SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2025
ORGANIZATION AND MANAGEMENT SERIES NO. 234

THE EFFECT OF EXPERT DECISION-MAKING STYLE ON THE DESIGN PROCESS OF INNOVATIVE TOOTHED GEAR PUMPS – A CASE STUDY

Anna M. DEPTUŁA[1*], Piotr OSIŃSKI[2], Paweł BURY[3], Rafał CIEŚLICKI[4]

[1] Faculty of Production Engineering and Logistics, Opole University of Technology; an.deptula@po.edu.pl, ORCID: 0000-0002-2073-4971
[2] Faculty of Mechanical Engineering, Wroclaw University of Science and Technology; piotr.osinski@pwr.edu.pl, ORCID: 0000-0001-9126-499X
[3] Faculty of Mechanical Engineering, Wroclaw University of Science and Technology; pawel.bury@pwr.edu.pl, ORCID: 0000-0002-1480-0653
[4] Faculty of Mechanical Engineering, Wroclaw University of Science and Technology; rafal.cieslicki@pwr.edu.pl, ORCID: 0000-0003-3525-672X
* Correspondence author

Purpose: The main goal of this research was to verify the adopted research thesis, i.e.: design engineers have a unique and uniform procedure applied in the decision-making process, which affects their ability to create new solutions.
Design/methodology/approach: The paper's authors assumed that experts – design engineers have specific personality traits that determine their decision-making style. In order to verify this assumption was maked: analysis of selected personality traits of experts, assessment of individual decision-making styles, detailed analysis of the decision-making process, within which the design of innovative toothed gear pumps is carried out, decision-making analysis related to the development of a new innovative solution, analysis of the impact of personality traits and decision-making style on the process of designing innovative gear pumps. The study used tools such as the Decision-Making Styles Inventory – KSPD, Expert Behavior Questionnaire – EBQ, Expert Mind Questionnaire – EMQ, and SCAMPER technique.
Findings: The analysis of the obtained results allows us to assume that the selected team of experts allows for creating and generating new solutions while maintaining the desired level of caution in the scope of risk analyses. In the case of forming project teams, the use of tools that support their selection, such as EBQ and EMQ, can be considered an advantage. Such analyses can be supplemented by the application of the KSPD. As a result of the broad analyses of the decision-maker's personality, it is possible to characterize the experts in terms of their predispositions to create new innovative solutions. Moreover, a distinctly rational approach to decision-making constitutes a common feature for designer engineers, which is supported by intuition at the same time. However, the research presented in the work shows that expert design engineers utilize intuition in their work and then make decisions based on facts and data. This style is strongly correlated with the areas of expert behaviors concerning cognitive motivation and open-mindedness.
Originality/value: Identify unique personality traits for design engineers and define their impact on the effectiveness of their decisions.

Keywords: decision-making process, design engineers, personality traits, intuition, rational approach.
Category of the paper: Research paper, case study.

1. Introduction

The decision-making process is a key issue from the perspective of management, as well as various types of activities where analysis and evaluation are necessary. It is a process of fundamental importance not only in the performance of enterprises but also in other areas that demand specialized knowledge and skills. Nowadays research frequently is focused on analyzing this process in the context of decisions made as part of economic activities; however, this is not the only area where the process plays a significant role. The individuals responsible for making challenging and complex decisions are experts, and they are not always associated with organizations such as enterprises. Design engineers form one such example, as they utilize their knowledge and experience to create new solutions. Based on the studies reported in (Deptuła, 2024), regarding the manner in which experts make challenging and complex decisions, the decision-making process through which new solutions are developed differs not only in terms of the scope of the decisions but also in the specificity of their analysis and the selection of alternative solutions compared to decisions made in business. In enterprises, economic and market factors are of crucial importance, whereas in the work of designer engineers, the priority is the realization of assumptions primarily related to technical and structural aspects, followed by financial calculations and economic analyses.

Therefore, in the case of analysis of projects implemented in a company, the expert is first focused on the selection of alternative solutions, then on maximizing profits, and only subsequently focuses on other aspects of the company's performance in the context of the implemented investment. As shown by research (Deptuła, 2024) dealing with the analysis of criteria for evaluating innovation projects, modern companies should reorganize their existing priorities and focus first on the correct statement of the needs of the customers. Analyzing these factors and adjusting corporate priorities demonstrate that decision-making processes within organizations remain still on a key area of research (Mousaei, Rezaei, 2023; Beheshti, Alavi, 2023; Singh, Singh, 2024; Khan et al., 2023; Taherdoost, Madanchian, 2023; González-Mendoza et al., 2022; Wang, Ruhe, 2007) at the intersection of disciplines such as mathematics, game theory, statistics, computer science, management, economics, psychology, neurobiology, sociology, philosophy, and engineering. They concern various issues, starting from the analysis of the complexity of decision-making problems, through the analysis of decision-making styles, and ending with the effect of the experts and their personal characteristics on the effectiveness of the decisions made. However, we can point out that in the literature dealing with the aspects of the subject of criteria analysis and project evaluation there is a lack of accurate analysis and

guidelines with regard to the way in which design engineers take decisions and the criteria they apply (Deptuła, 2025). Due to the fact that the priorities of the entrepreneur and the design engineer are slightly different, we should assume that each of these specific groups of experts is characterized by a specific and systematic way of making decisions. Understanding the specific conditions of the decision-making process that takes place in the design and construction phase may determine the essence of the effectiveness of the decision-making process that accompanies the creation of new solutions. The starting point for this type of research is the analysis of decision-maker's personality (personality traits) and linking them with the decision-making style of a given expert, which was presented in this paper.

The main goal of this article is therefore to verify the adopted research thesis, i.e. the following statement:

design engineers have a unique and uniform procedure applied in the decision- making process, which affects their ability to create new solutions.

In order to verify the adopted assumption, an analysis of the decision-making style of the experts- design engineers was carried out. This research procedure results from the need to analyze the decision-maker's personality of experts, which was described in more detail in (Deptuła, 2025). The research presented in this work shows that experts – design engineers utilize intuition in their work and then make decisions based on facts and data. In order to check how intuition is related to other personality traits of design engineers and how its activation can be converted into the effectiveness of the design process, the article presents a case study conducted for 3 designers involved in the design of innovative toothed gear pumps. The authors of the paper assumed that experts – design engineers have specific personality traits that determine their decision-making style. In order to verify this assumption, the following steps were undertaken:

1. Analysis of selected personality traits of experts. For this purpose, a behavioral questionnaire and an expert mindset questionnaire were used.
2. Evaluation of individual decision-making styles. The study utilized the Polish adaptation of the Decision-Making Styles Inventory – KSPD (in the original General Decision-making Style Inventory (GDMS) (Scott, Bruce, 1995)).
3. Detailed analysis of the decision-making process, within which the design of innovative toothed gear pumps is carried out.
4. Decision-making analysis related to the development of a new innovative solution. For this purpose, the metaplan technique, the rule breaker and the SCAMPER technique were utilized.
5. Analysis of the impact of personality traits and decision-making style on the process of designing innovative gear pumps.

The intention in the reported research process was to seek and provide answers to the following questions:

1. What personality traits of expert designers determine effective decision-making problem solving? In the analyzed case, focused on designing new solutions, i.e. development during a creative process.
2. What is the relationship between a design engineers decision-making styles and their ability to create innovative solutions?

2. Theoretical framework of the study

Given the increasing uncertainty and complexity of the environment, along with rising customer expectations and intensifying competition, new perspectives emerge for contemporary research on decision-making processes. The proposed approach does not merely offer an opportunity but constitutes a necessary stage in the advancement of scientific study. The decision-making process includes logically related mental operations involving the assessment of decision-making situation in selecting the most advantageous alternative. In the literature on the subject, "decision" is understood as "a conscious, non-random selection of a single course of action among many (at least two) possible alternatives" (Bolesta-Kukułka, 2000; Ściborek, 2003; Griffin, 2006; Mulyono et al., 2021; De Andreis, 2020; Jadhav, 2019). Such a decision forms an act of making a choice. It is the final effect of the decision-making process.

In the literature on the subject, one can find various decision-making schemes. They differ in the number of stages, levels of detail, or the names of the individual phases. However, the invariable element is the complexity and multi-stage nature of this process. A decision forms an act of making a choice. It constitutes the final outcome of the decision-making process (Drucker, 2005; Bieniok, 2006). As a general, a decision-making process includes the following stages (see: Hammond et al., 2002; Taherdoost, Madanchian, 2023; González-Mendoza et al., 2022; Lunenburg, 2010; Vroom, 2012; Yates, 2003; Wang, Ruhe, 2007; Orasanu et al., 1993):

1. Identification and analysis of a problem.
2. Defining criteria or selecting them.
3. Selection of the best option.
4. Identifying potential solutions.
5. Evaluating individual decision options.
6. Selection of an optimal alternative.
7. Development of tools and conditions needed for putting the selected solution to use – with the purpose of its implementation.
8. Evaluating the outcomes of the decision taken.

In the course of the development of research on decision-making processes, two approaches are observed to interpenetrate: normative and descriptive. The first approach involves guidance provided by universal principles and patterns in specific actions. The second one consists in reproducing processes and actions that are implemented in reality. However, a compromise seems to be an approach that combines both assumptions (Bolestra-Kukuła, 2003). These approaches also give rise to various typologies of the decision-making process, including a decision-making process that can defined as (Barnard, 1997; Isenberg, 1984; Bolestra-Kukuła, 2003; Klein, 1998; Scott, Bruce, 1995; Tavcar, 1995; La Pira, 2011):

1. Rational (logical, analytical) and intuitive (alogical).
2. Routine, rational and intuitive.
3. Rational, intuitive, spontaneous, dependent and avoidant.
4. Rational, quasi-rational, adaptive, quasi-intuitive, intuitive.

We can note that rational and intuitive models form the basis of the indicated typologies, and the remaining ones comprise combinations of the basic models. In the literature, models that assume the integration of the rational and intuitive approaches are called "dual process" models. The rational model fits into the assumptions of the normative approach, while the intuitive model is consistent with the guidelines of the descriptive approach. In turn, "dual process" models that integrate the approach oriented towards rational thinking and the approach oriented towards intuition take into account the assumptions of both the normative and descriptive approaches (Malewska, 2018).

The course of the decision-making process is largely determined by the way the human mind operates when decisions are made (Rowe, Davis, 1996; Nightingale, 2007). The reason why managers act differently in similar situations is investigated by researchers in the field of decision-making styles (Lewin, 1936; Nutt, 1990). The analysis of decision-making style is important because the style of the decision maker can explain a significant amount of variability in the decision-making process carried out by managers (Taggart et al., 1985). In this respect, it is also important to determine how a person uses information when decisions are made by them (Rowe, Mason, 1987). This issue forms the subject of many studies (McKenney, Keen, 1974; Robey, Taggart, 1981; Mitroff, 1983; Driver et al., 1990; Rowe, Mason, 1987; Kinicki, Williams, 2013).

The style of decision-making affects the way information is processed, which in turn is converted into the effectiveness of decisions made (Ayal et al., 2011, 2015; Shiloh et al., 2002). For this reason, an individual analysis of the decision-making style by an expert provides tools for adjustment of the tools that support this process.

The researchers in this area have remarked that there is a scarcity of research on the individual predispositions of design engineers. Theoretical descriptions focus on the analysis of decisions mainly of a financial nature of people associated with the company. However, it should be borne in mind that the beginning of the link of these decisions is situated accurately in the location where a new idea is created – an innovative solution. In this respect, it is also important to examine how individuals responsible for creating new solutions affect the decision-making process, which in the final part is related to the decision whether to implement a given solution or not. This article focuses on this aspect related to the decision-making process and presents examples that involve an analysis of psychological conditions of selected design engineers.

A variety of alternative psychometric tools can be used to measure decision-making style. Such tools include questionnaires testing cognitive traits and questionnaires designed specifically to assess decision-making style: Myers-Briggs Type indicator Test (MBTI), General Decision-Making Style Inventory (GDMS), The Cognitive Style Index (CSI), Kirton Adaption-Innovation Inventory (KAII) or The Rational-Experiential Inventory (REI). The key differences in the individual questionnaires are attributable to reasons related to the adopted concept and development of decision-making styles. From the point of view of the presented study, it is important to note that the selected tool provides a possibility of combining selected decision-making styles, because such an assumption is related to combining selected personality traits of experts. It is difficult, if at all possible, to find an expert who would have so-called pure personality traits that are not a specific mixture of other personality traits.

2.1. Characteristic of adopted research tools

Scott and Bruce's General Decision-Making Style Questionnaire is utilized for identifying the decision-making style of individuals undertaking analysis of decision-making (Scott, Bruce, 1995). The Polish edition of the questionnaire (Sitko, 2023) reported in the article was used for the purposes of this study. In the questionnaire, the decision-maker is examined in terms of five decision-making styles:

1. Rational style – which involves systematic analysis of information, searching for the best solutions, and logical and systematic analysis of all known alternatives.
2. Intuitive style – in which the decision-maker focuses on details in the flow of information and relies on their own feelings and intuitions.
3. Dependent style – which involves Seeking advice and guidance from others while placing significant weight on their opinions in decision-making and personal judgments.
4. Avoidant style – typical for people who procrastinate and hesitate to make decisions.
5. Spontaneous style, which involves impulsiveness, making choices without considering the consequences or their own hunches.

The Expert Behavior Questionnaire (EBQ) contains 18 statements characterizing three basic personality traits:

1. Open mind – UO.
2. Cognitive motivation – MP.
3. Reacting to uncertainty – RN.

The first aspect - open mind (UO) diagnoses the potential expert's mind orientation towards new information and preferences regarding more challenging tasks. It is related to the following attributes of the expert: knowledge and skills, experience and the need to meet new challenges.

Cognitive motivation (MO) is defined by the expert's desire to achieve success, expressed in openness to difficult and complicated tasks. In turn, reacting to uncertainty (RN) concerns the measurement of expert characteristics responsible for reacting in conditions of uncertainty. It indicates a lack of automation and stability in decision-making (Deptuła, 2025).

The Expert Mind Questionnaire (EMQ) is a supplement to the EBQ questionnaire. Its primary goal is to diagnose the level of expert mindfulness (Deptuła, 2025) It consists of 15 statements, which, due to their content, can be grouped into three categories, i.e. ones that concern the general self-assessment of mindfulness, verifying the trait of self-assessment ability and diagnosing mindfulness in practice.

2.2. Characteristics of techniques and methods used in the study

The study used several techniques and methods to support the problem-solving process, but also include processes that stimulate creativity and innovation. Their application at the specific stages was adjusted to the needs resulting from the specificity of a given stage of the study. For this reason, selected elements of the indicated techniques were repeatedly revised and reiterated.

METAPLAN approach formed the main method utilized in moderating the study. This approach involves an analysis of a problem and a creative search for a solution. As a consequence, it is possible to gather information about the progress and results of a given state of identified matters. The main goals of the approach include conducting an effective discussion and activating its participants to encourage a creative solution of the analyzed problem. The method is recommended in the circumstances when group members find it difficult to focus on the task, although its use in other conditions is not excluded. Its application involves the following stages (Szmidt, 2013; VanGundy, 2005):

1. Characteristic of the problem.
2. Defining the desired or satisfactory state.
3. Performing a diagnosis of the situation.
4. Developing proposals for solutions.

This study uses the term: *rule breaker*. This is a method developed by one of the greatest experts on innovation, Doug Hall in 1994. It is based on three steps (Szmidt, 2013; VanGundy, 2005):

Step 1. Description of beliefs regarding the given problem.

Step 2: Breaking each of the accepted assumptions.

Step 3. Using rule breaking to create new solutions.

The research also utilized the *SCAMPER* technique, in which an assumption is made that each new thing is a development of what already exists, by adjusting specific needs and expectations. The procedure is related to the steps in which (Eberle, 1996):

Step 1. Designers investigate what and how can be replaced? Can individual structural elements be substituted? Or, can a substitute be offered for people involved in the project? (*S* for *Substitute*).

Step 2. Designers investigate what can be combines with something else? What should be combined to achieve the desired effect? (*C* for *Combine*).

Step 3. Designers enquire whether they have already worked on a similar project that could be learnt from. What solutions from other projects can be applied to the project we are currently working on? (*A* for *Adapt*).

Step 4. Designers wonder what and how to magnify; duplicate to achieve the intended effect? In which area are more employees needed? (*M* for *Magnify*).

Step 5. Designers investigate how something can be applied for another purpose? Who can use the assumptions? Can people outside the target group reach for them? (*P* for *Put to Another Use*).

Step 6. Designers investigate how something can be simplified? What can be eliminated to standardize the design? What would happen if a step could be we skipped? (*E* for *Eliminate*).

Step 7. Designers enquire whether it is possible to use a different arrangement and reverse the order. What effect would that have? Can something be done in the opposite way? (*R* for *Reverse*). The first letters of the steps form the title of the method named SCAMPER.

The study also uses the ZWI technique – which consists in directing the decision-maker's attention to the successive elements of the analyzed:

Z – benefits of the idea.

W – drawbacks of the idea.

I – the interesting part in a given idea.

The individual stages of the study were also supported by direct interviews.

3. Outline of the study

The main objective of the study was to determine the influence of the expert's decision-making style on the design process of toothed gear pumps, which in turn was intended to offer a support to the design process in generating new solutions. The analysis of this issue seems to pose a challenge in the context of the development possibilities of gear wheels, as a research object they form a design that seems quite simple.

Experts think and act in accordance with a specific cognitive style, unique to them. This style is a way of operation that is discernible in the context of cognitive and intellectual activities (Sękowski, 1988). Experts can perceive and process stimuli from the environment at different levels of abstraction or concreteness, in an analytical or holistic manner, systematically and methodically, or by applying a trial-and-error approach. The tendency to use specific cognitive styles specific to a given expert is usually a mixture of different styles, which can additionally be used with different intensity depending on the situation (Matczak, 2000). Therefore, the analysis of decision-making styles should be contextual, which is also indicated by the prospect theory, and the selection of the appropriate expert for the risk assessment process is a consequence of these conclusions, which come down to the application of specific criteria for selecting experts (Deptuła, 2025).

3.1. Procedure applied in the study

As mentioned earlier, the starting point for the research was to conduct 3 questionnaires. Subsequently, the experts jointly began to develop a diagram presenting the basic goals of modifying the pumps they designed. The diagram is presented in Figure 1.

As part of the implementation of the projected scheme, experts specified a goal in which the entire process of developing pumps could be determined. Their optimization is the main subject of the analyses. The specificity of the designed innovations means that the most important goal of the designed objects is to increase the operating pressure. However, this does not mean that the significance of the remaining goals is underestimated, but rather that they are less important from the point of view of the development process of toothed pump design. The scheme also indicates the main elements that affect a given goal (black arrow) and the possible direction of its impact on another goal (blue arrow).

Subsequently, creative sessions were held in two rounds each lasting 120 minutes. Their effect involved the development of innovative solutions in the field of modification of the designed pumps by individual experts.

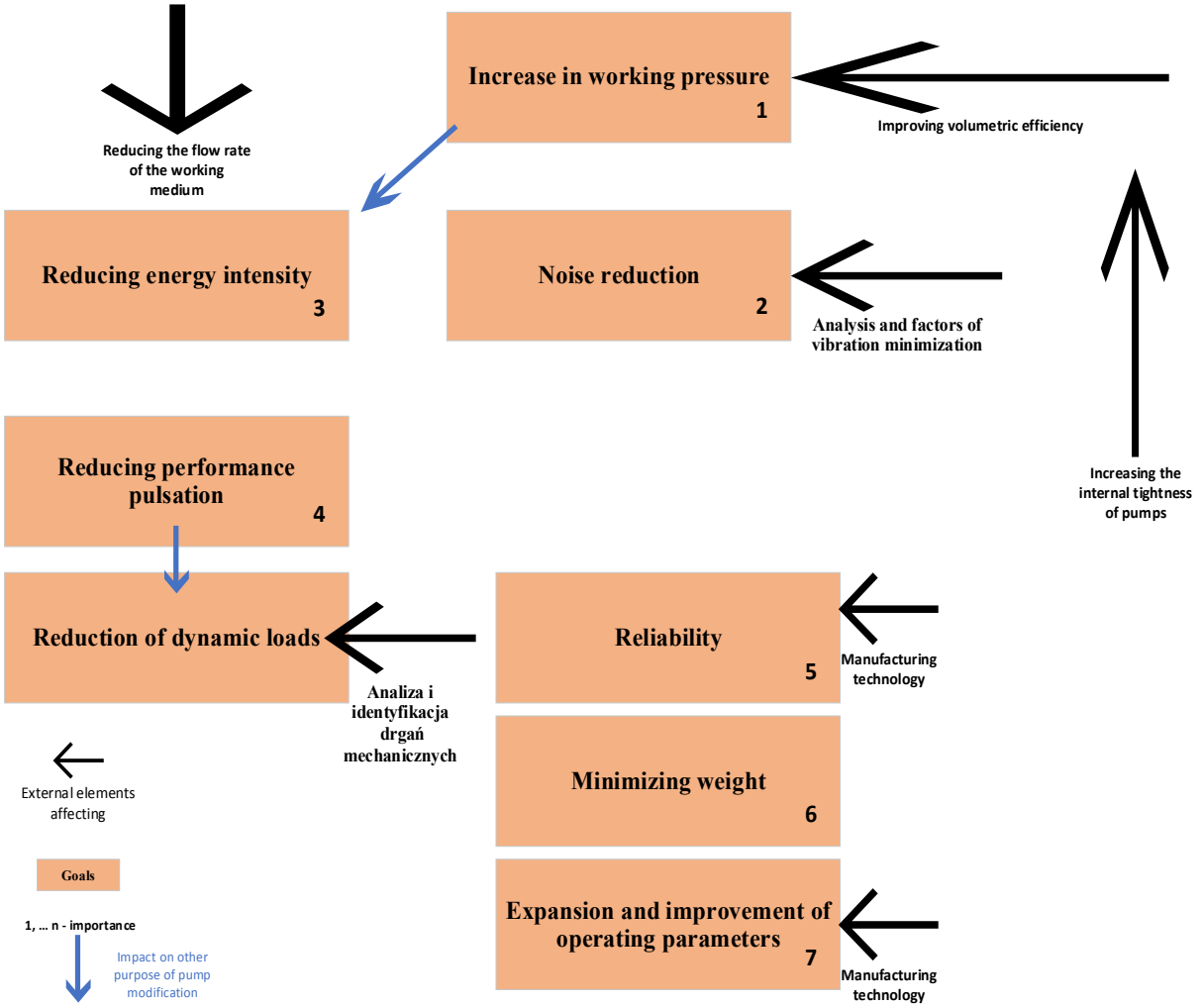


Figure 1. The basic goals of modifying the pumps they design.

Source: own elaboration.

The process of solving the problem of developing a new concept of an innovative geared pump was moderated by the person conducting the sessions in accordance with the METAPLAN formula, i.e.:

1. The session moderator aimed to determine the actual structure of the problem by seeking answers to the questions: what is it like? Or what was it before?
2. Using the *SCAMPER* method, the moderator aimed to establish an answer to the question: What should it be like?
3. In order to make a diagnosis and develop conclusions for future solutions, in addition to the classic discussion of participants, the *rule breaker* approach was also used.
4. The *ZWI* technique of directing attention was used to develop conclusions and proposals for developing new solutions.

Additionally, the study was supported by conclusions derived from direct interviews with the study participants.

3.2. Analysis of the results

Characteristics of the expert no. 1

The designer has extensive experience in designing innovative gear pumps, confirmed by patents in this area. The results of the self-assessment of the use of intuition in the decision-making process indicate that he is largely guided by hunches and feelings of an intuitive nature. The result obtained from the EMQ questionnaire demonstrated that the decision-making process is supported by expert intuition scoring at 72%. The detailed analysis of intuition indicated that in the general self-assessment, the design engineer evaluates their ability to use intuition very highly (80%), and its verification that involves the assessment of their own abilities in this area is also high (63%). It is notable that the expert's use of intuition in practice was not categorized as entirely intuitive, suggesting a balanced reliance on both rational and intuitive foundations in their decision-making. The KSPD results support this observation. Analysis indicates that expert 1 predominantly employs a rational decision-making style. However, their decision-making process is significantly influenced by others' opinions (reflecting strong tendencies towards a dependent style) and involves rational and scientific reasoning. Additionally, the expert's decisions are notably shaped by personal feelings and intuitive insights. This individual demonstrates exceptionally high cognitive motivation (89%) and remarkable openness to new solutions, with an impressive score of 94%. They maintain a neutral attitude towards risk, scoring 53% in this area.

Characteristics of the expert no. 2

The designer has only recently dealt with developing innovative solutions. The results of his self-assessment confirm that he uses intuition in everyday life and at work to make decisions. The result obtained from the EMQ questionnaire indicates a 74% self-assessment of using intuition in making decisions. In the overall self-assessment, the design engineers rate their ability to use intuition highly (70%), and its verification consisting in assessing their own abilities in this area is also high (75%). Statements regarding the use of intuition in practice, similarly to the case of expert 1, were not rated so strongly (69%). Statements regarding the application of intuition in practice, similarly to expert 1, were not rated as strongly (69%). The designer has based their decisions on rational and intuitive premises to an equal extent. The personality profile is also very similar to expert 1. This is also an expert who, compared to the other two, is characterized by a large influence of spontaneity in decision-making. At the same time, cognitive motivation, defined by the need to achieve success and the desire to implement difficult and complicated tasks, is high (86%). The need to create new solutions is even higher, as it was rated at 91%. In turn, the assessment of the attitude towards risk is moderate (53%), which indicates their neutrality towards risk.

Characteristics of the expert no. 3

The result obtained from the EMQ questionnaire is 65%. In the general self-assessment, the designer assesses the ability to use intuition at the level of 60%, and its verification based on the assessment of their own abilities is similar (67%). Statements regarding the use of intuition in practice, similarly to the case of experts 1 and 2, were not assessed so strongly (75%).

Just like the previous experts, decisions by this design engineer are based on rational and intuitive premises, whereby in this expert the intuitive style is basically at the same level as the rational style and characterizes their decision-making style to a greater extent compared to experts no. 1 and 2. The analysis of the answers provided in the IBQ questionnaire indicates that the level of cognitive motivation was assessed at 66%, which is also the lowest result obtained in the examined expert group. The same is true for their openness to new solutions (57%). In turn, the approach to risk taking is identical to the level recorded in other experts. The analysis of the individual decision-making style shows that, like the other experts, the expert is guided mainly by rational premises, and their decisions are also strongly supported by intuition.

4. Analysis of the results

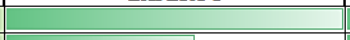
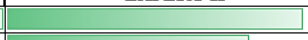
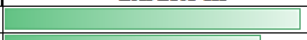
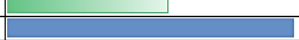
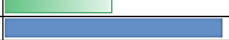
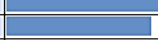
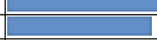
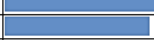
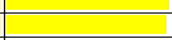
The analysis of the obtained results allows us to assume that the selected team of experts allows for the creation and generation of new solutions while maintaining the desired level of caution in the scope of risk analyses. The people who are part of the project team are well-selected experts who have an extremely valuable attitude towards risk, which is neutrality.

We can emphasize that experts 1 and 2 are characterized by an almost identical level of its use from the point of view of self-assessment of intuition. Such an observation encourages a more in-depth analysis of the influence of experience on the use of intuition in the decision-making process. The literature on the subject, which focuses mainly on the description of the expert – entrepreneur, the correlation between experience and intuition is very strongly emphasized. However, this finding was not definitively validated in this case. This is therefore the first aspect that differentiates the expert designer from the expert entrepreneur (research is conducted on this group of decision-makers). At the same time, the significant effect of selected areas of expert behavior is perceivable, as it is supported by specific decision-making styles on the creation of new solutions.

The rational approach indisputably plays a leading role in the decision-making processes of innovators. However, this does not exclude their openness to going beyond theoretical frameworks, which results in the creation of impressive innovative solutions. This style is strongly correlated with the areas of expert behaviors concerning cognitive motivation and

open-mindedness. And here, we can see an increase in the number of proposals for new solutions associated with a greater intensity of the open-mindedness trait. A list of the examined decision-making styles and personalities and a summary of their impact on the process of creating innovations is summarized in Table 1.

Table 1.
Summary of investigated cognitive features

		EXPERT I	EXPERT II	EXPERT III
Decision-making style	Rational			
	Intuitive			
	Dependent			
	Avoidant			
	Spontaneous			
EBQ	MP			
	UO			
	RN			
EMQ	O			
	W			
	P			
		MP -cognitive motivation UO - Open mind RN -responding to new and uncertain situations O - general self-assessment of intuition W -verifying the trait of self-assessment P - diagnosing intuition in practice		
COMMENTARY TO THE PROCESS OF CREATING INNOVATIONS		During the creative sessions, the expert was more open to developing new solutions, generating ideas and their evaluation. The solutions developed are characterized by great knowledge and innovation..	During the creative sessions, the expert is conservative towards them. There is no basis for many modifications, which, however, does not convert into the ultimate solutions generated. They are realistic and highly innovative. The expert demonstrates greater interest in activities created spontaneously than those carried out in accordance with a set path of action.	Throughout the study, the expert approached the programmed method of developing new solutions with considerable enthusiasm. The focus of the proposals on one style of solutions and commitment to one of the solutions is noticeable. At the same time, they are open to new ideas, although the so-called termination effect described in the prospect theory temporarily hinders this process. The expert clearly relies on intuition and focuses on the solution that is considered to be the best.
COMMITMENT TO THE RESULTS		During brainstorming, both experts have not become excessively committed to their own ideas. They are guided by research curiosity regarding the generated solutions and it is on this basis (depending on individual interests) that they indicate the priority related to the desire to develop given ideas.		The expert is open to the ideas of others, but is definitely committed to the yourself ideas and involuntarily strives to develop this very solution.

Source: own elaboration.

5. Conclusions

The analysis reported in this study demonstrates that a distinctly rational approach to decision-making constitutes a common feature for designer engineers, which is supported by intuition at the same time. These results may seem contradictory at first glance, because rationality is based on facts and data, whereas intuition is identified with ability of foresight. However, this should not be surprising, because according to the results of the research presented in (Deptuła, 2025); experts dealing with innovative solutions are people who demonstrate a high ability to make intuitive decisions, which are the result of their extensive experience and knowledge. We can also emphasize that, as the analyzed example indicates, these are individual who perform well as team players. Their tendency to cooperate, exchange

knowledge and communicate effectively means that creating interdisciplinary task groups should be considered with priority. Such an approach not only promotes the efficiency of design processes, but also increases the chances of success of innovative solutions by simultaneously using both rational analyses and intuitive reasoning.

The results of the analysis of the conducted case study, in which the techniques of metaplan, rule breaker and SCAMPER were used to develop innovative solutions, indicate a relationship: the higher the cognitive motivation and open-mindedness, the more flexible and creative expert performance is in terms of activity. The conducted analysis can be considered fully reliable. The effect of the conducted creative session includes solutions that will be subject to the patent paper procedure in the future.

Therefore, in the case of forming project teams, the use of tools that support their selection, such as EBQ and EMQ can be considered as an advantage. Such analyses can be supplemented by application of the Decision-Making Style Questionnaire - KSPD by S. Scott and R. Bruce. As a result of the broad analyses of the decision-maker's personality, it is possible to characterize the experts in terms of their predispositions to create new innovative solutions, which, due to their selection based on EBQ and EMQ, will have the basis for conducting a comprehensive risk evaluation.

Due to the novelty of the EBQ and EMQ questionnaires, there are no detailed analyses of the impact of their use on the long-term results achieved by designers selected based on the questionnaires. It is also difficult to estimate the costs of their application, as these mainly boil down to the time needed to complete the questionnaire and interpret its results. Certain limitations result from using the proposed solutions, primarily those related to the practical use of personality questionnaires. The most significant of these is the manipulation of answers by providing socially considered correct responses. In such cases, interpreting the questionnaire results requires greater skill and experience. Nevertheless, the analyses so far indicate the validity of using the indicated tools and confirm the general conclusion that the evaluation of innovative solutions should be process-oriented (cf. Bogucki, 2022).

In summary, creation of optimal environment for creating new solutions should form a priority task, since such conditions promote efficiency in teamwork, increase innovation and offers more effective solutions to solve complex design problems. The key role in this process is played by the appropriate selection of experts, which should be carried out through the use of dedicated personal questionnaires. Such tools can assist in identification of key characteristics and aptitudes of candidates, which will ultimately lead to formation of teams with diverse but complementary competencies. The use of such methods not only increases the chances of effectively implementing innovative solutions, but also promotes better matching of team members with regard to their work style, decision-making method and ability to cooperate effectively.

References

1. Ayal, S., Gino, F., Barkan, R., Ariely, D. (2015). Three Principles to REVISE People's Unethical Behavior. *Perspectives on Psychological Science*, *10(6)*, pp. 738-741, doi: 10.1177/1745691615598512. PMID: 26581728.
2. Ayal, S., Hochman, G., Zakay, D. (2011). Two sides of the same coin: Information processing style and reverse biases. *Judgment and Decision Making, 6(4)*, pp. 295-306. https://doi.org/10.1017/S193029750000190X
3. Barnard, C.I. (1997). *Funkcje kierownicze*. Kraków: Akademia Ekonomiczna w Krakowie.
4. Beheshti, M., Alavi, M. (2023). Business Analytics in Managerial Decision-Making. *Management and Business Economics, 45(3)*, pp. 78-94, doi: 10.1108/mbe-09-2023-0130
5. Bieniok, H. (2006). *System zarządzania zasobami ludzkimi przedsiębiorstwa*, Katowice: Wydawawnictwo AE im. Karola Adamieckiego.
6. Bogucki, D. (2022). *Studium wykonalności w praktyce*. Wrocław: Biblioteka Administracja Publiczna, Presscom.
7. Bolesta-Kukułka, K. (2000). *Decyzje menedżerskie w teorii i praktyce zarządzania*. Warszawa: Wydawnictwo Naukowe Wydziału Zarządzania Uniwersytetu Warszawskiego.
8. Bolestra-Kukuła, K. (2003). *Decyzje menedżerskie.* Warszawa: PWE.
9. De Andreis, F. (2020). A Theoretical Approach to the Effective Decision-Making Process. *Scientific Research Publishing*. Retrieved from: https://www.scirp.org/journal/paperinformation.aspx?paperid=100896
10. Deptuła, A.M. (2024). Assessment Criteria of Innovations Risks: Analysis of Research Results. *Journal of Knowledge Economy*. https://doi.org/10.1007/s13132-023-01659-1
11. Deptuła, A.M. (2025 in print). *Kryteria doboru ekspertów do procesu zarządzania ryzykiem w przedsiębiorstwie. Narzędzia wspomagające - sposób doboru - wyniki badań*. Opole: Oficyna Wydawnicza Politechniki Opolskiej.
12. Driver, M.J., Brousseau, K.R., Hunsaker, P.L. (1990). *The dynamic decision maker: five decision styles for executive and business success*. New York: Harper & Row.
13. Drucker, P.F. (2000). *Zarządzanie w XXI wieku – wyzwania*. Warszawa: Muza.
14. Eberle, B. (1996). *Scamper on Games for Imagination Development*. Prufrock Press Inc.
15. González-Mendoza, J.A., de Jesús Cañizares-Arévalo J., Cardenas-García, M. (2022). Decision-making, rationality, and human action. *Journal of Positive Psychology and Wellbeing, 6(1)*, pp. 3977-3991.
16. Griffin, R.W. (2006). *Podstawy zarządzania organizacjami*. Warszawa: PWN.
17. Hammond, J.S., Keeney, R.L., Raiffa, H. (2002). *Decisions, Risk, and Reward*. Routledge.
18. Isenberg, D.J. (1984). How Senior Managers Think. *Harvard Business Review, November-December*.

19. Jadhav, S. (2019). *A Conceptual Study of Decision Making and Thoughtful Decisioning*. Retrieved from: https://ssrn.com/abstract=3413706
20. Khan, A., Ghose, A., Dam, H., Syed, A. (2023). *A Survey of Process-Oriented Data Science and Analytics for Supporting Business Process Management*. arXiv preprint. Retrieved from: https://arxiv.org/abs/2301.10398
21. Kinicki, A., Williams, B. (2013). *Management: A practical introduction (6 ed.)*. New York: McGraw-Hill.
22. Klein, G. (1998). *Sources of Power: How People Make Decisions.* Cambridge: MIT.
23. La Pira, F. (2011). Entrepreneurial Intuition, an Empirical Approach. *Journal of Management and Marketing Research, vol. 6, January*.
24. Lewin, K. (1936). *Principles of topological psychology*. New York: McGraw-Hill.
25. Lunenburg, F.C. (2010). The decision making process. *National Forum of Educational Administration & Supervision Journal*, *27(4)*, pp. 1-12.
26. Malewska, K. (2018). *Intuicja w podejmowaniu decyzji kierowniczych*. Poznań: Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu.
27. Matczak, A. (2000). Style poznawcze. In: J. Strelau (Ed.), *Psychologia. Podręcznik akademicki, t. 2*. Gdańsk: Gdańskie Wydawnictwo Psychologiczne, pp. 761-782.
28. McKenney, J.L., Keen, P.G. (1974). How managers' minds work. *Harvard Business Review, 52(3)*, pp. 79-90.
29. Mitroff, I. (1983). *Stakeholders of the organizational mind. San Francisco*. CA: Jossey-Bass Publishers.
30. Mousaei, A., Rezaei, R. (2023). *Decisions That Drive Success: Navigating Effective Decision-Making in Business Management*. Retrieved from: https://www.researchgate.net/publication/377684018_Decisions_That_Drive_Success_Navigating_Effective_Decision-Making_in_Business_Management
31. Mulyono, H., Purba, N., Hadian, A., Syamsuri, A.R., Hasibuan, M.Z. (2021). *Decision-Making Culture in Organizations*. Atlantis Press. Retrieved from: https://www.atlantis-press.com/article/125954032.pdf
32. Nightingale, J. (2007). *Think Smart: Act Smart: Avoiding The Business Mistakes That Even Intelligent People Make*. Wiley.
33. Nutt, P.C. (1990). Strategic decisions made by top executives and middle managers with data and process dominant styles. *Journal of Management Studies, 27(2)*, pp. 173-194, doi:10.1111/j.1467- 6486.1990.tb00759.x
34. Orasanu, J., Calderwood, R., Zsambok, C.E. (1993). *Decision making in action: Models and methods*. Norwood, NJ: Ablex Publishing. https://doi.org/10.1002/bdm.3960080307
35. Robey, D., Taggart, W. (1981). Measuring managers' minds: The assessment of style in human information processing. *Academy of Management Review, 6(3)*, pp. 375-393. doi:10.5465/AMR.1981.4285773

36. Rowe, A.J., Davis, S.A. (1996). *Intelligent information systems: Meeting the challenge of the knowledge era*. Westport: Quorum Books.
37. Rowe, A.J., Mason, R.O. (1987). *Managing with style: A guide to understanding, assessing, and improving decision making*. San Francisco, CA: Jossey-Bass.
38. Ściborek, Z. (2003). *Podejmowanie decyzji*. Warszawa: Agencja Wydawnicza Ulmak.
39. Scott, S.G., Bruce, R.A. (1995). Decision Making Style: Development and Assessment of a New Measure. *Educational and Psychological Measurement, No. 55*.
40. Scott, S.G., Bruce, R.A. (1995). Decision-making style: the development and assessment of a new measure. *Educational and Psychological Measurement, 55(5)*, pp. 818-831.
41. Sękowski, A. (1988). *Uzdolnienia ogólne. Struktura i uwarunkowania*. Lublin: Wydawnictwo KUL.
42. Shiloh, S., Salton, E., Sharabi, D. (2002). Individual differences in rational and intuitive thinking styles as predictors of heuristic responses and framing effects. *Personality and Individual Differences, 32(3)*, pp.415-429.
43. Singh, S.K., Singh, R.K. (2024). Business Decision Making Through Big Data Analytics Using Machine Learning. *International Journal of Intelligent Systems and Applications in Engineering*, *12(1)*, pp. 112-129. Retrieved from: https://ijisae.org/index.php/IJISAE/ article/view/6798
44. Sitko, E. (2023). *Wybrane psychologiczne uwarunkowania stylów podejmowania decyzji u osób we wczesnej dorosłości* (Unpublished PhD dissertation). Katolicki Uniwersytet Lubelski Jana Pawła II.
45. Szmidt, K.J. (2013). *Trening kreatywności. Podręcznik dla pedagogów, psychologów i trenerów grupowych*. Gliwice: Helion.
46. Taggart, W., Robey, D., Kroeck, G. (1985). Managerial decision styles and cerebral dominance: An empirical study. *Journal of Management Studies, 22(2)*, pp. 175-192, doi:10.1111/j.1467- 6486.1985.tb00071.x
47. Taherdoost, H. (2017). Decision making using the Analytic Hierarchy Process (AHP); A step by step approach. *International Journal of Economics and Management Systems, 2*, pp. 244-246. Retrieved from: https://ssrn.com/ abstract=3224206
48. Taherdoost, H., Madanchian, M. (2023). Decision Making: Models, Processes, Techniques. *Cloud Computing and Data Science*.
49. Targalski, J. (1986). Podejmowanie decyzji. In: A. Stabryła, J. Trzcieniecki (Eds.), *Organizacja i zarządzanie*. Warszawa: PWN, pp. 194-214.
50. Tavcar, M. (1995). Obvaladovanje dejavnosti managerjev. *Organizacija, revija za management, informatyko in kadre, No. 28*, pp. 9-10.
51. VanGundy, A.B. (2005). *101 Activities for Teaching Creativity and Problem Solving*. San Francisco: Pfeiffer.
52. Vroom, V. (2012). Leadership and the decision-making process. *Organizational Dynamics. 28*, pp. 82-94.

53. Wang, Y., Ruhe, G. (2007). The cognitive process of decision making. *International Journal of Cognitive Informatics and Natural Intelligence (IJCINI)*, *1(2)*, pp. 73-85.
54. Yates, J.F. (2003). *Decision management: How to assure better decisions in your company*. John Wiley & Sons.