

# Unification of Design Decisions on the Basis of Average Distribution of Probabilities and Introduction of Isolated Areas for Elements of Products Described by Structured Multiple Modules

*Boris Bazrov, Mikhail Kheifets, and Nikolay Popok*

Analytical approach to the design of technological complexes and preparation of production, taking into account self-organization of database structures and control procedures, is considered; the classification and coding of functional technological modules during their unification, which are the basis for modern methods of digital production preparation, are proposed.

*Key words:* technological complex, production preparation, unification, self-organization, technological module, coding

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## СПИСОК ЦИТИРУЕМОЙ ЛИТЕРАТУРЫ:

1. [B.M. Bazrov](#). Modular technology in mechanical engineering. (Mashinostroyeniye Pulisher), Moscow, 2001). (in Russian)  
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2. [N.N. Popok](#). Mobile reorganization of engineering production. (Tekhnoprint Publisher, Minsk, 2001). (in Russian)

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3. [M.L. Kheyfets](#) et al. Statistical analysis of structural elements and technological parameters of machine parts. (PGU Publisher, Novopolotsk, 2001). (in Russian)

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4. Intellectual production: state and prospects of development. Eds. M.L. Kheyfets and B.P. Chemisova. (PGU Publisher, Novopolotsk, 2002). (in Russian)

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5. [N.A. Kusakin](#), [V.S. Tochilo](#), [M.L. Kheyfets](#). Quality management of motorplant repair enterprises. (PGU Publisher, Novopolotsk, 2009). (in Russian)

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6. Technological and operational methods to support machine quality. Ed. P.A. Vityaz. (Belaruskaja Navuka, Minsk, 2010). (in Russian)

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7. [R. Light, D. Gossard. Modification of geometric models through variational geometry. CAD. 14, 209-214 \(1982\).](#)

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9. [J. Gausemeier](#). Von CAD zu CIM. ZWF. 81, 467-472 (1986).

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10. [S.P. Mitrofanov](#), [YU.A. Gul'nov](#), [D.D. Kulikov](#). Automation of technological preparation of mass production. (Mashinostroyeniye Publisher, Moscow, 1974). (in Russian)

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14. [P. Glansdorff](#), [I. Prigogine](#). Thermodynamic Theory of Structure, Stability and Fluctuations. (Wiley Interscience, London, 1971).

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15. [Yu.L. Klimontovich](#). About Synergetics without formulas. (Vyssh. shk., Minsk, 1986). (in Russian)

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16. [P.A. Vitiaz.](#), [M.L. Kheifetz.](#), [S.V. Koukhta](#). Laser-Plasma Techniques in Computer-Controlled Manufacturing. (Belorusskayanauka, Minsk, 2011). (in Russian)

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19. [G. Nicolis](#), [I. Prigogine](#). Self-Organization in Nonequilibrium Systems. From Dissipative Structures to Order Through Fluctuations. (Wiley, New York, 1977).

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20. Flexible manufacturing complexes. Eds. P.N. Belyanin, V.A. Leshchenko. (Mashinostroyeniye, Moscow, 1984). (in Russian)

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21. Theoretical foundations of the design of technological complexes. Eds. A.M. Rusetskiy, P.A. Vityaz', M.L. Kheyfets et al. (Belarus. navuka, Minsk, 2012). (in Russian)

**Контекст:** *...structure minimize duplication in the creation of new of the PD: the composition of the elements, designs and effectively develop technologies for its structure, dimensional, accuracy, strength, their manufacture [21, 22]. hardness and other relationships between the To solve these problems, it is necessary, first, elements of PD, affecting the*

*formation of output to obtain information on the characteristics of indicators of PD. product designs (PD)...*

22. Design and equipment of technological complexes. Eds. A.M. Rusetskiy, P.A. Vityaz', M.L. Kheyfets et al. (Belarus. navuka, Minsk, 2014). (in Russian)

**Контекст:** *...structure minimize duplication in the creation of new of the PD: the composition of the elements, designs and effectively develop technologies for its structure, dimensional, accuracy, strength, their manufacture [21, 22]. hardness and other relationships between the To solve these problems, it is necessary, first, elements of PD, affecting the formation of output to obtain information on the characteristics of indicators of PD. product designs (PD)...*

23. [B.M. Bazrov](#). The modular principle of building up machine equipment. [Vestnik mashinostroyeniya](#). 11, 51-53 (2011). (in Russian)

**Контекст:** *...As a result, we obtain a graph, an example description of the PD is proposed using a set of of which is shown in Fig. 1. modules [1, 23]. Consider the description of PD as an object As PD modules are take the module of of operation...*