects of Organisational Learning and Work Environment*. Economic Research, 32(1), 1152-1168. https://www.tandfonline.com/doi/full/10.1080/1331677X.2019.1592007.

4.7. Dziallas, Marisal and Knut Blind (2019). *Innovation Indicators throughout the Innovation Process: An Extensive Literature Analysis*. Technovation, 80–81, 3–29.

4.8.Christothea Herodotou, Mike Sharples, Mark Gaved, Agnes Kukulska-Hulme, Bart Rienties, Eileen Scanlon and Denise Whitelock (2019). *Innovative Pedagogies of the Future: An Evidence-Based Selection*. Frontiers in Education.https://www.frontiersin.org/articles/10.3389/feduc.2019.00113/full. DOA: 12.23.2021.

4.9.Looney, Janet W. (2009). *Assessment and Innovation in Education*. OECD Education Working Papers, No. 24, OECD Publishing: Organisation for Economic Co-operation and Development. http://dx.doi.org/10.1787/222814543073.

4.10. Valitova, Shami M. and Almaz Kh. Khakimov (2015). *Innovative Potential as a Framework of Innovative Strategy for Enterprise Development*. Procedia Economics and Finance, 24, 716–721. International Conference on Applied Economics (ICOAE 2015): Kazan, Russia. https://pdf.sciencedirectassets.com/282136/1-s2.0-S2212567115X00074/1-s2.0-S2212567115006826/main.pdf.

4.11.Da Silva, Fabiana Matos, Edson Aparecida de Araujo Querido Oliveirab,c,Marcela Barbosa de Moraesc (2016). *Innovation Development Process in Small and Medium Technology Management and Regional Development by the University of Taubate (UNITAU)*. Revista de

Administração e Inovação, 13, 176–189. www.sciencedirect.comhttp://
www.revistas.usp.br/raiRAI

5.1. Purc, Ewalina and Mariola Laguna (2019). *Personal Values and
Innovative Behavior of Employees.* Frontiers in Psychology, 10, 865.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6482311/.

5.2. Yuan, Feirong and Richard W. Woodman (2010). *Innovative
Behavior in the Workplace: The Role of Performance and Image Outcome
Expectations.* The Academy of Management Journal, 53(2), 323–342.
https://www.jstor.org/stable/25684323.

5.3. Wang, Yanfei, Yi Chen and Yu Zhu (2021). *Promoting Innovative
Behavior in Employees: The Mechanism of Leader Psychological Capital.*
Frontiers in Psychology, 11, 598090. https://www.frontiersin.org/
articles/10.3389/fpsyg.2020.598090/full.

5.4. Anderson, Neil, Kristina Potocnik and Jing Zhou (2014).
*Innovation and Creativity in Organizations: A State-of-the-Science
Review, Prospective Commentary, and Guiding Framework.* Journal
of Management, 40(5):1297–1333. https://journals.sagepub.com/
doi/10.1177/0149206314527128.

5.5. Bos-Nehles, Anna, Maarten Renkema and Maike Janssen (2017).
HRM and Innovative Work Behaviour: A Systematic Literature Review.
Personnel Review, 46(7), 1228–1253. ISSN: 0048-3486. https://www.
emerald.com/insight/content/doi/10.1108/PR-09-2016-0257/full/html.
DOA: 11.07.2021.

5.6. De Spiegelaere, Stan (2014). The Employment Relationship
and Innovative Work Behavior. https://www.researchgate.net/
publication/265421090_The_Employment_Relationship_and_Innovative_
Work_Behaviour#fullTextFileContent. DOA: 11.07.2021.

5.7.Purc, Ewelina and Mariola Lagun (2019). *Personal Values and
Innovative Behavior of Employees.* Frontiers in Psychology. https://doi.
org/10.3389/fpsyg.2019.00865.

5.8.Pei-Xu, He, Wu Tung-Ju, Zhao Hong Dan and Yang Yang (2019). *How to Motivate Employees for Sustained Innovation Behavior in Job Stressors? A Cross-Level Analysis of Organizational Innovation Climate*. International Journal of Environmental Research and Public Health.16(23), 4608. https://www.ncbi.nlm.nih.gov/pmc/articles/ PMC6926950/.

5.9. Stock, Ruth Maria (2015). *Is Burnout a Threat to Frontline Employees' Innovative Work Behavior?* Journal of Product Innovation Management, 32(4), 574–592. https://onlinelibrary.wiley.com/ doi/10.1111/jpim.12239.

5.10. Jung, Hyo Sun, Min Kyung Song and Hye Hyun Yoon (2021). *The Effects of Workplace Loneliness on Work Engagement and Organizational Commitment: Moderating Roles of Leader-Member Exchange and Coworker Exchange.* Sustainability (Special Issue: Workplace Flexibility and Engagement towards Employee's Well-Being and Sustainable Behavior), *13*(2), 948. https://www.mdpi.com/2071-1050/13/2/948

6.1 Adamiecki K.: O nauce organizacji. Wybór pism. Polskie Wydawnictwo Ekonomiczne, Warszawa 1985, s. 203.

6.2. Antoszkiewicz J.: Metody heurystyczne. Polskie Wydawnictwo Ekonomiczne, Warszawa 1982, s. 18.

6.3. Brown R.: Procesy grupowe. GWP, Gdańsk 2006.

6.4. Chybicka A.: Psychologia twórczości grupowej. Oficyna Wydawnicza „Impuls", Kraków 2006, s. 117–131.

6.5. Clegg B., Birch P.: Instant Creativity – Simple techniques to ignite innovation & problem-solving, Kogan-Page, London 2007, pp. 186.

6.6. De Bono E.: Six-thoughtless hats. Helion Publishing House. Gliwice 2008, pp. 48–52.

6.7. Golczyk K.: Walt Disney's fighting technique, the team's creativity, http://golczyk.com/kreatywne-myslenie-technika-walta-disneya/, 1.02.2015 access

6.8. Góralski A.: Być nowatorem. Poradnik twórczego myślenia. Państwowe Wydawnictwo Naukowe, Warszawa 1990, s. 5.

6.9. Jagoda-Sobalak D., Knosala R.: Zastosowanie metod inwentycznych w procesie projektowania na przykładzie praktycznym, [w:] Knosala R. (red.): Innowacje w zarządzaniu i inżynierii produkcji. Oficyna Wydawnicza Polskiego Towarzystwa Zarządzania Produkcją, Opole 2012, s. 39–49.

6.10. Karlińska B., Knosala R.: Sesja twórcza jako sposób kreatywnego rozwiązywania problemów. Zarządzanie Przedsiębiorstwem, nr 2, 2013, s. 16–22.

6.11. Kaufmann A.: Inwentyka: metody poszukiwania twórczych rozwiązań. Wydawnictwo Naukowo-Techniczne, Warszawa 1975.

6.12.Kirton J.M.: Adaptors and Innovators. Styles of Creativity and Problem Solving. Routledge, London 1994, p. 364–368.

6.13. Kosieradzka A.: Methods and techniques to stimulate creativity in organization and management. Edu-Libri 2013, pp. 121-126.

6.14. Martyniak Z.: Przegląd wybranych metod heurystycznych. Organizacja – Metody – Technika, nr 1/1976, s. 28–30.

6.15. Martyniak Z.: Wstęp do inwentyki. Wydawnictwo Akademii Ekonomicznej w Krakowie, Kraków 1997, s. 9.

6.16. Mikolajczyk Z.: Organising techniques in resolving management problems. State Scientific Publishing House, Warsaw 2002, pp. 37.

6.17. Proctor T.: Twórcze rozwiązywania problemów. Podręcznik dla menedżerów. Gdańskie Wydawnictwo Psychologiczne, Gdańsk 2002.

6.18. Rietzschel E., Nijstad B., Stroebe W.: Effects of Problem Scope and Creativity Instructions on Idea Generation and Selection. Creativity Research Journal,Vol. 26, 2014, s. 185–191.

7.1 Wolniak R.: The role of QFD method in creating innovation, „Systemy Wspomagania Inżynierii Produkcji", z. 3, 2016, s. 127–134.

7.2. Oslo, Manual. Guidelines for Collecting and Interpreting Technological Innovation Data, 3rd Edition, OECD/Eurostat, Paris 2005.

7.3.. Avvisati, F., G. Jacotin and S. Vincent-Lancrin: Educating higher education students for innovative economies: What international data tell us", Tuning Journal for Higher Education, 2013, no. 1, pp. 223–240.

7.4. European Ambassadors for Creativity and Innovation (2009), Manifesto, European Union,

www.create2009.europa.eu/fileadmin/Content/Downloads/PDF/ Manifesto/manifesto.en.pdf., [access 5.01.2018].

7.5. Montonen T., Eriksson P.: Teaching and learning innovation practice: a case study from Finland, International Journal Human Resource Development and Management, nr 2/3, 2013, pp. 107–118.

7.6. Peschl, M. F., Bottaro, G., Hartner-Tiefenthaler, M., Rötzer, K. Learning how to innovate as a socio-epistemological process of co-creation. Towards a constructivist teaching strategy for innovation. Constructivist Foundations, 9(3), 2014, 421–433.

7.7. Standing, C., Jackson, D., Larsen, A.-C., Suseno, Y., Fulford, R., & Gengatharen, D. Enhancing individual innovation in organisations: A review of the literature. International Journal of Innovation and Learning, 19(1), 2016, 44–62, https://doi.org/10.1504/IJIL.2016.073288.

7.8. Mulder, M. Competence-based education and training, The Journal of Agricultural Education and Extension, 18(3), 2012, 305–314, https://doi.org/10.1080/1389224X.2012.670048.

7.9. Sturing, L., Biemans, H. J. A., Mulder, M., & De Bruijn, E. The nature of study programmes in vocational education: Evaluation of the model for comprehensive competence-based vocational education in the Netherlands. Vocations and Learning, 4(3), 2011, 191–210, https://doi.org/10.1007/s12186-011-9059-4.

7.10. Hero, L.M., Lindfords, E., Taatila, V. Individual Innovation Competence: A Systematic Review and Future Research Agenda, International Journal of Higher Education, 2017, 6(5), 1041–121.

7.11. Ortt, R., Verburg, R. Determinants of Innovative Behaviour A Firm's Internal Practices and its External Environment, Palgrave Macmilan, 2008.

7.12. Ortt, J. R., Smits, R. Innovation Management: Different Approaches to Cope with the Same Trend, International Journal of Technology Management, 34: 3/4, 2006; 296–318.

7.13. Jones, G., Teegen, H. Factors Affecting Foreign R&D Location Decisions: Management and Host Policy Implications', International Journal of Technology Management, 25(8), 2002, 791–813.

7.14. Srobl, A., Matzer, K., Nketia, B.A., Veider, V. Individual innovation behaviour and firm-level exploration and exploitation: how family firms make the most of their managers, Review of Managerial Science, 14, 2020, 809–844.

7.15. Nedkovski, V. Guerci, M.: Innovative behaviour in organizations: A social network perspective, 2015, https://www.researchgate.net/publication/279534751_Innovative_behaviour_in_organizations_A_social_network_perspective, access date: 29.12.2021.

7.16. Yuan, F., Woodman, R.W. Innovative behaviour in the workplace: the role of performance and image outcome expectations. Academy of Management Journal, 53, 2010, 323–342.

7.17. Åmo, B.W. Employee innovation behaviour, Thesis for the Degree of Doctor Oeconomia, Bodø, June, 2005.

7.18. Sousa, C. M. P., Coelho, F. Exploring the relationship between individual values and the customer orientation of front-line employees. Journal Marketing Management, 29, 2013, 1653–1679. doi: 10.1080/0267257X.2013.798674.

7.19. Purc, E., Lagun, M. Personal Values and Innovative Behavior of Employees, Frontiers Psychology, 2019, 10:865. doi: 10.3389/fpsyg.2019.00865.

7.20. Schwartz, S. H. Universals in the content and structure of values: theoretical advances and empirical tests in 20 countries, in Advances in experimental social psychology. ed. M. P. Zanna, Vol. 25 (San Diego, CA, US: Academic Press), 1992, 1–65.

8.1. Van Offenbeek, M., & Koopman, P. Interaction and decision making in project teams. In M. A. West (Ed.), Handbook of work group psychology, 1996, London, Wiley, 159–187.

8.2. Drach-Zahawy, A. Understanding team innovation: The role of team processes and structures, Group Dynamics: Theory, Research, and Practice, 5(2), 2001, 111–123.

8.3. Gafney, L. Varma-Nelson, P. Peer-Led Team Learning. Evaluation, Dissemination, and Institutionalization of a College Level initiative, Springer, Berlin, 2018.

8.4. Adair, J. leadership for innovation. How to organize team creativity and harvest ideas, Kogan Page, London and Philadelphia, 2007.

8.5. Sloane, P. The Leader's guide to lateral thinking skills, Kogan Page, London and Philadelphia, 2006.

8.6. Meinel, Ch., Leifer, L. Design Thinking research. Investigating Design Team Performance, Springer, Potsdam, 2020.

8.7. Sonalkar, N., Mabogunje, A., Cutkosky, M. Quadratic model of reciprocal causation for monitoring, improving, and reflecting on design team performance. In H. Plattner, C. Meinel, & L. Leifer (Eds.), Design thinking research.Making distinctions: collaboration versus cooperation, Vol. 14, 2018, Cham, Switzerland: Springer, 43–57.

8.8. Archibald, R.D., Archivald, S.C. andManaging InnovationRussell D. ArchibaldShane C. Archibald, What Every Executive Team Must Know about Project, Program, andPortfolio Management, CRC Press, New York, 2016.

8.9. Bozeman, B., Boardman, C. research Collaboration and team Science. A state-of-the-Art Review and Agenda, Springer, London, 2014.

8.10. Riedl, Ch. Tool-Supported Innovation Management in Service Ecosystem, Gabler, Wiesbaden, 2011.

8.11. Ziegert, J.C., Dust, S.B. Integrating Formal and Shared Leadership: the Moderating Influence of Role Ambiguity on Innovation, Journal of Business and Psychology, 36(6), 21, 969-984.8.12. Mitchell, R., Boyle, B. Professional faultlines and interprofessional differentiation in multidisciplinary team innovation: The moderating role of inclusive leadership, Health care management review, 46(4), 2021, 332–340.

8.12 Mitchell, R., Boyle, B. Professional faultlines and interprofessional differentiation in multidisciplinary team innovation: The moderating role of inclusive leadership, Health care management review, 46(4), 2021, 332–340.

8.13. Ali, A., Wang, H., Bodla, A.A., Bahadur, W. A moderated mediation model linking transactive memory system and social media with shared leadership and team innovation, Scandinavian Journal of Psychology, 62(4), 2021, 625-637.

8.14. Liu, Z., Liu, X., Zhang, X. How to Solve the Time Dilemma? The Influence of Team Temporal Leadership on Team Innovation Performance, Frontiers in Psychology, 2021, 12, 634133.

8.15. Han, Z., Ren, H., Yang, S., Han, Y. Human resource practice management for knowledge intensive team: Impact on team innovation performance and substitution effect of empowerment leadership, Sustainability, 13(9), 2021, 4801.

8.16. Hu, W., Zheng, D. Research on the influence of team i-deals level on team innovation-from the perspective of collective thriving, E3S Web of Conferences, 2021, 251,03087.

8.17. Mitchell, R., Boyle, B., Nicholas, S. Team innovative capability: Does positive mood unlock the innovative potential of environmental cues?, Journal of Business Research, 126, 2021, 376-384.

8.18. Lei, S., Qin, C., Ali, M., Freeman, S., Shi-Jie, Z. The impact of authentic leadership on individual and team creativity: a multilevel perspective, Leadership and Organization Development Journal, 42(4), 2021, 644-662.

8.19. Wolniak R. The role of QFD method in creating innovation, Systemy Wspomagania Inżynierii Produkcji, 3, 2016, 127-134.

8.20. Wolniak, R., Skotnicka-Zasadzień, B. The use of value stream mapping to introduction of organizational innovation in industry, Metalurgija, 53(4), 2014, 709-712.

8.21. Gajdzik, B., Wolniak, R. Digitalisation and innovation in the steel industry in Poland - selected tools of ICT in an analysis of statistical data and a case study, Energies, 14(11), 2021, 1-25.

8.22. Jonek-Kowalska, I, Wolniak, R. The influence of local economic conditions on start-ups and local open innovation system, Journal Open Innovations Technology, 7(2), 2021, 1-19.

9.1. Patterson, F., Kerrin, M., Gatto-Roissard, G. Characteristics & Behaviours of Innovative People in Organisations. Literature Review, https://www.researchgate.net/publication/242102530_Characteristics_

Behaviours_of_Innovative_People_in_Organisations, acess data: 29.12.2021.

9.2. Guilford, J. P. The nature of human intelligence. New York: McGraw-Hill, 1967.

9.3. MacKinnon, D. W. In search of human effectiveness, New York: Creative Education Foundation, 1978.

9.4. Eysenck, H.J. The measurement of creativity. In: M. Boden (Ed.), 'Dimensions of Creativity.' Cambridge, MA: MIT Press, 1994.

9.5. Harrison, M.M., Neff, N.L., Schwall A.R., Zhao, X. A Meta-analytic Investigation of Individual Creativity and Innovation, paper presented at the 21st Annual Conference for the Society for Industrial and Organizational Psychology, Dallas, Texas, 2006.

9.6. Mumford, M.D., Scott, G.M., Gaddis, B.H. Strange, J.M. Leading creative people: Orchestrating expertise and relationships. Leadership Quarterly, 13, 2002. 705–750.

9.7. Sauermann, H., Cohen, W.M. What makes them tick? Employee motives and firm innovation. NBER Working Paper, 2008, N.14443. and creativity: Moderating effects of openness to experience and support for creativity. Journal of Applied Psychology. 91, 2006, 963-970.

9.8 Baer, M., Oldham, R. The Curvilinear Relation Between Experienced Creative Time Pressure and Creativity: Moderating effects of openness to experience and support for creativity. Journal of Applied Psychology. 91, 2006, 963–970.

9.9. Wolfradt, U., Pretz, J.E. Individual differences in creativity: Personality, story writing and hobbies. European Journal of Personality, 15 (4), 2001, 297–310.

9.10. George, J. M., Zhou, J. When openness to experience and conscientiousness are related to creative behaviour: An interactional approach, Journal of Applied Psychology, 86, 2001, 513–524.

9.11. Furnham, A., Bachtiar, V. Personality and intelligence as predictors of creativity. Personality and Individual Differences, 45(7), 2008, 613-617.

9.12. Adair, J. leadership for innovation. How to organize team creativity and harvest ideas, Kogan Page, London and Philadelphia, 2007.

9.13. Alan, R. 32 traits of Highly creative People, http://www.cre8ng. com/materials/wp-content/uploads/2010/08/32-traits-w-crayons.pdf, access date: 29.12.2021.

9.14. Seon-Young, L., Jiyeon, M. The Profiles of Creative Potential and Personality Characteristics of Adult Professionals, Creativity Research Journal, 28(3), 2016, 298-309.

9.15. Costa, S., Paez, D., Sanchez, F., Garaigordobil, M., Gondim, S. Personal factors of creativity: A second order meta-analysis, Journal of Work and Organizational Psychology, 31, 2015, 165-173.

9.16. Jauk, E., Eberhardt, L., Koschmieder, C., Diedrich, J., Pretsch, J., Benedek, M., Neubauer, A.C. A New Measure for the Assessment of Appreciation for Creative Personality, Creativity Research Journal, 31(2), 2019, 149–163.

9.17. Gaur, S.P. Kindling the Creative Potential, Vision, 20(4), 2016, 290–299.

9.18. Ng, R.Y.-K., Yeung, S.S.-M. Stage-gate model in action: Regulating creativity and business imperatives in creative industries, Proceedings of the International Conference on Engineering Design, ICED, 7 DS75-07, 2013, 567–573.

9.19. Raviv, D. Innovative thinking: Desired skills and related activities, ASEE Annual Conference and Exposition, Conference Proceedings, 2008.

10.1. Adair J.: The concise: Adair on Creativity and innovation. Thorogood Publishing LTd, 2004, s. 15–16.

10.2.   Amabile A.: How to kill creativity. Harvard Business Review, September – October 1998, s. 74–84.

10.3.   Amabile T.M., Hadley C.N., Kramer S.J.: Creativity under the gun. *Harvard Business Review,* August 2002, 52–61.

10.4.   Andriopoulos C., Dawson P.: Managing Change, Creativity and Innovation. Sage. London/ Thousand Oaks 2011, s. 107–110.

10.5.   Antoszkiewicz J.: Innovations in the company. Poltex Publishing House, Warszawa 2008, pp. 12–16.

10.6.   Barkley B.: Project Management in New Product Development. McGraw-Hill Companies, New York 2008, s. 14.

10.7.   Barreto I.: Dynamic capabilities: A review of past research and an agenda for the future. Journal of Management, Vol. 36, 2010, s. 256-280

10.8.   Bergendahl M., Magnusson M.: Creating Ideas for Innovation: Effects of Organizational Distance on Knowledge Creation Processes. Creativity and Innovation Management, Vol. 24, 2015, s. 87–101.

10.9.   Bieniok H., Gruszczyńska-Malec G., Królik G.: Elementarz twórczego myślenia. Wydawnictwo Akademii Ekonomicznej im. Karola Adamieckiego, Katowice 2006, s 6.

10.10. Bilton C., Cummings, S.: Creative strategy. Reconnecting business and innovation. Chichester, Wiley 2010, s. 101.

10.11. Brzeziński M.: Creative Organization. State Scientific Publishing House, Warsaw 2009, pp. 64–71.

10.12. Bugdol M.: Organizational values. Publisher UJ, Kraków 2006, p. 35–68.

10.13. Bundy W.: Innovation, Creativity and Discovery in Modern organizations. Quorum Boos, Westport 2002, s. 66-72.

10.14. Caniëls M., Rietzschel E.: Organizing Creativity: Creativity and Innovation under Constraints. Creativity and Innovation Management, Vol. 24, 2015, s. 184–196.

10.15. Choi J.N., Anderson T.A., Veillette A.: Contextual inhibitors of employee creativity in organizations. The insulating role of creative ability, "Group & Organization Management, Vol. 34, 2009, s. 330–357.

10.16. Çokpekin Ö., Knudsen M.P.: Does Organizing for Creativity Really Lead to Innovation? Creativity and Innovation Management, Vol. 21, 2010, s. 304–314.

10.17. Courtney H., Kirkland J.: Viguerie P.: Strategy Under Uncertainty. Harvard Business Review, November – December 1997, s. 67–79.

10.18. Derc M.: Doświadczenie i twórczość w koncepcji Abrahama H. Maslowa. Wydawnictwo Uniwersytetu Mikołaja Kopernika, Toruń 1996, s. 18-22.

10.19. Drozdowski R., Zakrzewska A., Puchalska K., Morchat M., Mroczkowska D: Wspieranie postaw proinnowacyjnych przez wzmacnianie kreatywności jednostki, http://www.parp.gov.pl/files/74/81/380/9721.pdf, dostęp 1.01.2015.

10.20. Drucker P.: Innovation and Entrepreneurship: Practice and Principles. Innowacje I przedsiębiorczość. Praktyka i zasady. Polskie Wydawnictwo Ekonomiczne, Warszawa 1992, s. 38–41.

10.21. Eisenhardt K., Sull D.N.: Dynamic capabilities: what are they? Strategic Management Journal, Vol. 21, 2001, s. 1105–1121.

10.22. Eysenck H.J.: Genius: The Natural History of Creativity. Cambridge University Press, New York 1995, s. 83.

10.23. Florida R.: The Flight of the Creative Class. Harper Collins, New York 2007, s. 84–85.

10.24. Ford C.M.: The Futurity of decisions asfacilitator of organizational creativity and change. Journal of Organizational Change Management, Vol. 15, 2002, pp. 635–646.

10.25. Góralski A.: Być nowatorem. Poradnik twórczego myślenia. Państwowe Wydawnictwo Naukowe, Warszawa 1990, s. 5.

10.26. Guilford J.P.: Some Theoretical Views of Creativity [w:] Helson H., Bevan W. (red.): Contemporary Approaches to psychology, Van Nos and Princeton, New York 1967, s. 33–64.

10.27. Houghton J.D., Di Liello T.C.: Leadership development: The key to unlocking individual creativity in organizations. Leadership & Organization Development Journal, Vol. 31, 2010, s. 230–245.

10.28. Houghton J.D., DiLiello T.C.: Leadership development: The key to unlocking individual creativity in organizations. Leadership & Organization Development Journal 2010, s. 230–245.

10.29. Hülsheger U.R., Anderson N., Salgado F.: Team level predictors of innovation at work... op. cit., p. 11281154.

10.30. Hunter S., Friedrich T., Bedell K., Mumford M.: Creative thought in real – world innovation. Serbian Journal of Management, Vol. 1, 2006, s. 29–39.

10.31. Isaksen S., Lauer K.: The climate for creativity and change in teams. Creativity and Innovation Management, Vol. 11, 2002, pp. 74-86.

10.32. Jerzyk E., Leszczyński G., Mruk H.: Kreatywność w biznesie. WAE, Poznań 2006, s. 44–64.

10.33. Karasek A.: Klasa kreatywna a kompetencje twórcze. Kwartalnik Naukowy „Organizacja i Zarządzanie" nr 3 (15), Wydawnictwo Politechniki Śląskiej, Gliwice 2011, 83–85.

10.34. Karwowski M.: Klimat dla kreatywności. Koncepcje, metody badania. Difin, Warszawa 2009, s. 110–124.

10.35. Kharkhurin A.: Creativity.4in1: Four-Criterion Construct of Creativity. Creativity Research Journal, Vol. 26, 2014, s. 338–352.

10.36. Martyniak Z.: Wstęp do inwentyki. Wydawnictwo Akademii Ekonomicznej w Krakowie, Kraków 1997.

10.37. Nęcka E., Trop – wórcze rozwiązywanie problemów. Oficyna Wydawnicza „Impuls", Kraków 1994.

10.38. Nęcka E.: Psychologia twórczości. Oficyna Wydawnicza „Impuls", Kraków, 2003, s. 6–10.

10.39. Nieckarz Z.: Management style and creative behaviour of employees, [in:] Popek S., Bernacka R.E., Domański C.W., Gawda B., Turska D., Zawadzka A.M. (ed.): Psychology of creativity. Publisher Nowe Horizons UMCS, Lublin 2009, pp. 26-29.

10.40. Ottemiller D., Elliott C.E., Giovannetti T.: Creativity, Overinclusion, and Everyday Tasks. Research Journal, Vol. 26, 2014, pp. 289–296.

10.41. Penc J.: Strategic management System. AW Placet, Warszawa 2001, pp. 324–320.

10.42. Pichlak M.: The role of human potential and relational potential in shaping the innovation of the organisation. Marketing and Market, R. 21, No. 5, 2014, p. 1164–1169.

10.43. Pinker S.: How the Mind Works. W. W. Norton, 2009, s. 30–45.

10.44. Proctor T.: Twórcze rozwiązywanie problemów. Podręcznik dla menedżerów. Gdańskie Wydawnictwo Psychologiczne, Gdańsk 2002, s. 43–47.

10.45. Rietzschel E., Nijstad B., Stroebe W.: Effects of Problem Scope and Creativity Instructions on Idea Generation and Selection. Creativity Research Journal, Vol. 26, 2014, s. 185–191.

10.46. Tokarz A.: Dynamika procesu twórczego. Wydawnictwo Uniwersytetu Jagiellońskiego, Kraków 2005, s. 22.

10.47. Trompenaars F.: Connecting people and organizations in a culture of innovation. Infinite Ideas Limited. United Kindom 2007, s. 9–30.

10.48. Wang A.C., Cheng BS.: When does benevolent leadership lead to creativity? The moderating role of creative role identity and job autonomy. Journal of Organizational Behavior, Vol. 31, 2010, s. 106–121.

10.49. West M.A.: Rozwijanie kreatywności wewnątrz organizacji. Państwowe Wydawnictwo Naukowe, Warszawa 2000, s. 40–65.

10.50. Wilson J.G., Wilson M.W.: Management, innovation and system design. New York 1971, s. 19–21.

10.51. Woodman R.W., Sawyer J.E., Griffin R.W.: Toward a theory of organizational creativity. Academy of Management Review, No. 18, 1993, s. 293–321.

10.52. Zeffane R. and Al Zarooni M.H. Empowerment, Trust and Commitment: The moderating Role of Work-unit centrality, International Journal of Management, Vol. 29, 2012, p. 114–124.

10.53. Zhang X., Bartol K.M.: Linking empowering leadership and employee creativity: The influence of psychological empowerment, intrinsic motivation and creative process engagement. Academy of Management Journal, Vol. 53, 2010, s. 107–128.

10.54. Zhou J.: New look at creativity in the entrepreneurial process. Strategic Entrepreneurship Journal, Vol. 2, 2008, s. 1–5

11.1. CultureWizard by RW3. (2016). Trends in Global Virtual Teams: Virtual Teams Survey Report. https://www.rw3.com/2016-trends-in-virtual-teams-report?submissionGuid=06a8ef96-e6e6-4c77-a010-6b5e71b33d24

11.2. Dess, G.G., & Picken, J.C.: Changing roles: Leadership in the 21st century. *Organizational dynamics*, 2020, 28(3), 18–34. https://doi.org/10.1016/S0090-2616(00)88447-8

11.3. Fosslien, L., & Duffy, M.W.: How to combat zoom fatigue. *Harvard Business Review*, 2020, 29.

11.4. Grebski, M.E.: Comparative Analysis of Innovativeness Network in Poland and the United States (Monograph). TNOiK, Torun 2021.

11.5. Grebski M.: Mobility of the Workforce and Its Influence on Innovativeness (Comparative Analysis of the United States and Poland). *Production Engineering Archives* 2021, 27(4), pp. 272–276.

11.6. Gurmińska, K. (2017). Uwarunkowania osobowościowe kreatywności. Kreatywność – cecha pozytywna czy negatywna? *Modern Management Systems*, 2017, 12 (4), 105–117.

11.7. Kuzior A.: Development of Industry 4.0 and the Issue of Technological Unemployment. Case Study – Poland. In: Innovation management and information technology impact on global economy in the era of pandemic. Proceedings of the 37th International Business Information 11.8. Management Association Conference (IBIMA), Cordoba, Spain. Ed. Khalid S. Soliman. International Business Information Management Association 2021, pp. 7843-7849.

11.9. Kuzior, A.: Problem bezrobocia technologicznego w perspektywie rozwoju Przemysłu 4.0. *Etyka Biznesu i Zrównoważony Rozwój* 2017, 2, 31–38.

11.10. Kuzior, A., Grebski, W. and Lyulyov, O.: Rola etyki w kształceniu inżynierów', *Etyka Biznesu i Zrównoważony Rozwój*, 2019, 1, 15–27.

11.11. Kuzior, A.; Kuzior, P. (2020). The quadruple helix model as a smart city design principle. *Virtual Economics,* 3(10), 39–57.

11.12. Kuzior A., Kwilinski A., Tkachenko V. Sustainable development of organizations based on the combinatorial model of artificial intelligence. *Entrepreneurship and Sustainability Issues*, 2019, 7 (2), pp. 1353–1376. https://jssidoi.org/jesi/article/442

11.13. Kwilinski A., Kuzior A.: Cognitive Technologies in the Management and Formation of Directions of the Priority Development of Industrial Enterprises. *Management Systems in Production Engineering* 2020, 2, 133–138.

11.14. Kwilinski A., Tkachenko V., Kuzior A.: Transparent Cognitive Technologies to Ensure Sustainable Society Development. *Journal of Security and Sustainability Issues*, 2019, 9 (2), 561-570. http://doi.org/10.9770/jssi.2019.9.2(15)

11.15. Reiter-Palmon, R.: Creative cognition at the individual and team levels: What happens before and after idea generation. In: R.J. Sternberg & J.C. Kaufman (Eds.), The Nature of Human Creativity. Cambridge University Press 2018, pp. 184–202.

11.16. Reiter-Palmon, R., Kramer, W., Allen, J.A., Murugavel, V.R., Leone, S.A.: Creativity in Virtual Teams: A Review and agenda for Future Research. *Creativity* 2021, 8(1), pp. 165–188.

11.17. Zdolności człowieka w ujęciu współczesnej psychologii. Klinkosz W., Sekowski A. E. (eds.). Tow. Nauk. KUL. Lublin 2010.

12.1. Curry, Bob (2018). In This Rust Belt Town, Immigrants Felt Unwelcome, but a Grassroots Community Center Is Changing That. The Morning Call: Allentown, Pennsylvania. https://www.therenewalproject.com/in-this-rust-belt-town-immigrants-felt-unwelcome-but-a-grassroots-community-center-is-changing-that/. DOA: 11.08.2021.

12.2. Małys-Zaremba, Emilia (2021). Poland needs a more systematic and holistic approach to the integration of foreigners: Demography, Labor and Social Policy. Case News. https://www.case-research.eu/en/poland-needs-a-more-systematic-and-holistic-approach-to-the-integration-of-foreigners-101845. DOA: 11.08.2021.

12.3. Kogan, Irena, Eric Fong and Jeffrey G. Reitz (2020). Religion and Integration among Immigrant and Minority Youth. Journal of Ethnic and Migration Studies, 46(17), 3543-3558. https://www.tandfonline.com/doi/full/10.1080/1369183X.2019.1620408. DOA: 11.07.2021.

12.4. Kemppainen, Teemu, Laura Kemppainen, Hannamaria Kuusiom Shadia Rask and Pasi Saukkonen (2020). Multifocal Integration and Marginalisation: A Theoretical Model and an Empirical Study on Three Immigrant Groups. Sociology, 54(4), 782–805. https://journals.sagepub.com/doi/full/10.1177/0038038520904715. DOA: 11.07.2021.

12.5. Boyer, Stephen P. (2009). Learning from Each Other The Integration of Immigrant and Minority Groups in the United States and Europe. Center for American Progress. https://cdn.americanprogress.org/wp-content/uploads/issues/2009/04/pdf/immigrant_integration.pdf?_ga=2.101841474.25510892. DOA: 11.08.2021.

12.6. Center for Penn State Student Entrepreneurship. https://cpsse.psu.edu/about. DOA: 11.08.2021.

12.7. Launch Box News. https://hazleton.psu.edu/launchbox/news. DOA: 11.08.2021.

12.8. Arias-Perez, Jose, Geovanny Perdomo and Nelson Lozada (2014).Business Incubator Research: A Review and Future Directions. Pensamiento & Gestión: Universidad del Norte, 37, 41-65. https://www.researchgate.net/publication/311882761_Business_incubator_research_a_review_and_future_directions. DOA: 11.08.2021.

12.9. Dahms, Sven,Suthikorn Kingkaew (2016). University Business Incubators: An Institutional Demand Side Perspective on Value Adding Features. Entrepreneurial Business and Economics Review, 4(3), 41-56.

12.10. Bala, Subrahmanya, Mungila Hillemane, Krishna Satyanarayana and Deepak Chandrashekar (2019). Technology business incubation for start-up generation: A literature review toward a conceptual framework. International Journal of Entrepreneurial Behavior & Research, 25(7),1471-1493.ISSN: 1355-2554. https://www.emerald.com/insight/content/doi/10.1108/IJEBR-02-2019-0087/full/html. DOA: 11.08.2021.

12.11. New Approach to Entrepreneurship Education in Primary Schools. (2017)Turkish Online Journal of Educational Technology (Special Issue for INTE 2017). İşman, Aytekin, Jerry Willis, J. Ana Donaldson, Dabaj Fahme, Eric Zhi and Feng Liu. (Eds.).ISSN 21467242. https://www.researchgate.net/publication/323368854_New_Approach_to_Entrepreneurship_Education_in_Primary_Schools_The_BGENTL. DOA: 11.08.2021.

12.12. Lackeus, Martin (2015). Entrepreneurship in Education: What, Why, When, How. OECD (European Commission). https://www.oecd.org/cfe/leed/BGP_Entrepreneurship-in-Education.pdf.DOA:11.08.2021.

12.13. Kromydas, Theocharis (2017).Rethinking Higher Education and Its Relationship with Social Inequalities: Past Knowledge, Present State and Future Potential. Palgrave Communications. https://www.nature.com/articles/s41599-017-0001-8.pdf. DOA: 11.08.2021.

12.14. Wei, Xingjian, Xiaoland Liu and Jian Sha (2019). How Does the Entrepreneurship Education Influence the Students' Innovation? Testing on the Multiple Mediation Model. Frontiers in_Psychology,10,1557. ISSN=1664-1078. https://www.frontiersin.org/articles/10.3389/fpsyg.2019.01557/full. DOA: 11.08.2021.

12.15. Ngak-Ling, Sum and Bob Jessop (2012). Competitiveness, the Knowledge-Based Economy and Higher Education. Journal of the Knowledge Economy 4(1). 24-44. https://www.researchgate.net/publication/257796624_Competitiveness_the_Knowledge-Based_Economy_and_Higher_Education. DOA: 11.08.2021.

12.16. Economic Development Administration (2013). The Innovative and Entrepreneurial University: Higher Education, Innovation & Entrepreneurship in Focus. U.S. Department of Commerce:Washington,D.C. https://www.eda.gov/pdf/the_innovative_ and_entrepreneurial_university_report.pdf. DOA: 11.08.2021

12.17. Karlsson, Charlie, Jonna Rickardsson and Joakim Wincent (2021). Diversity, Innovation and Entrepreneurship: Where Are We and Where Should We Go in Future Studies? *Small Business Economics*, 56, 759–772. https://link.springer.com/article/10.1007/s11187-019-00267-1. DOA: 11.08.2021.

12.18. Wang, Lili and Zexia Li (2021). Knowledge Flows from Public Science to Industrial Technologies. *The Journal of Technology Transfer*, 46, 1232–1255. https://link.springer.com/article/10.1007/s10961-019-09738-9. DOA: 11.08.2021.

12.19. Brockmann, Carsten and Narcyz Roztocki (2017). The Six Pillars of Knowledge Economics. Proceedings of the 50th Hawaii International Conference Science, Maui, Hawaii, 4444-4453. ISBN: 978-0-9981331-0-2. https://scholarspace.manoa.hawaii.edu/bitstream/10125/41701/paper0552.pdf. DOA: 11.08.2021.

13.1. Draper, Nora (2017). Fail Fast: The Value of Studying Unsuccessful Technology Companies. Media Industries 4(1). https://pdfs.semanticscholar.org/22b2/e061bb246b3b1f96c81aa8a6d0be8ea047fe.pdf. DOA:1.08.2021.

13.2. Matson, Jack (1991). The Art of Innovation: Using Intelligent Fast Failure. Pennsylvania State University Press: State College.

13.3. Tahirsylai, Armend S. (2012). Stimulating Creativity and Innovation through Intelligent Fast Failure. Thinking Skills and Creativity, 7(3), 265-270. ISSN: 1871-1871. https://eric.ed.gov/?id=EJ983807. DOA: 11.08.2021.

13.4. https://www.coursera.org/lecture/creativity-innovation/ introduction-to-iff-QQcBC. DOA: 11.08.2021.

13.5. Matson, Jack V. (1996). Innovate or Die : A Personal Perspective on the Art of Innovation. Paradigm Press: Royal Oak, MI. ISBN: 978-0-96544490-3.

13.6.Jablokow, Kathryn W., Jack V. Matson, Darrell Velegol and Armend Tahirsylaj. *Creativity, Innovation and Transformation.* coursera. https://www.coursera.org/learn/creativity-innovation#syllabus.

13.7.Maltese, Adam V., Amber Simpson and Alice anderson (2018). *Failing to Learn: The Impact of Failures during Making Activities.* Thinking Skills and Creativity, 30, 116-124. www.sciencedirect.com/science/article/pii/S187118711730175X.

13.8.Haefner, Naomil, Joakim Wincent, Vinit Parida and Oliver Gassmann (2021). *Artificial Intelligence and Innovation Management: A Review, Framework, and Research Agenda.* Technological Forecasting and Social Change, 162, 120392.www.sciencedirect.com/science/article/pii/S004016252031218X.

13.9.Jablokow, Kathryn W., Xiaorui Zhu, Jack V. Matson and Akshay Nitin Kakde (2016). *Stimulating Creativity in Online Learning Environments through Intelligent Fast Failure.* ASSE Peer. New Orleans, LA: 2016 ASEE Annual Conference & Exposition (Classroom Practice II: Technology and Game-Based Learning. ISBN: 978-0-692-68565-5. ISSN: 2153-5965. peer.asee.org/stimulating-creativity-in-online-learning-environments-through-intelligent-fast-failure.pdf.

13.10.Michaud, Chris (2020). *Getting to the Future: Strategic Adaptation and the Importance of Backcasting.* EPAM. www.continuuminnovation.com/en/how-we-think/blog/whats-better-than-failing-fast-succeeding.

13.11.McGrath, Rita Gunther (2011). *Failing by Design.* Harvard Business Review. hbr.org/2011/04/failing-by-design.

13.12. Tahirsylaij, Armend (2012). Stimulating creativity and innovation through Intelligent Fast Failure. Thinking Skills and Creativity, 7(3), 265-270. https://www.researchgate.net/publication/257701331_Stimulating_creativity_and_innovation_through_Intelligent_Fast_Failure.

13.13. European Commission (2019). *SKILL IT Competence Framework (Digital Pathway for Youth Work)*. https://digipathways.io/content/uploads/2019/10/IO2-Competency-Framework-Report.pdf.

13.14. Matson, Jack V. (1996). *Innovate or Die: A Personal Perspective on the Art of Innovation.* Paradigm Press, Limited: Seattle, WA. ISBN 10: 0965444902 / ISBN 13: 9780965444903.

13.15. Giles, Sunnie (2018). *How To Fail Faster -- And Why You Should*. Forbes Magazine. www.forbes.com/sites/sunniegiles/2018/04/30/how-to-fail-faster-and-why-you-should.

14.1. Indeed Editorial Team (2021).What are the 7 Steps of the Engineering Design Process? https://www.indeed.com/career-advice/career-development/design-process. DOA: 11.08.2021.

14.2. The Engineering Design Process. https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-process-steps. DOA: 11.08.2021.

14.3. Levy, Yair and Timothy J. Ellis (2006). *A Systems Approach to Conduct: An Effective Literature Review in Support of Information Systems Research.* Informing Science Journal, Eli Cohen (Ed.), 9, 181-212. https://inform.nu/Articles/Vol9/V9p181-212Levy99.pdf.

14.4. Laukkanen, Eero, [a]Juha Itkonen[a] and Casper Lassenius[ba](2017). Problems, Causes and Solutions When Adopting Continuous Delivery – A Systematic Literature Review. Information and Software Technology, 82, 55–79. https://www.sciencedirect.com/science/article/pii/S0950584916302324.

14.5. Perkmann, Markus, [a]ValentinaTartari[k], MaureenMcKelvey[b], ErkkoAutio[a], AndersBroström[c], PabloD'Este[d], RiccardoFini[f], AldoGeuna[el], RosaGrimaldi[f], AlanHughes[m], StefanKrabel[h], MichaelKitson[g], PatrickLlerena[i], FrancesoLissoni[j], AmmonSalter[a]MaurizioSobrero[f] (2013). Academic Engagement and Commercialisation: A Review of the Literature on University–Industry Relations. Research Policy, 42(2), 423–442. https://www.sciencedirect.com/science/article/pii/S0048733312002235.

14.6. Egbert, Joy (2017). *Supporting Student Problem-Solving: Methods of Education Technology: Principles, Practice, and Tools,* Ch. 6. Press Book (Open Education Resource): Montreal, Canada. https://opentext.wsu. edu/tchlrn445/chapter/chapter-6-supporting-student-problem-solving.

14.7. Graybeal, Geoffrey (2018). *Problem-Solving to Find Entrepreneurial Solutions.* Entrepreneurship, Ch 6, Section 1. https://openstax. org/books/entrepreneurship/pages/6-1-problem-solving-to-find-entrepreneurial-solutions.

14.8. Graybeal, Geoffrey (2018). *Business Models for Content and Technology Plays: Media Innovation and Entrepreneurship.* Ferrier, Michelle and Elizabeth Mays (Eds.) The Rebus Foundation: Montreal, Quebec, Canada. ISBN: 13-9781989014004. https://press.rebus. community/media-innovation-and-entrepreneurship/.

16.1. Wolniak, R.; Grebski, M.E.; Skotnicka-Zasadzień, B. Comparative analysis of the level of satisfaction with the services received at the business incubators (Hazleton, PA, USA and Gliwice, Poland). Sustainability 2019, 11, 2889.

16.2. Zhong, R.Y.; Xu, X.; Klotz, E.; Newman, S.T. Intelligent Manufacturing in the Context of Industry 4.0: A review. Engineering 2017, 3, 613–630.

16.3. Pilloni, V. How Data Will Transform Industrial Processes: Crowdsensing, Crowdsourcing and Big Data as Pillars of Industry 4.0. Future Internet 2018, 10, 24.

16.4. Zunino, C.; Valenzano, A.; Obermaisser, R.; Petersen, S. Factory Communications at the Dawn of the Fourth Industrial Revolution, Comput. Stand. Interfaces 2020, 71, 103433.

16.5. Herceg, I.V.; Kuč, V.; Mijušković, V.M.; Herceg, T. Challenges and Driving Forces for Industry 4.0 Implementation. Sustainability 2020, 12, 4208, doi:10.3390/su12104208.

16.6. Saniuk, S.; Grabowska, S., Gajdzik, B. Social expectations and market changes in the context of developing the Industry 4.0 concept. Sustainability 2020, 12, 1–20.

16.7. Lee, J.; Kao, H.-A.; Yang, S. Service innovation and smart analytics for industry 4.0 and big data environment. Procedia Cirp 2014, 16, 3–8.

16.8. Longo, F.; Nicoletti, L.; Padovano, A. Smart operators in industry 4.0: A human-centered approach to enhance operators' capabilities and competencies within the new smart factory context. Comput. Ind. Eng. 2017, 113, 144–159.

16.9. Nagaro, G.; Koc-Lem, A.; Vinces, L.; Ronceros, J.; Mesones, G.; Acquiring, Monitoring, and Recording Data Based on the Industrie 4.0 Standard Geared Toward the Maca Drying Process. Adv. Intell. Syst. Comput. 2020, 1066, 42–53.

16.10. Zimmermann, M.; Schellenberger, C.; Schotten, H.D. Dynamic live wireless communication monitoring for jamming and interference detection in industry 4.0 | [Dynamische Echtzeit-Überwachung von Funkkommunikation zur Erkennung von Jamming und Interferenzen für Industrie 4.0], 24. ITG Symp. Mob. Commun. Technol. Appl. 2020, 5, 52–57.

16.11. García-Muiña, F.E.; Medina-Salgado, M.S.; Ferrari, A.M.; Cuchi, M. Sustainability Transition in Industry 4.0 and Smart Manufacturing with the Triple-Layered Business Model Canvas. Sustainability 2020, 12, 2364, doi:10.3390/su12062364.

16.12. Ashton, K. That 'Internet of Things' Thing. In the real world, things matter more than ideas. RFID J. 2009, 22, 97–144. Available online: http://www.rfid journal.com/articles/pdf?4986 (accessed on 25 April 2020).

16.13. Sittón-Candanedo, I.; Alonso, R.S.; Rodríguez-González, S.; García Coria, J.A.; De La Prieta, F. Edge Computing Architectures in Industry 4.0: A General Survey and Comparison. Adv. Intell. Syst. Comput. 2020, 950, 121–131.

16.14. Tran, T.K.; Yahoui, H.; Siauve, N. An interactive approach to teach automation in the training of the industry 4.0. In Proceedings of the 13th International Conference on Software, Knowledge, Information Management and Applications, SKIMA, Ukulhas, Maldives, 26–28 08 2019; p. 8982491.

16.15. Zhang, X. Intelligent Distribution System Based on "Internet +" Logistics. Adv. Intell. Syst. Comput. 2020, 1017, 1680–1684.

16.16. Zezulka, F.; Marcon, P.; Vesely, I.; Sajdl, O. Industry 4.0–An Introduction in the phenomenon. IFAC PapersOnLine 2016, 49, 8–12.

16.17. Veselovsky, M.Y.; Pogodina, T.V.; Ilyukhina, R.V.; Sigunova, T.A.; Kuzovleva, N.F. Financial and economic mechanisms of promoting innovative activity in the context of the digital economy formation. Entrep. Sustain. Issues 2018, 5, 672–681.

16.18. Brozzi, R.; Forti, D.; Rauch, E.; Matt, D.T. The Advantages of Industry 4.0 Applications for Sustainability: Results from a Sample of Manufacturing Companies. Sustainability 2020, 12, 3647, doi:10.3390/su12093647.

16.19. Miśkiewicz, R.; Wolniak R. Practical application of the Industry 4.0 concept in a steel company. Sustainability 2020, Volume 12, No 14, 5776, pp. 1-12.

16.20. Shahbazi, S.; Wiktorsson, M.; Kurdve, M.; Jönsson, C.; Bjelkemyr, M. Material efficiency in manufacturing: Swedish evidence on potential, barriers and strategies. J. Clean. Prod. 2016, 127, 438–450.

16.21. Oluyisola, O.E.; Sgarbossa, F.; Strandhagen, J.O. Smart Production Planning and Control: Concept, Use-Cases and Sustainability Implications. Sustainability 2020, 12, 3791, doi:10.3390/su12093791.

16.22. Duflou, J.R.; Sutherland, J.W.; Dornfeld, D.; Herrmann, C.; Jeswiet, J.; Kara, S.; Hauschild, M.; Kellens, K. Towards energy and resource efficient manufacturing: A processes and systems approach. CIRP. Ann. Manuf. Technol. 2012, 61, 587–609, doi:10.1016/j.cirp.2012.05.002.

16.23. Müller, J.M.; Buliga, O.; Voigt, K.I. Fortune favors the prepared: How SMEs approach business model innovations in Industry 4.0. Technol. Forecast. Soc. Chang. 2018, 132, 2-17.

16.24. Wilkesmann, M. Wilkesmann, U. Industry 4.0 – organizing routines or innovations?, Journal of Information and Knowledge Management Systems, 48(2), 2018, 238-254.

16.25. Russell, M.G., Smorodinskaya, N. V., Leveraging complexity for ecosystemic innovation. Technol. Forecast. Soc. Change, 2018, 1–18, https://doi.org/10.1016/j.techfore.2017.11.024.

16.26. Tsujimoto, M., Kajikawa, Y., Tomita, J., Matsumoto, Y. A review of the ecosystem concept – Towards coherent ecosystem design. Technol. Forecast. Soc. Change, 136, 2018, 49–58. https://doi.org/10.1016/j.techfore.2017.06.032.

16.27. Benitez, G.B., Ayala, N.F., Frank, A.G. Industry 4.0 innovation ecosystems: an evolutionary perspective on value cocreation, International Journal of Production Economics, 228, 2020, 107735.

16.28. Top 10 Industry 4.0 Trends & Innovations in 2021, https://www.startus-insights.com/innovators-guide/top-10-industry-4-0-trends-innovations-in-2021/, access data: 30.12.2021.

16.29. Industry 4.0 Innovation Map Reveals Emerging Technologies & Startups, https://www.startus-insights.com/innovators-guide/industry-4-0-innovation-map-reveals-emerging-technologies-startups/, access data: 30.12.2021.

16.30. Industry 4.0 and the fourth industrial revolution explained, https://www.i-scoop.eu/industry-4-0/, access data: 30.12.2021.

16.31. Osika, G. Social innovations as support for industry 4.0, Scientific Papers of Silesian University of Technology, 141, 2019, 289-301.

16.32. Stawiarska, E., Szwajca, D., Matusek, M, Wolniak, R. Diagnosis of the maturity level of implementing Industry 4.0 solutions in selected functional areas of management of automotive companies in Poland, Sustainability, 29(9), 2021, 1-38.

16.33. Drozd, R., Wolniak, R. Metrisable assessment of the course of stream-systemic processes in vector form in industry 4.0, Quality and Quantity, 2021, 1-16, DOI: 10.1007/s11135-021-01106-w.

16.34. Gajdzik, B., Wolniak, R. Transitioning of steel producers to the steelworks 4.0 - literature review with case studies, Energies, 14(14), 2021, 1-22.

17.1. Brzóska J.: Innovation as a factor of steel sector companies value growth, Prace Instytutu Metali Nieżelaznych, nr 2, 2016, s. 17-23.

17.2. Visser W.: The cognitive artifacts of designing, Lawrence Erlbaum Associates, 2006.

17.3. Dorst K.: The core of "design thinking" and its applications, Design Studies, nr 32, 2011, pp. 521-532.

17.4. Dorst K.: Frame Innovation: Create new thinking by design, Cambridge, MA: MIT Press, 2012.

17.5. Cross N.: Designery ways of knowing, Birghauser, Boston, 2007.

17.6. Pink D. H.: A whole new mind: Why right brainers will rule the future, Riverhead, New York, 2006.

17.7. Dorst K.: Frame Innovation: Create new thinking by design, Cambridge, MA: MIT Press, 2012.

17.8. Anderson L., Shattuck J.: Design-based research: A decade of progress in education research?, Educational Researcher, nr 41, 2012, pp. 16–25.

17.9. Plattner H., Meinel Ch. Leifer L.: Design Thinking research. Building innovations, Stanford, Springer, 2015.

17.10. Carleton T., Cockayne W.: Playbook for strategic foresight and innovations, Stanford University, Stanford, CA, 2013.

17.11. Wolniak R.: The Design Thinking method and its stages, „Systemy Wspomagania Inżynierii Produkcji", z. 6, 2017, s. 247–255.

17.12. Ambrose G., Harris P.: Design Thinking, AVA Publishing, Lausanne, 2010.

17.13. Tschimmel K.: Design Thinking as an effective Toolkit for Innovation, [w]: Proceedings of the XXIII ISPIM Conference: Action for Innovation: Innovating from Experience. Barcelona 2012.

17.14. Hobcraft, P. Improving the potential for Innovation through Design Thinking, HYPE Simplify Innovation, Bonn, Germany, 2020.

17.15. Modrzejewska, D. The impact of Desigh Thinking on innovativeness of an organization and personal creativity of its employees, Business Informatics, 2(56), 2020, 43–50.

17.16. Ivanova, D., Koleva, G. Design Thinking – an innovative management approach, Conference: Innovation in forest industry and engineering design 2020, At: Sofia, Bulgaria.

17.17. Gullberg, G., Widmark, E, Nyström, M., Landström, A. Design Thinking in Business innovation, MFE, 2006, http://www.diva-portal.org/smash/get/diva2:414819/fulltext01.pdf, access data: 29.12.2021.

17.18. Liedtka, J. Perspective: Linking Design Thinking with Innovation Outcomes through Cognitive Bias Reduction, journal Production Innovation Management, 32(6), 2015, 925–338.

18.1 Matson, Jack (1991). The Art of Innovation: Using Intelligent Fast Failure. 3Pennsylvania State University Press: State College.

18.2 Matson, Jack V. (1996). Innovate or Die : A Personal Perspective on the Art of Innovation. Paradigm Press: Royal Oak, MI. ISBN: 978-0-96544490-3.

18.3. Kathryn W Jablokow, Darrell Velegol, Armend Tahirsylas, Jock Matson (2021) Creativity, Innovation and Transformation. On behalf of The Pennsylvania State University and Coursera

18.4. Jablokow, Kathryn, Jack V. Matson, Darrell Velegol (2014). *A Multidisciplinary MOOC on Creativity and Change: Encouraging Experimentation and Experiential Learning on a Grand Scale*. 360° of Engineering Education. 121st ASEE Annual Conference and Exposition: Indianapolis, IN. Paper ID# 9669. https://peer.asee.org/a-multidisciplinary-mooc-on-creativity-innovation-and-change-encouraging-experimentation-and experiential-learning-on-a-grand-scale.pdf.

18.5. Darrell Velegol, Gambling on Innovation, Industrial & Engineering Chemistry Research 2021 60 (20), 7689-7699, DOI: 10.1021/acs.iecr.1c00511

18.6. Darrell Velegol, How To Innovate During a Crisis, Chemical Engineering Progress ; 116(8):52-56, 2020

18.7. Rohan Prabhu, Jennifer Bracken, Clinton B. Armstrong, Kathryn Jablokow, Timothy W. Simpson & Nicholas A. Meisel (2020) Additive creativity: investigating the use of design for additive manufacturing to

encourage creativity in the engineering design industry, International Journal of Design Creativity and Innovation, 8:4, 198–222, DOI: 10.1080/21650349.2020.1813633

18.8. Jablokow, K. (2001, June), The Thinking Expedition: A Course In Creativity, Innovation And Change Paper presented at 2001 Annual Conference, Albuquerque, New Mexico. 10.18260/1-2--9902

18.9.Jablokow, Kathryn W., Jack V. Matson, Darrell Velegol and Armend Tahirsylaj. *Creativity, Innovation and Transformation.* coursera. https://www.coursera.org/learn/creativity-innovation#syllabus.

18.10.*How to Create Personal Goals with the Wheel of Life* (2020). projectleaderacademy.com/blog/wheel-of-life. (Note: This site could be used when developing assignments.)

19.1 Psychology Today. (2018). Everyday Creativity. [online] Available at: https://www.psychologytoday.com/us/articles/200911/everyday-creativity [Accessed 3 Jul. 2018].

19.2 Kanter, R.M.: The middle manager as innovator. *Harvard business review* 1982, 60, 4, pp. 95-105.

19.3 Miron E., Erez M. and Naveh E.: Do personal characteristics and cultural values that promote innovation, quality, and efficiency compete or complement each other? *Journal of Organizational Behavior* 2004, 25 (2), pp. 175–199.

19.4 Scott S.G. and Bruce R.A.: Determinants of Innovative Behavior: A Path Model of Individual Innovation in the Workplace. *The Academy of Management Journal* 1994, 37 (3), pp. 580–607.

19.5 Tjosvold D.: The conflict-positive organization: it depends upon us. *Journal of Organizational Behavior* 2008, 29 (1), pp. 19–28.

19.6 Yuan F. and Woodman R.W.: Innovative Behavior in the Workplace: The Role of Performance and Image Outcome Expectations. *Academy of Management Journal* 2010, 53 (2), pp. 323–342.

20.1. Kerschensteiner, Georg (2013). *Theorie der Buildung.* Serverus: New York. ISBN: 9783863475635.

20.2. Rowson, Jonathan (2019). Bildung in the 21st Century – Why Sustainable Prosperity Depends upon Reimagining Education. https://cusp.ac.uk/wp-content/uploads/09-Jonathan-Rowson-online.pdf. DOA: 12.28.2021.

20.3.Tahirsylaj, Armed. & Werler, Tobias Christoph (2022). *In Search of Dimensions of Bildung: A Quantitative Approach*. Nordic Studies in Education. *41*(1), 1–23. https://noredstudies.org/index.php/nse/article/download/2130/5130?inline=1.

20.4. Paulsen, Michael, Jesper Garsdal and David Kergel, Birte Heidkamp-Kergel (Eds.), 2022. *Bildung in the Digital Age: Exploring Bildung through Digital Media in Education*. Routledge (Taylor & Francis Group): New York, NY. ISBN: 9780367746360 https://portal.findresearcher.sdu.dk/en/publications/bildung-in-the-digital-age-exploring-bildung- through-digital-media-in-education.

20.5.Bengtsen, Soren, Anders Sonesson, Anders Ahlberg (2019). *The Nordic Doctorate at a Crossroads between Bildung, Schoolification and Projectification.* Research Portal: Lund University, SRHE International Conference on Research into Higher Education, Newport, United Kingdom, 88. https://www.srhe.ac.uk/conference2019/downloads/SRHE_ARC_Abstracts_2019.pdf#page=88.

20.6. Taylor, Carol A. (2020). *Reconceptualising the Subject-Citizen of Bildung in a Posthuman World: Rethinking the Promise of Higher Education.* In: Strand, Torill (Ed.) Rethinking Ethical-Political Education. Contemporary Philosophies and Theories in Education, Springer International Publishing: Cham, Germany, 16, 209-222. ISBN: 978-3-030-49523-7. link.springer.com/book/10.1007/978-3-030-49524-4.

21.1. Langley, S. (2018). Facilitating positive emotions for greater creativity and innovation. In L. Petitta, C. E. J. Härtel, N. M. Ashkanasy, & W. J. Zerbe (Eds.), *Individual, relational, and contextual dyanmics*

of emotions (pp. 259–270). Emerald Group Publishing. https://doi.org/10.1108/S1746-979120180000014020

21.2. Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American Psychologist,* 56(3), pp. 218–226.

21.3. Friedman R. & Foster J. (2001). The effects of promotion and prevention cues on creativity. *Journal of Personality and Social Psychology,* 81, pp. 1001–1013.

21.4. Subramaniam, K., Kounios, J., Parrish, T. B., & Jung-Beeman, M. (2009). A brain mechanism for facilitation of insight by positive affect. *Journal of Cognitive Neuroscience,* 21, pp. 415-432.

21.5. Association for Psychological Science. (2011, June 3). People with depression get stuck on bad thoughts, unable to turn their attention away, study suggests. *ScienceDaily*. Retrieved January 1, 2022 from www.sciencedaily.com/releases/2011/06/110602162828.htm

22.1. Malik F, Marwaha R. Cognitive Development. [Updated 2021 Jul 31]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK537095/

22.2. Orenstein GA, Lewis L. Eriksons Stages of Psychosocial Development. [Updated 2020 Nov 22]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK556096/

22.3. Straub, R. (2019). Health Psychology: A Biopsychosocial Approach, Sixth Edition. New York. Worth.

22.4. Munsey, C. (2006, June). Emerging adults: The in-between age. *Monitor on Psychology*, *37*(7). http://www.apa.org/monitor/jun06/emerging

22.5. Anthony, Scott D., Paul Cobban, Rahul Nair and Natahe Puchaud (2019). *Breaking Down the Barriers to Innovation.* Harvard Business Review. hbr.org/2019/11/braking-down-the-barriers-

22.6. Cartwright,Teryl (2013). *Applied Creativity Tools toward Transformation (An Undergraduate Curriculum).* Boston, MA: University of Massachusetts. Scholarworks.umb.edu/cg0/viewcontent.cgi?article=1341/content=cct_capstone.

22.7. Lee, Sang M. and Silvana Trimi (2018). *Innovation for Creating a Smart Future.* Journal of Innovation and Knowledge, 3(1), 1-8. Sciencedirect.com/science/article/pii/S2444569X16300154.

22.8. Newman, Daniel (2017). *Innovation vs Transformation: The Difference in a Di*gital World. https://www.forbes.com/sites/danielnewman/2017/02/16/innovation-vs-transformation-the-difference-in-a-digital-world/?sh=.

22.9. *Frontiers of Innovation* (2022). Center of Developing Child. Harvard University. https://developingchild.harvard.edu/innovation-application/frontiers-of-innovation/.

23.1. Shao, Yong & Zhang, Chenchen & Zhou, Jing & Gu, Ting & Yuan, Yuan. (2019). How Does Culture Shape Creativity? A Mini-Review. Frontiers in Psychology (Cognitive Processes in Individual and Collective Creativity: A Cross-Cultural Perspective). https://www.frontiersin.org/articles/10.3389/fpsyg.2019.012119/full.

23.2. Hockenbury, S. E., Nolan, S. A. (2018). Psychology (Ed.). United States: Macmillan Higher Education. ISBN: 13: 978-1319050634.

24.1. Bush, George. Poland Business and Economic Relations Treaty: Poland Concerning Business and Economic Relations Message From the President of the United States. Signed 03/21/1990. Amended 05/01/2004. Washington, D.C.: United States Government Printing Office, 1990. pp. 1-22.

24.2. Czerpiąc z przeszłości, kreuj przyszłość. Wynalazki i patenty. AGH Centrum Informacji Patentowej. https://www.google.pl/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&ved=0ahUKEwiNpoqrjKLYAhVGJ1AKHQv6BcQFghEMAU&url=http%3A%2F%2Fpatenty.bg.agh.edu.pl%2Fgraf%2Fczerpiac_z.pdf&usg=AOvVaw2pdyA5x8MWiGCgeY0caxLa, DOA: 24/12/2017.

24.3. Dziennik Ustaw: Rzeczypospolitej Polskiej. October 6, 2016. pp. 1–34.

24.4. Posner, Richard A.: Why There are Too Many Patents in America, *The Atlantic*, July 12, 2012.

24.5. Procedury patentowe. Internetowe centrum przedsiębiorczości akademickiej, Wrocław 2010.

24.6. Raport o stanie patentowania w Polsce. Cirdo Taxend, Warszawa 2015.

24.7. Śnieżko A.: *Jak chronic wynalazki w Polsce, w Europie iI na swiecie: Podstawowe pojecia i procedury.* WTS Rzecznicy Patentowi. 2014. pp. 1–20.

24.8. Turczak A.: Problemy ochrony patentowej w Polsce, Equilibrium, nr 1, 2010, pp. 203-216.

24.9. United States Patent and Trademark Office. General Information Concerning Patents. USA Department of Commerce, 2014.

24.10. .www.uspto.gov/learning-and-resources/fees-and-payments. DOA: 11/30/2017.
(Fees and payments for patent applications in the United States)

24.11. www.uspto.gov/learning-and-resources/support-centers. DOA: 11/30/2017.
(Support for patent applications in the United States)

24.12. www.uspto.gov/patents-getting-started/general-information. DOA: 11/30/2017.
(General information for getting a patent in the United States)

24.13. https://www.uspto.gov/patents-getting-started/patent-basics/types-patent-applications/utility- patent/process-obtaining. DOA: 12/29/17. (Patent application process in the United States)

24.14 .https://www.uspto.ov/patents-getting-started/patent-process-overview. DOA: 12/29/17.
(Overview of the patent process in the United States)

27.1. Matson, Jack V. (1996). Innovate or Die : A Personal Perspective on the Art of Innovation. Paradigm Press: Royal Oak, MI. ISBN: 978-0-96544490-3.

27.2. Kathryn W Jablokow, Darrell Velegol, Armend Tahirsylas, Jock Matson (2021) Creativity, Innovation and Transformation. On behalf of The Pennsylvania State University and Coursera

27.3. Darrell Velegol:
https://scholar.google.com/citations?view_op=list_works&hl=en&hl=en&user=D8NY9lUAAAAJ&pagesize=100&alert_preview_top_rm=2

29.1. Asimov, I. (2013). I am a robot. Poznań 2013; Asimov, I. (1985). Robots and Empire. New York.

29.2. White Paper on Artificial Intelligence. A European approach to excellence and trust. Brussels, 19.2.2020 COM (2020) 65; https://ec.europa.eu/info/sites/default/files/commission-white-paper-artificial-intelligence-feb2020_en.pdf

29.3. http://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation

29.4. http://www.rri-tools.eu/about-rri

29.5. Gasparski, W., Lewicka-Strzałecka, A, Bąk, D., Rok, B. and Kuraszko, I .: Business ethics - inventions and innovations. *Praxeology*, 2016, 158 (1).

29.6. Grebski, ME: Comparative Analysis of Innovativeness Network in Poland and the United States (Monograph). TNOiK, Torun 2021.

29.7. Grebski M .: Mobility of the Workforce and Its Influence on Innovativeness (Comparative Analysis of the United States and Poland). *Production Engineering Archives* 2021, 27 (4), pp. 272–276.

29.8. Kiepas A .: (2006). Ethics as a factor of eco-development in science and technology. Problems of Eco-development, 2006, 1 (2), pp. 77–86.

29.9. Kiepas A .: Philosophy of technology in the era of new media. Katowice, Publishing House of the University of Silesia 2017.

29.10. Kopaliński, W .: Dictionary of foreign words and foreign phrases, Wiedza Powszechna Warszawa 1986.

29.11. Krawczyk, D. The influence of modern communication technologies on changes in the specificity of the journalist profession. Studia Politicae Universitatis Silesiensis, 2018, 23, pp. 135–151.

29.12. Kuzior A.: Aksjologia zrównoważonego rozwoju. Belianum. Banska Bystrica 2014.

29.13. Kuzior A.: Applied ethics, Tygiel, Lublin 2021.

29.14. Kuzior A.: Bycie, posiadanie, nadzieja..., Stowarzyszenie na Rzecz Rozwoju Nauki Polskiej, Zabrze 2011.

29.15. Kuzior A.: (2021). Development of Industry 4.0 and the Issue of Technological Unemployment. Case Study - Poland. In: Innovation management and information technology impact on global economy in the era of pandemic. Proceedings of the 37th International Business Information Management Association Conference (IBIMA), Cordoba, Spain. Ed. Khalid S. Soliman. International Business Information Management Association 2021, pp. 7843–7849.

29.16. Kuzior, A., Grebski, W. and Lyulyov, O.: The role of ethics in engineering education, *Business Ethics and Sustainable Development. Interdisciplinary theoretical and empirical studies*, 2019, 1, pp. 15–27.

29.17. Kuzior A., Kochmańska A., Marszałek-Kotzur I.: Information and Communication Technologies as a Tool of Modern Communication in Organizations and Society. Proceedings of the 37th International Business Information Management Association (IBIMA), 30–31 May 2021, Cordoba, Spain 2021.

29.18. Kuzior A., Kwilinski A., Tkachenko V.: Sustainable development of organizations based on the combinatorial model of artificial intelligence. *Entrepreneurship and Sustainability Issues*, 2019, 7 (2), pp. 1353–1376. https://jssidoi.org/jesi/article/442

29.19. Kuzior A., Lobanova A. Tools of information and communication technologies in ecological marketing under conditions of sustainable development in industrial regions (through examples of Poland and Ukraine). *Journal of Risk and Financial Management*, 2020, 13 (10), 238. https://doi.org/10.3390/jrfm13100238

29.20. Kuzior A., Mańka-Szulik M., Krawczyk D.: Changes in the Management of Electronic Public Services in the Metropolis During the Covid-19 Pandemic. *Polish Journal of Management Studies* 24 (2), pp. 261–275.

29.21. Kuzior A., Zozulak J.: Adaptation of the idea of phronesis in contemporary approach to innovation, *Management Systems and Production Engineering*, 2019, 27 (2), pp. 84-87. http://doi.org/10.1515/mspe-2019-0014

29.22. Kwilinski A.: Implementation of blockchain technology in accounting sphere. *Academy of Accounting and Financial Studies Journal*. 2019, 23 (2), pp. 1-7.

29.23. Kwilinski A., Tkachenko V., Kuzior A.: Transparent Cognitive Technologies to Ensure Sustainable Society Development. *Journal of*

Security and Sustainability Issues, 2019, 9 (2), 561-570. http://doi.org/10.9770/jssi.2019.9.2(15)

29.24. Okoń-Horodyńska, E.: Education for innovation (Are only the chosen ones doomed to innovative success?) „ *Science and Higher Education*, 2008, 1 (31), pp. 34-54.

29.25. Wajszczyk P.: Ethics of the engineering profession in the light of selected codes, *Annales. Ethics in economic life* 2013, 16, http://www.annalesonline.uni.lodz.pl/archiwum/2013/2013_wajszczyk_241_258.pdf;

29.26. Wajszczyk P.: Reflections on Professional Engineering Ethics - a Personalistic Perspective, *Management and Business Administration. Central Europe* 2012, 3 (116), pp. 60-70.

30.1. Agenda 21: Earth Summit: The United Nations Program of Action from Rio. 1993 (enacted in 1992). Available online: https://sustainabledevelopment.un.org/outcomedocuments/agenda21 (accessed on 14 April 2021).

30.2. Białoń, L. and Werner, K.: Cognitive competences of management in the conditions of the fourth industrial revolution, *MINIB* , 2018, 27 (1), pp. 81-106.

30.3. Bilan Y., Streimikiene D., Vasylieva T., Lyulyov O., Pimonenko T. and Pavlyk A.: Linking between renewable energy, CO2 emissions, and economic growth: Challenges for candidates and potential candidates for the EU membership. *Sustainability* 2019, 11 (6), 1528.

30.4. Bilovodska O., Kholostenko A., Mandrychenko Z. and Volokitenko O.: Innovation management of enterprises: Legal provision and analytical tools for evaluating business strategies, *Journal of Optimization in Industrial Engineering* , 2021, 14 (1), pp. 89-96.

30.5. Bina O.: The Green Economy and Sustainable Development: An Uneasy Balance? *Environment and Planning C: Government and Policy* , 2013, 31 (6), pp. 1023-1047. https://doi.org/10.1068/c1310j

30.6. Bowonder, B., Dambal, A., Kumar, S. and Shirodkar, A.: Innovation Strategies for Creating Competitive Advantage', *Research-Technology Management* , 2010, 53 (3), pp. 19-32. https://doi.org/10.1080/08956 308.2010.11657628

30.7. Chyhryn, O.Y., Bilan, Y.V. and Kwilinski, A.: Stakeholders of green competitiveness: Innovative approaches for creating communicative system', *Marketing and Management of Innovations*, 2020, 3, pp. 356-368.

30.8. Grebski, M.E.: Comparative Analysis of Innovativeness Network in Poland and the United States (Monograph). TNOiK, Torun 2021.

30.9. Grebski M.: Mobility of the Workforce and Its Influence on Innovativeness (Comparative Analysis of the United States and Poland). *Production Engineering Archives,* 2021, 27 (4), pp. 272-276.

30.10. Grebski M., Grebski W.: Project-based approach to engineering technology education. *Production Engineering Archives* 2019, 25 (25), pp. 56–59.

30.11. Kopaliński W.: Słownika wyrazów obcych i zwrotów obcojęzycznych, Wiedza Powszechna. Warszawa 1968.

30.12. Kuzior A.: Aksjologia zrównoważonego rozwoju. Belianum. Banska Bystrica 2014.

30.13. Kuzior A.: Development of Industry 4.0 and the issue of technological unemployment case study - Poland. In: Innovation management and information technology impact on global economy in the era of pandemic of the 37th International Business Information Management Association Conference (IBIMA), 30-31 May 2021, Cordoba, Spain. Ed. Khalid S. Soliman, International Business Information Management Association, 2021, pp. 7843–7849.

30.14. Kuzior A.: Innovation management as a tool for sustainable development and improving the quality of life of societies. In: Innovation management

and sustainable economic development in the era of global pandemic. Ed. Khalid S. Soliman. Proceedings of the 38th International Business Information Management Association Conference (IBIMA). Seville, Spain 2021.

30.15. Kuzior A.: Innowacje a odpowiedzialność jako kategoria relacyjna. In: Globalne konteksty poszanowania praw i wolności człowieka. Aktualne problemy. A. Kuzior (ed.), Katedra Stosowanych Nauk Społecznych. Wydział Organizacji i Zarządzania Politechnika Ślaska, Zabrze, pp. 135–144.

30.16. Kuzior A. and Czajkowski W.: Knowledge management in the context of sustainable development'. In: Innovation management and information technology impact on global economy in the era of pandemic. Proceedings of the 37th International Business Information Management Association Conference (IBIMA), 30-31 May 2021, Cordoba, Spain. Ed. Khalid S. Soliman. [Bm]: International Business Information Management Association, 2021, pp. 10846-10852.

30.17. Kuzior A. and Grebski W.: Directions of implementation of the assumptions of the idea of sustainable development. Polish and American experiences. In: Humanistic, technical and social aspects of environmental protection. Ed. Kuzior A. Publishing. Scientific „Silesia", Katowice 2021, pp. 39–53.

30.18. Kuzior A., Grebski M. and Grebski W.: Marketing of an Academic Program: Case Study of an Engineering Program. *Marketing and Management of Innovations*, 2021, 1, pp. 56-64. http://doi.org/10.21272/mmi.2021.1-05

30.19. Kuzior A., Grebski W. and Lyulyov O.: The role of ethics in engineering education', *Business Ethics and Sustainable Development. Interdisciplinary theoretical and empirical studies*, 2019, 1, pp. 15–27.

30.20. Kuzior A. and Kuzior P.: The quadruple helix model as a smart city design principle', *Virtual Economics*, 2020, 3 (1), pp. 39-57. http://doi.org/10.34021/ve.2020.03.01(2)

30.21. Kuzior A. and Kwilinski A.: Zarządzanie refleksyjne – prolegomena. In: Wybrane aspekty komunikacji i zarządzania turbulentnym środowisku, Kuzior, A. and Krawczyk, D. (eds.), Wydawnictwo Naukowe Śląsk, Katowice 2021.

30.22. Kuzior A., Kwilinski A. and Tkachenko V.: Sustainable development of organizations based on the combinatorial model of artificial intelligence. *Entrepreneurship and Sustainability*, 2019, 7 (2), pp. 1353-1376. http://doi.org/10.9770/jesi.2019.7.2(39)

30.23. Kuzior A., Lobanova A. and Kalashnikova L.: Green Energy in Ukraine: State, Public Demands, and Trends. *Energies*, 2021, 14, 7745. https://doi.org/10.3390/en14227745

30.24. Kuzior A. and Lobanova A.: Tools of information and communication technologies in ecological marketing under conditions of sustainable development in industrial regions (through examples of Poland and Ukraine). *Journal of Risk and Financial Management*, 2020. 13 (10), 238. https://doi.org/10.3390/jrfm13100238

30.25. Kuzior A., Staszek M.: (2021). Energy management in the railway industry: a case study of rail freight carrier in Poland. *Energies*, 2021, 14, 6875. https://doi.org/10.3390/en14216875

30.26. Kuzior A. and Zozulak J.: Adaptation of the Idea of Phronesis in Contemporary Approach to Innovation. *Management Systems in Production Engineering*, 2019, 27 (2), 84-87. https://doi.org/10.1515/mspe-2019-0014

30.27. Kvilinskyi O. and Kravchenko S.: Optimization of Innovative Project Realization Conditions. *Scientific Papers of the Poznań University of Technology. Organization and Management*, 2016, 70, pp. 101-111.

30.28. Kwilinski A.: Mechanism of formation of industrial enterprise development strategy in the information economy. *Virtual Economics*, 2018, 1 (1), pp. 7-25.

30.29. Kwilinski A.: Reflexive management. Tygiel, Lublin 2021.

30.30. Kwilinski A. and Kuzior A.: Cognitive technologies in the management and formation of directions of the priority development of industrial enterprises, *Management Systems in Production Engineering*, 2020, 28 (2), pp. 133-138, https: / /doi.org/10.2478/mspe-2020-0020 ;

30.31. Kwilinski A., Pająk K., Halachenko O., Vasylchak S., Pushak Y. and Kuzior P.: Marketing tools for improving enterprise performance in the context of social and economic security of the state: innovative approaches to assessment, *Marketing and Management of Innovations*, 2019, 4, pp. 172-181. https://doi.org/10.21272/mmi.2019.4-14

30.32. Kwilinski A., Tkachenko V. and Kuzior A.: Transparent cognitive technologies to ensure sustainable society development. *Journal of Security and Sustainability Issues*, 2019, 9 (2), pp. 561-570. http://doi.org/10.9770/jssi.2019.9.2(15)

30.33. Loiseaua E., Saikkub L., Antikainenb N., Drostec N., Hansjürgensc B., Pitkänenb K., Leskinenb P., Kuikmand P. and Thomsene, M.: Green economy and related concepts: An overview. *Journal of Cleaner Production,* 2016, 139 (15), pp. 361-371. https://doi.org/10.1016/j.jclepro.2016.08.024

30.34. Mikhnevych L., Marchenko V., Hristov P. and Kuzior A.: (2020), 'Conceptual relationships between country image and economic security', *Marketing and Management of Innovations*, 1, pp. 285-293. http://doi.org/10.21272/mmi.2020.1-24

30.35. Technology transfer negotiations. Training manual. Investment and Technology Promotion Office in Warsaw, United Nations Industrial Development Organization, UNIDO ITPO Warsaw 2004, 18-19.

30.36. Okoń-Horodyńska E.: Education for innovation (Are only the chosen ones doomed to innovative success?), *Science and Higher Education* , 2008, 1 (31), pp. 34-54.

30.37. Schumpeter J.: Kapitalizm, socjalizm i demokracja. PWN, Warszawa 2009. Original version: Schumpeter J.: Capitalism, Socialism and Democracy. Harper & Brothers. New York 1942.

30.38. Schumpeter J.: Teoria rozwoju gospodarczego, PWN, Warsaw 1960. Original version: Schumpeter J.: Theorie der wirtschaftlichen Entwicklung, 1912.

30.39. Shvindina H.: Coopetition as an emerging trend in research: perspectives for safety & security. *Safety* 2019, 5 (3), 61. https://doi.org/10.3390/safety5030061

30.40. Shvindina H.: Innovations of strategic management development: from competition to coopetition. *Marketing and Management of Innovations* 2017, pp. 180-192. http://doi.org/10.21272/mmi.2017.1-16

30.41. Sienkiewicz-Małyjurek K.: Relational risk factors in public safety networks. *Scientific Quarterly „Organization and Management",* 2018, 2 (42), 51-61. https://doi.org/10.29119/1899-6116.2018.42.5

30.42. Strbova M. and Kuzior P.: Safety management in the age of internet threats', *Management Systems in Production Engineering* , 2019, 27 (2), pp. 88-92. https://doi.org/10.1515/mspe-2019-0015

30.43. The Business Case for the Green Economy. Sustainable Return on Investment, UNEP, 2012. http://www.unep.org/greeneconomy/Portals/88/documents/partnerships/UNEP%20BCGE%20A4.pdf (07/14/2021)

30.44. Tkachenko, V. Kuzior A. and Kwilinski A.: Introduction of artificial intelligence tools into the training methods of entrepreneurship activities', *Journal of Entrepreneurship Education*, 2019, 22 (6), pp. 1–10.

31.1 Brandeau G., Hill. L.A., Lineback K. and Truelove E.: Collective Genius: The Art and Practice of Leading Innovation, Harvard Business Review Press, 2014.

31.2 Gryffin R.W.: Podstawy zarządzania organizacjami (Basics for management of organizations), Wydawnictwo PWN, Warszawa, 2004.

31.3 Kotter J. P.: A Force for Change, How Leadership Differs from Management. New York, Free Press, 1990.

31.4 Kuzior A., Kettler K., Rąb Ł.: Digitalization of Work and Human Resources Processes as a Way to Create a Sustainable and Ethical Organization, *Energies* 2022, 15(1).

31.5 Lasswell H. D.: The structure and function of communication in society. In L. Bryson (Ed.), The communication of ideas. New York, Harper and Row, 1948.

31.6 Northouse P.G.: Leadership. Theory and Practice, Sixth Edition, Sage Publications, Inc, London 2013.

31.7 French J.R.P., Raven B.: The Bases of Social Power, [w:] Cartwright D. (red.), *Studies in Social Power,* University of Michigan Press, Ann Arbor, Michigan, 1959.

31.8 Shannon, C.E.: A Mathematical Theory of Communication, *Bell System Technical Journal*, 1948.

31.9 Weber M.: Wirtschaft und Gesselschaft. Grundriss der Verstehnden Soziologie, J.C.B. Mohr (Paul Siebeck), Tubingen, 1972.

Authors' biographies

■ **Prof. SUT Aleksandra Kuzior, PhD, Dsc., Dr. h.c.**

Prof. SUT Aleksandra Kuzior, PhD, Dsc., Dr. h.c. is a habilitated doctor, Professor of the Silesian University of Technology (SUT), honored with Doctoris Honoris Causa. Scientifically deals with the issues of sustainable development, business ethics, Smart City, safety management, technology assessment, artificial intelligence and cognitive technologies, Industry 4.0, green economy. At the Faculty of Organization and Management of the SUT she is the Vice-Dean for Cooperation and Development and the Head of the Department of Applied Social Sciences. She is the President of Silesian Center of Business Ethics and Sustainable Development, Vice-president of the Polish Association for Technology Assessment. Chairwoman of the Committee on Corporate Social Responsibility and Social Communication at the Regional Chamber of Commerce in Katowice, project evaluation expert from Scientific Grant Agency of the Ministry of Education, Science, Research and Sport and of the Slovak Academy of Sciences (VEGA), project evaluation expert from the National Research Foundation of Ukraine. Manager of 8 completed projects financed by the European Social Fund, polish National Center for Research and Development and Polish National Agency for Academic Exchange. She is the author of over 210 scientific publications. Laureate prize: 1) Special Award 'Black Diamond' awarded by the Regional Chamber of Commerce and Industry of the Rybnik Industrial District (2018); 2) Silesian Scientific Award (2017); Medal of the National Education Commission (2015); 4) Award of the Minister of Education and Science for organizational activity (2021).

✉ aleksandra.kuzior@polsl.pl
✍ ORCID: 0000-0001-9764-5320

■ **Prof. Radosław Wolniak, PhD**

Prof. Radosław Wolniak, PhD, works as a professor in the Department of Economics and Informatics, Faculty of Organisation and Management, Silesian University of Technology Silesian University of Technology. He is the author

of more than 450 articles and 20 books on management science and quality sciences. He has promoted 4 doctorates. He deals with the following issues: quality management, management methods and tools, Smart City, Industry 4.0, internationalisation of management, CSR. He is a vice-president of the Silesian Branch of the Society for Organisation and Management and editor of many national and international journals.

■ Agnieszka Czerwińska-Lubszczyk PhD

Agnieszka Czerwińska-Lubszczyk, PhD works at University of Bielsko-Biala (Poland), Department of Economic and Social Science. Her research is focused on interorganizational cooperation, included cooperation for innovation, development of graduates' competencies and sustainability. She has authored articles and books. From the beginning of her research career, she has been involved in cooperation with partners from foreign Universities (Germany, Czech Republic, USA).

■ Dariusz Krawczyk Ph.D.

Member of the Polish Society of Social Communication and the Commission of Organization and Management Sciences of the branch of the Polish Academy of Sciences in Katowice, lectures in media relations and management (Silesian University of Technology, University of Silesia in Katowice), court expert in the field of social communication and management established at the District Court in Gliwice, Head of the Department of Social Contacts in the City Hall in Zabrze.

✉ dariusz.krawczyk@polsl.pl
✍ ORCID: 0000-000 3-1823-0309

■ Dominika Jagoda-Sobalak PhD

Since 2009, she has been a researcher at the Opole University of Technology. In 2016, she obtained a PhD in economics in the field of management sciences at the Silesian University of Technology, defending her thesis on the use of inventive methods to increase the innovation of enterprises in the SME sector. In 2013, she also completed postgraduate studies "Preparation in the field of psychological, pedagogical and didactic" at the Higher School of Management and Administration in Opole. Member of the Polish Society of Production Management, Polish Society of Innovation Management.

Participant of internship programs aimed at generating innovative solutions, including: "Science for innovation", "Innovative Opolskie", "Innovative Transfer PLUS". Author of numerous national and international publications in the field of innovation management, the use of creative problem-solving methods in the process of designing and implementing innovations, and managing project teams. He is an expert in the field of innovation at the Marshal's Office in Opole.

▪ Michalene Eva Grebski PhD

Michalene Eva Grebski has a multidisciplinary background combining Masters' degrees in Psychology and Business Administration as well as a Doctorate in Management. From 2016 through 2020, she was a faculty member at Northampton Community College (Pennsylvania USA). Presently she is a faculty member at Colorado Mesa University (Colorado USA). Michalene Eva Grebski has co-authored six books and fifty-seven scholarly articles. Her research interest is innovativeness and creativity in education and entrepreneurial networks. She has conducted research related to the development of innovativeness skills and attributes as well as a multidisciplinary holistic approach as a method of enhancing innovative behavior.

▪ Wieslaw Grebski PhD

Wieslaw Grebski is Professor Emeritus at The Pennsylvania State University. He was an Engineering faculty at Penn State Hazleton and Coordinator of the Engineering Program. His research focus is sustainable energy and power generation. He has coauthored one hundred and fifty publications and five books. He has also taught the dual enrollment class, *Introduction to Engineering Design*.

Chcesz wiedzieć więcej?

zapraszamy
do naszej księgarni internetowej

ZARZĄDZANIE

UNIA EUROPEJSKA

RACHUNKOWOŚĆ

DYDAKTYKA

EKONOMIA

PRAWO

www.wydawnictwo.tnoik.torun.pl/sklep/

"In terms of physical and mental features, the authors of the monograph titled *Creativity and Innovativeness in Psychology and Management* focused on two dimensions, i.e., creativity and innovativeness, that can be used by modern decision-makers to create the organisation's market success. In this context, the monograph provided to me for review provides an answer to the needs of both decision-makers searching for knowledge and inspiration to act, and for management adepts (the academic environment) who, based on structured knowledge, will have an opportunity to get acquainted with the complex matter of creativity and innovativeness in organisation management."

"It is especially noteworthy that the Authors raised the issue based on the conditions in Poland and the United States, thereby additionally increasing the content's value and attractiveness."

"Thanks to its interdisciplinary frame of raising the issue, it is necessary to state that the publication is valuable and is an important voice in the publication market that supports both decision-makers and the academic society."

<div align="right">

Katarzyna Hys Prof. dr. hab. inż.
Production and Logistics Engineer
Politechnika Opolska
Opole, Poland

</div>

"Creativity" and "Innovativeness" are two of the most popular adjectives in our contemporary world. Everyone wants to be a creative person and find or discover a creative solution. Creativity was and is one of the fundamental features of the progressive development of our human species from generation to generation. The book, "Creativity and Innovativeness in Psychology and Management", deals with some aspects of such a broadly understood meaning of the term "creativity" but partially narrowing it down to a psychological and management perspective."

"Theoretical and practical considerations are measurable sides of "creativity" which are found elsewhere in this book. The promotion of an accepted broad point of view is decisive for the versatility and, above all, for the multidisciplinary aspect of this book."

"One of the conclusions that arises after reading the book is that personal mastery and an accurate sense of domain are necessary factors for innovation."

<div align="right">

Jozef Bremer Prof. dr. hab.
Rektor
Jesuit University Ignatianum
Kraków, Poland

</div>