CREATIVE FORMATION OF PRODUCTS IN MECHANICAL ENGINEERING

This contribution is dealing with products creation in progressive machining. Creatics is a new science discipline which formulates laws of production of objects. The production has its theoretical background. The contribution informs about the evolution and the present state and formulated axioms and laws. The revealed laws prove convergence of phenomena and processes of production. The laws show that the theoretical number of variant of part manufacturing processes is innumerable. The advantages of use creatics for practice are described in final evaluation.

Key words: creatics, pattern, cutting, production

1. INTRODUCTION

The resolved technologic assignments are of a routine or creative character. Shares of the routine and creative part vary depending on a determined task. The routine parts of the assignments are resolved on the base of previous resolutions’ patterns. The created parts are resolved through a method of TRIAL – ERROR – SUCCESS. One must know how to make products to use them consequently without making avoidable errors and to reach directly successful resolutions.

A new branch of science dealing with products creation called CREATICS is arising. Creatics aims to reveal the production laws, coherence among machines, tools and components, which, in its eventuality, is going to be proved in an optimal formation of products. Therefore, the principle of creatics is framed in axioms, lemmas and laws of engineering technology. These features, which do not occur spontaneously – it’s a continuously developing goal-directed process – are consequently discovered and elaborated in more and more details.

Prof. Ján Békes is one of significant believers in creatics who has been engaged in examination of hypothesis, coherence and natural relations of
components engineering production more than fifty years. He has originated the “creatics” term; he has provided the process of products creation with mathematic symbols and formulated the first axioms and laws of creatics. In science, researching products creation and implementing creatics as a new discipline into practice has a cardinal importance for research and development [1, 2, 3].

An existing educational system that prepares people for practice has emphasised in particular a cognitive and information aspect of education. There was time when the dynamics of developing and spreading information wasn’t as fast as nowadays. Yet in these days, when ten or fifteen years old knowledge in particular branch of science is considered to be relatively old, we would find emphasis on cognitive system in studying anomalous. There is a trend to concentrate on creativeness and use it in creative formation of products.

This treatise is geared to summarise history and development, to analyse contemporary state of components production theory and to focus on creative products formation in the progressive machining. To prove contributions of the creative approach in products formation, a practical application focused on a particular case has been done. However, with respect to the treatise extent, it’s not included here. In its conclusion, the creatics contributions to practice are summarised.

2. HISTORY, DEVELOPMENT AND REVIEW OF THE THEORY’S CONTEMPORARY STATE OF COMPONENTS PRODUCTION

2.1. Production beginnings

Production is defined as formation of new products, which society needs to its existence and development. The production origin has been determined by human needs. The needs are subjectively experienced or perceived lacks of something fundamental for particular individuals. They are always connected with activities focused on getting over felt lacks. And just these deficiencies make a human satisfy his demands.

People have always had a need of making products, which could facilitate their work. At the same time, they’ve had a wish of self-realisation when making the articles, machines, inventions etc. The needs have been the first impetuses to form and develop some production or production technology. At first, and rarely nowadays as well, production has been generated by the TRIAL – ERROR – SUCCESS method. A wide range of either successful or unsuccessful trials results in patterns for further production. Thanks to the patterns a number of fruitless experiments is decreasing, which effectively helps to reach given goals (Fig. 1).
First steps of scientific attitude to technologies appeared in work of J. Beckman, who in his work named General Technology (published in 1806) claimed that technological processes must be sorted out not according to the processed material but to the tools, which are used during their transformation. In the 19th century, many discoveries in production field emerged, nevertheless technology as a branch of science started to develop as late as in the 20th century.

A mass production has meant another significant milestone. Henry Ford put into effect the mass production principle by means of an assembly line, which was put into operation in 1913. The line became a symbol of a new way of production, sometimes called as Fordism. Other producers all over the world soon imitated Ford’s production method.

2.2. Contemporary production methods

The names of Type technology and Group technology became known as late as in the 1940s. They were introduced by their authors A. P. Sokolovsky (around 1939) and S. P. Mitrofanov (around 1950). The machining production started its formation by components classification. A. P. Sokolovsky and his colleagues found out that components have been produced according to patterns. Sample trees of components and type production processes started to arise.

Sokolovsky formulated principles of the type technology: “Similar components are produced in a similar way”. S. P. Mitrofanov developed an idea coming out from the type technology to the group technology. Finally, some fifty years later, J. Békes added a third attribute “... in similar circumstances” to the theorem [1].

3. CREATICS – A BRANCH OF SCIENCE

The theory proposes to arrange particular pieces of knowledge, then to link them into a comprehensive unit, to explain and predict a course and concurrence of circumstances and, on the base of that to plan a requested development. Laws,
axioms and lemmas of products creation that had been formulated then led to establishing a new branch of science dealing with production and making new articles. The new subject got the name *Creatics*.

![Diagram](image)

*Fig. 2. Schema of production in the future
Rys. 2. Przyszłościowy schemat produkcji*

*Creatics* is an innovative scientific branch. This science investigates production matters and making new products; it’s an area, which tries to summarise present-day engineering and technological knowledge. Its goal is to reveal production laws, relationship among machines, tools and components. The origin of its title – *creatics* – is tied up with Ján Békes, who has been dealing with the topic more than fifty years and it’s possible to say that *creatics* is his mission.

### 4. FORMULATED AXIOMS AND LAWS OF CREATICS

In recent centuries, science and consequently also production technologies have been extraordinarily diversified. Naturally, now a trend of their convergence must come, which requests comprehension of the core. The matter’s essence is expressed in axioms, lemmas and laws. The axioms, lemmas and laws of machining technology do not arise themselves but during a permanent process. They are successively discovered and specified in further details.

Each branch of science includes sorting out – that’s how a structure comes out. The machining technology is based on a production processes structure containing several grading systems. The starting point to the axiomatic theory of components production is mathematical logic. Axioms are fundamental theorems, which are accepted and considered to be true on trust.

By way of illustration, we are presenting here some axioms examples of geometric (shape) features of components:

1° A shape of solid states is changed by means of adding, shifting or stock removing.

2° A formation of solid states is a process, in which material and tool concur in a particular environment.
3° Both material and tool can be of any state (solid, liquid, gaseous or plasma); nevertheless 4°, 5° is still valid.

4° A tool must have sufficient shape solidity.

5° At the end of the process, the material state is solid.

6° Change of shape – flow of material – needs energy. The energy bearer can be material, tool or environment while energy can be of various characters.

7° Used flow of material is controllable.

8° The work matter (object) gradually gets requested qualities.

Lemmas will be specified in the process of creating axiomatic theory of components production:

L1: Bodies (components) are of solid state.

L2: Bodies shapes are created by means of concurrence of two objects in particular environment.

L3: Qualities and relations of real bodies are approximate with tolerance.

L4: Changes of body shapes are caused by means of an appropriate activity of another body, an operator.

L5: Simultaneous multiple use of the operator accelerates the process of changing the shape.

The laws of creatics, which have been revealed up to now, enable understanding the basis of production and making new articles. They generate a theoretical support of not only machining technology but also of creatics itself as creation of new products with requested material of shape qualities. The laws of creatics are probably valid both for material products and ideological products of intellectual nature.

Till now, the research in creatics branch has conduced to three groups of laws of creatics (Table 1).

The formal laws are based on mentioned principle of similarity: “In similar circumstances, similar things are considered similarly”; or “In similar circumstances, similar objects are produced similarly.

The physical (natural) laws express a relationship among products qualities and means of their creation. First, so-called genes of shapes were discovered and formed as logical models. M. Mosny introduced them for purpose of welding machines’ motions modelling when creating the weld beads. With respect to axes of the coordinate system [3] he used the symbols: TRSX, TRSY, TRSZ (with relevance to translation motions); and ROTX, ROZY, ROTZ (with relevance to rotary motions). As late as these shapes genes had been discovered, the laws of shapes formation (production) were formulated; other rules came even later (the law of dimensions creation, mutual location and order of operations).

Originally, the existence laws should have been named “economic”. A product may be often made in various ways. A man decides how a particular product will be made. In his final decision he takes into account his relation to nature, resources usage, resulting financial balance of the product (profit or loss) etc.
Particular existence laws are mutually linked. The existence law of survival is considered to be the strongest of the rules. It deals with needs satisfying. To survive, nowadays one must have resources at his disposal; creating products – that’s just what can ensure an adequate profit as a resource of further development. However, the profit maximisation is not always what is wanted.

### Table 1

<table>
<thead>
<tr>
<th><strong>FORMAL</strong></th>
<th><strong>PHYSICAL (NATURAL)</strong></th>
<th><strong>EXISTENCE</strong></th>
</tr>
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<tbody>
<tr>
<td>Comprehensiveness</td>
<td>Shape formation</td>
<td>Survival</td>
</tr>
<tr>
<td>Exactness</td>
<td>Creation of dimensions</td>
<td>Maximum adequate profit</td>
</tr>
<tr>
<td>Orderliness</td>
<td>Mutual location</td>
<td>Savings of energy, time, material</td>
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<tr>
<td>Model’s reciprocity</td>
<td>Order of operations</td>
<td>Conservation</td>
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### 5. CONTRIBUTIONS OF CREATICS FOR PRACTICE

The theory of creatics in its use in practice helps us to change the production method of TRIAL – ERROR into TRIAL – SUCCESS. Practice and theory can be hardly separated. Theories go out of practice and are enriched by means of practice; there is a relationship of mutual influence between them. Thanks to practice analysis formal, physical and existence laws of creatics could be introduced. In practice, creatics as a branch of science can be implemented not only in technological preparation of production, but also in its construction preparation [4, 5, 6].

Creatics enables technologists to propose components production when focusing on an optimal use of production resources. By means of utilising creatics, for instance, it is possible to decrease production time, consumption of producing energies or to behave economically in using exhaustible and inexhaustible natural resources etc. Understanding laws of creatics, technologists learn to create products, which consequently develops their creativeness and innovative abilities in production processes.

When analysing contributions of creatics usage in practice, we can’t omit its influence on designing new types of producing machinery. The machines have been named as “integral”. They have arisen out of grasping principle of shapes formation. An essential factor here is a tool’s shape and its motion with respect to material. An example of such integral machine is a lathe, on which first a model is made and subsequently, in a second process a product is made by means of...
spinning. Another example of the integral machine is equipment, which is used for hardening and soldering processes by means of laser beam.

The laws of creatics don’t resolve production problems; they just explain internal coherences. They furnish instructions how to determine a plan of the decision procedure. Knowing the laws of creatics gives an extreme support to creativeness, searching new unconventional solutions, which suit conditions for surviving or, which reveal reasons of failures. If trainings of technologists strive to be orientated in future, it is necessary to develop their creativeness in particular.

Technologists can’t be educated nor trained or comprehensively and broadly developed just by means of old pieces of knowledge. It is necessary to support developing of their creativeness and implementing their creative ideas. To introduce creatics into educatory-instructional processes means to govern these processes not empirically but on scientific grounds towards creating new values.

6. CONCLUSIONS

Production used to run according to patterns and such way of producing was successful and tested in practice. However, nowadays we know that solving assignments according to patterns means stagnation of production processes. Therefore, we have to handle important development matters – how to find better resolutions of old assignments; or how to deal with new tasks, for which we miss any pattern. And just in such case axioms, lemmas and laws of creatics can be put into effect.

REFERENCES


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S t r e s z c z e n i e

Niniejszy artykuł jest poświęcony refleksji nad tworzeniem wyrobów. Kreatyka jest nową dyscypliną nauki, w obrębie której formułuje się prawa produkcji obiektów. Produkcja ma swoją teoretyczną podbudowę. W pracy podano informacje na temat ewolucji i obecnego stanu kreatyki oraz sformułowanych aksjomatów i praw. Odkryte prawa dowodzą konwergencji zjawisk i procesów produkcji. Prawa te pokazują, że teoretyczna liczba wariantów procesów wytwarzania części jest ogromna. Korzyści związane z zastosowaniem kreatyki w praktyce opisano w końcowej części pracy.

Słowa kluczowe: kreatyka, wzór, produkcja