

PAPER • OPEN ACCESS

## The generalized algorithm of making decisions on practicability of cooperation for machine building enterprises in the context of digital economy

To cite this article: Vladimir Kobzev *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **497** 012008

View the [article online](#) for updates and enhancements.

# The generalized algorithm of making decisions on practicability of cooperation for machine building enterprises in the context of digital economy

Vladimir Kobzev <sup>1\*</sup>, Aleksandr Skorobogatov <sup>1</sup> and Maksim Izmaylov <sup>1</sup>

<sup>1</sup> Peter the Great Saint-Petersburg Polytechnic University, Politechnicheskaya str., 29, Saint Petersburg, Russia

\* E-mail: kobzev\_vv@mail.ru

**Abstract.** The urgency of the research is determined by the acuity of the following problem for Russian machine building enterprises: making decisions on cooperation and insufficient degree of its scientific-practical elaboration as related to its tools applied to the digital economy conditions. The aim of the research: working out a generalized algorithm of making decisions on practicability of cooperation for machine building enterprises in the context of digital economy. The scientific result and novelty: based on the analysis of the external and internal environment of machine building enterprises in the context of digital economy and on revealing the factors which require accounting when making decisions on cooperation, a generalized algorithm has been worked out for making decisions on practicability of cooperation for machine building enterprises in the context of digital economy which differs by complexity of accounting of technical and process design, organizational and economic peculiarities of science-based high-technology production in machine building and by complexity of accounting of risks for economic security of machine building enterprises at the strategic, tactical and operational levels of management in the context of digital economy. Further direction of the research: elaboration and practical implementation, as exemplified by the calculation methodology of complex technical and economic substantiation of cooperation practicability for machine building enterprises in the context of digital economy. Theoretical relevance of the research results: developing the theory of economy, organization and management of enterprises, branches, industrial complexes as related to the tools of economic substantiation of management decisions on cooperation in relation to machine building enterprises in the context of digital economy. Practical significance: the elaborated tools and practical recommendations on its use will allow machine building enterprises to apply them in management practice in the context of digital economy for solving cooperation problems by means of greater substantiation of decisions, with the help of increasing the efficiency of the current activity and providing stability of development for the future.

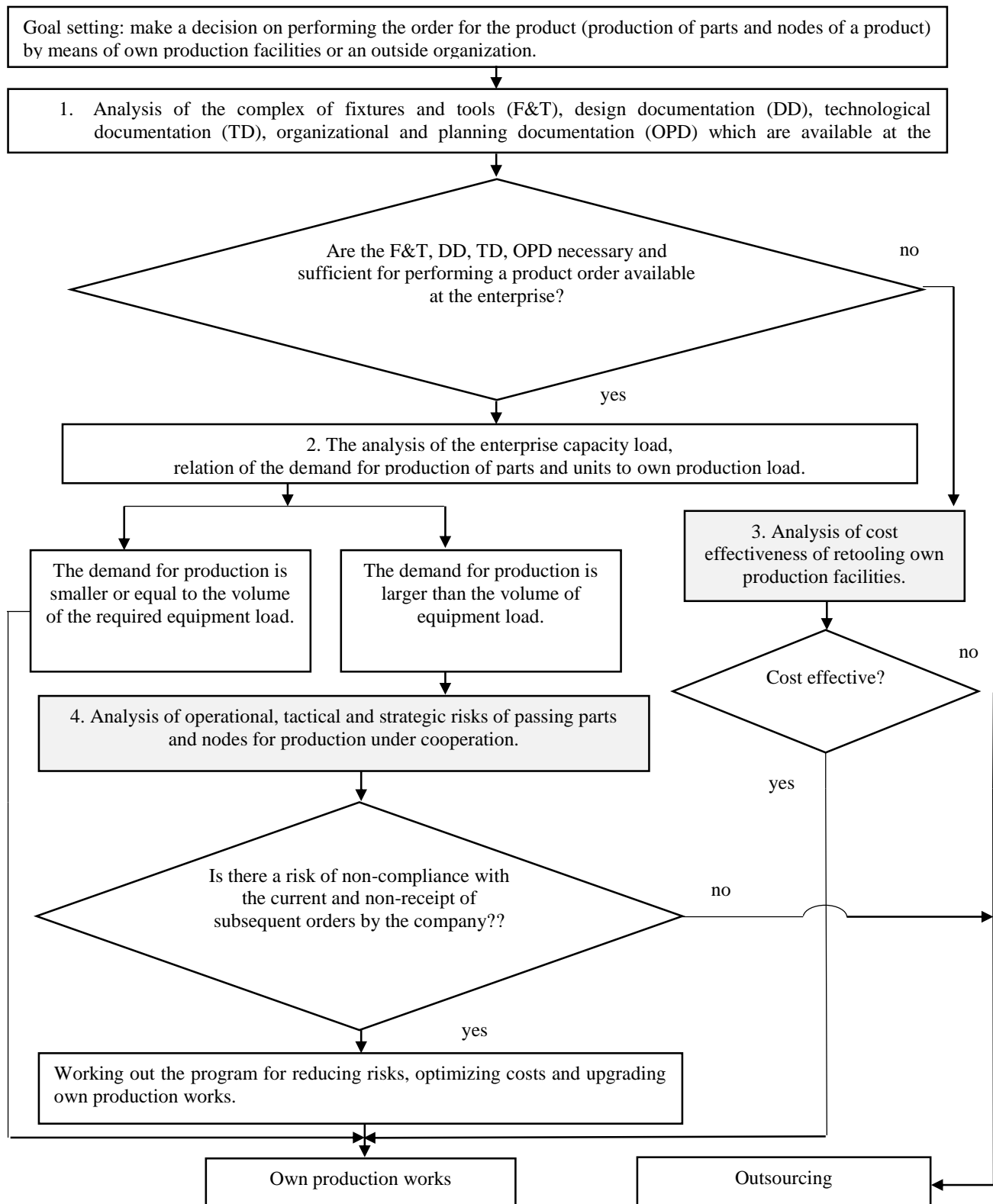
An important differential peculiarity of machine building is introduction of products of a complex composition, which include a lot of item names of various nodes and assemblies, mechanisms and systems, and that, objectively, requires wide cooperation between specialized enterprises and organizations of many branches. In the context of stiffening of competitive activity on product markets between local and foreign producers, higher demands are raised to machine building production: it



should be more and more innovative in its consumer properties, technological and economical in elaboration, production, exploitation, utilization [1–4]. As a result: it is getting more science-intensive in elaboration and technology-intensive in production, cost-demanding in engineering support at all stages of a product life cycle. Therefore, economic aspects of digitalization of the following branches are getting actual: scientific-research and research-development (R&D) elaborations, designing preproduction (DP), preproduction engineering (PE) and maintenance of mechanical equipment delivered by machine building enterprises, organization and planning preproduction (OPP) and mechanical equipment maintenance, including organizational preproduction planning of new production facilities and upgrading and retooling of the existing production facilities at machine building enterprises.

The problem of making decisions on cooperation practicability has become especially actual among the key tasks of enterprise management. In production and operations managements, logistics and supply chain management it is known as the task “do or buy”. However, the existing scientific-practical elaborations in this field suggest solutions which take account of the following aspects in an inadequate degree: specificity and condition of the science-technical and production potential, variety of risks under the influence of external and internal environment factors, complexity of the organizational and technical events being implemented, multilevel composition of management decisions being made in relation to machine building enterprises in Russia. Firstly, solving this problem is actual for machine building enterprises which are general contractors of orders and attract joint contractors [5–9]. Technical and technological reasons are in the first place, the most typical of them is insufficiency of own scientific and production capacities for performing an order. At that, in the context of economy digitalization, such enterprises have the risk of losing unique technologies and other results of intellectual labor including information on R&D, DP, PE, OPP which is a commercial and other secret. In particular, in order to protect such information, enterprises use supporting means of economic security [10, 11].

A generalized algorithm is suggested for solving the problem of cooperation practicability for machine building enterprises in the context of digital economy; the flow chart of this algorithm is presented in figure 1. A distinguishing peculiarity of this algorithm is the complexity of accounting of technical and process design, organizational and economic peculiarities of production in mechanical engineering and accounting of risks for economic security at the strategic, tactical and operational levels of management at machine building enterprises in the context of digital economy [12–15].



**Figure 1.** A flow chart of the generalized algorithm of making decisions on practicability of cooperation for machine building enterprises in the context of digital economy.

*Analysis 1.* A list of F&T, DD, TD, OPD series is formed necessary for producing parts and nodes of each name according to needs. On the basis of design of parts and nodes of different names, the entire list or its part is changed, correspondingly. The fact of availability is checked according to the list. If separate elements are missing (for example, executive software for NC machine tools or development means) — proceeding to Analysis 3 [16].

*Analysis 2.* On the basis of technological equipment loading capacity specified in technological processes, calculation and analysis according to the enterprise capacity load is carried out, correlation of the demand for production of parts and units and owns production load is determined. In case of exceeding the capacity of its own production facilities there is a transition to the option of outsourcing. It's a traditional decision. In the context of competition on the market: it's necessary to pass to Analysis 4 [17].

*Analysis 3.* Checking the profitability of technical upgrading and retooling of own production. If the order for the product is a unit order but it is for a large volume of production for the period sufficient for payback — this variant should be foreseen and calculated. The source of financing and terms are of importance.

*Analysis 4.* It has become actual in the context of digital economy. Digitalization of R&D, DP, PE, OPP of new equipment, managing projects, production chains, supply and sales networks, the life cycle of products has lead to the appearance and intensification of danger for machine building enterprises from the point of view of both their informational and economic security. An important element: determining key parts and nodes in the product, allotting of which to own production will allow preserving unique competences and remaining competitive on the market. It requires estimation of risks of operational, tactical and strategic nature. The decision is made only taking this into consideration. A respective program of organizational and technical and other events is being worked out.

The generalized algorithm is implemented as a basis for calculation methodology of substantiation of cooperation practicability as exemplified by a machine building enterprise with batch series production [18–20].

## References

- [1] Nikolova L V, Rodionov D G and Afanasyeva N V 2017 *European Research Studies Journal* **20** (2) 396–410
- [2] Alesinskaya T V, Arutyunova D V, Orlova V G, Ilin I V and Shirokova Academy of Strategic Management Journal **16** (1) 10–20
- [3] Kozlov A, Gutman S, Zaychenko I and Rytova E 2016 *Advances in Intelligent Systems and Computing* **524** 115–126
- [4] Glukhov V, Turichin G, Klimova-Korsmik O, Zemlyakov E and Babkin K 2016 *Key Engineering Materials* **684** 461–467
- [5] Kuladzhi T, Babkin A and Murtazaev S-A 2017 *International Scientific Conference Energy Management of Municipal Transportation Facilities and Transport EMMFT 2017* 1333–1346
- [6] Kobzev V V, Izmaylov M K and Skorobogatov A S 2018 *European Social Science Journal* **7**
- [7] Kalinina O V and Churkin V I 2016 *Actual Problems of Economics* **10** (184) 278–282
- [8] Nekrasova T, Levencov V and Axionova E 2016 *16th International Conference, NEW2AN 2016 and 9th Conference, ruSMART 2016 St. Petersburg, Russia, September 26–28, 2016 LNCS 9870* 741–751
- [9] Wild R 1997 *Production and Operations Management. Text and Cases* (London: Cassell Educational) 430
- [10] Suloeva S B and O V 2017 *Scientific and Technical Journal, Saint Petersburg State Polytechnic University. Economic sciences* **1** (10) 129–139
- [11] Kobzev V V, Radaev A E and Krivchenko A S 2018 *Mathematical Modeling of Production Systems* (Saint Petersburg: Publ. House of Polytechn. Univ-ty) 248

- [12] Bobyl A V, Zabrodsky A G, Kudryashov S A, Malyshkin V G, Makarov V M, Terukova E E and Erk A F 2017 *Report of the Russian Academy of Sciences. Energetic* **6** 46–58
- [13] Ronald H 2003 *Ballou Business Logistics: Supply Chain Management* (New Jersey: Prentice Hall) 816
- [14] Semenov V P, Sokolitsyn A S and Sokolitsyna N A 2016 *IEEE 5th Forum Strategic Partnership of Universities and Enterprises of Hi-Tech Branches, Science. Education. Innovations* 76–78
- [15] Mintzberg H, Ahlstrand B and Lampel J B 2013 *Management? It's not what you think!* (London: Pearson UK) 144
- [16] Adam E E and Ebert J R 1989 *Production and Operations Management: Concepts, Models and Behavior* (New York: Prentice-Hall, Englewood Cliffs) 620
- [17] Heizer J H and Render B 1993 *Production and Operations Management: Strategies and Tactics* (Boston: Allyn and Bacon) 871
- [18] Little A D G 1970 *Management Science* **16** (8) B-466–85
- [19] Mackworth A K 1977 *Artificial Intelligence* **8** 99–118
- [20] Kobzev V V, Radaev A E and Izmaylov M K 2016 *ESSUTM Journal* **5** (62) 117–124