Tools to create innovation investment project based on conversion operation cycle in the context of digitalization

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Abstract. The relevance of the study is determined by the necessity to elaborate the math tools to design investment, innovation and combined projects covering technological, product, enhancing and breakthrough innovations in production technological systems of machine builders. The innovation activity of machine building enterprise should be implemented in the mode ‘think-do-think’ so in digital economy each mastered innovation shall be placed in a digital information analytical system of enterprise managerial accounting. The purpose of the study is to develop the tools to regulate the sequence and substantiation of taking managerial decisions on forming of innovation investment project based on conversion operation cycle in the context of digitalization. The model of production process will be a closed operational cycle of conversion of production capital of enterprise production and technological system to monetary capital in the form of produced and sold products with market added value. The outcome of the study is the developed graphic analytical tools in the form of cashflow vectors graph. Further investigations will be devoted to development of entropic analysis method and design of innovation projects in machine building enterprises.

1. Introduction
Production-technological systems (PTS) at engineering business enterprises [1] built in the context of industrial market (regulated) economy were focused on continuous increase of production capacity for low product range. These PTS in the context of innovation market economy should increase the volume of product sales through continuous growth of product added market value share. This task can be solved through continuous mastering of product and technological innovations [2]. Continuous innovation activity of enterprise [3] is a component of controlling [4] including organization of production [5] and managerial accounting [6]. Each mastered innovation should be immediately digitized and placed to a digital information and analytical system of enterprise managerial accounting [7]. Only then innovation activity will be efficient. Developed by authors model of production process as the closed operational cycle of conversion of production capital of enterprise production and technological system to money capital in required to implement production activity digitalization processes in the modern context of digital economy development according to [8, 9]. The model
information logic enables to take substantiated decisions to master these or those beneficial ideas as technological or product innovations [10].

2. Purpose and objectives of the study
The purpose of the study is to develop the tools to regulate the sequence and substantiation of taking managerial decisions on forming of innovation investment project based on conversion operation cycle in the context of digitalization.

The objective of the study is to adapt the model and tools of the production enterprise to innovation activity [11].

3. Method of study
The model of production process will be a closed operational cycle of conversion of production capital of enterprise production and technological system to monetary capital in the form of produced and sold products with market added value [12]. The authors suggested the graphic and analytical vector analysis and projecting of innovation processes in production and technological systems of production enterprises.

Study of investment project in a closed operational cycle of production capital conversion to money capital

Figure 1 shows the diagram of cash flow vectors [12]. The balanced closed operational cycle of conversion of production capital \( Q_{mc} \) (1–3) to money capital \( V_{sv} \) (1–2) is given as a equilateral vector triangle (1–2–3). According to managerial accounting model [13], the production capital \( Q_{mc} \) (1–3) is a sum of equal orthogonal vectors of technological costs \( C_{tc} \) (1–4) and fixed capital stock vector \( U_{mf} \) (4–3), including fixed assets and balance intangible assets of all technological stages 10–11, 12–13, 14–15.

Likewise money capital vector \( V_{sv} \) (1–2) is equal to a sum of orthogonal vectors of technological costs (product cost price) \( V_{tv} \) (1–4) and net profit vector (product added value) \( V_{av} \) (4–2). Production capital vector \( Q_{mc} \) (1–3) is a sum of collinear vectors of technological stages (for instance: ball production (10–11), separator production (12–13), ring production (14–15), grinding and assembling production) and business residue. Likewise money capital vector \( V_{mc} \) (1–2), technological costs vector \( C_{tc} \) (1–4), net profit (added value) vector \( V_{av} \) (4–2) and stock fixed capital vector \( U_{mf} \) (4–3) is a sum of collinear vectors of corresponding technological stages.

Figure 1. Diagram of cash flows in closed operational cycle of conversion of production capital PTS to money capital in the form of produced and sold products when mastering investment products
The product sales volume $\Delta V_{sv}$ and production capital $\Delta Q_{mc}$ will increase in the result of mastering the innovation.

At balanced cycle of conversion of production capital to money capital the increments of production and money capital are equal. The increment of production capital is equal to fixed assets in the investment project, and as for innovation projects this increment is equal to an intangible asset and at the combined project we face a share of tangible and a share of intangible assets.

For unbalanced operational cycle of conversion $V_{sv}$ (1–8) and $\Delta V_{sv}$ (8–9) the increment of product sales volume is less than increment of production capital.

If it is an investment project the increment of production capital is equal to a sum of operational costs and taxable fixed assets. Consequently the added value will be used to compensate corporate property tax and operational costs. As a rule investment projects are not effective. If it is an innovation project the increment of production capital comes from not taxable but depreciable intangible assets and the share of labor costs increases in the structure of operational costs. As a rule the projects should be innovation and investment. In such a case the innovation component of a project determines the effectiveness of mastering the innovations.

**Study of investment project in coordinate system productivity $T$, rub/hour and entropy $S$, hour/year**

Figure 2 contains a diagram of graphic and analytical design [14] of added market innovation value $V_{sv}$ based on reduced share of business residues (technological innovation) in operational cycle of conversion of production capital to money capital in the form of produced and sold products.

![Diagram of balanced operational and innovation cycles of conversion of production and innovation capitals to money capital and the form of cost and added market value of products.](image-url)

**Figure 2.** Diagram of balanced operational and innovation cycles of conversion of production and innovation capitals to money capital and the form of cost and added market value of products.

The diagram is formed in coordinates productivity $T$, rub/hour, operational processes, measured in productivity of technological costs processing $C_{tc}$, rub/hour and entropy of fixed assets $S$, hour/year [15], measured by year resource of working time $R_0$, equal to annual resource of fixed assets useful
life $R_G$, hour/year. Bearing plant is operated in two shifts so the estimated annual resource to equal to 4,000 hour/year.

Product sales volume $V$, rub/year is divided by working time annual resource $R_0$, hour/year, so we get the productivity $T$, rub/hour. Cost of fixed assets $U$, rub/year is divided by assets useful life annual resource $R_G$, hour/year, so we get the productivity $T$, rub/hour for fixed assets. Business intensity should provide equality of $R_G$ and $R_0$. These constants are numerical values of entropy of fixed assets and product sales volume.

Parameter entropy [16] is very important to estimate modernization, renovation, simple and expanded reproduction of fixed assets. In such cases the investment fact should be considered justified if the total (resulting) entropy of fixed assets is being reduced.

The balanced operational conversion cycle (1–2–3–4) including conversion operational cycles of all technological stages consists of the following processes: formation of fixed assets (1–2), formation of technological costs (2–3), production process (3–4), forming product cost and forming product added market value (4–1).

A technological innovation has been mastered at one of operational cycles of a stage (2–8–9–10). As a result of using the share of business waste, the effective area of the equilibrium operating cycle has increased by (11–12–13).

The innovation balanced cycle of profitable idea conversion (7–4–5–6) consists of an intangible asset (7–4), labor compensation with accruals (4–5), added customer appeal of the products (5–6) and net profit with tax and depreciation of intangible assets (6–7). As a result the technological costs were increased by labor compensation, fixed assets were increased by intangible asset increment and the added value was increased by net profit for shareholders.

4. Study results
The authors have developed digital information and analytical tools in the form of graphic and analytical vector analysis and projecting of innovation processes in production and technological systems of production enterprises.

Analysis and studies of closed operational conversion cycles have demonstrated that investment projects should contain such a share of innovations (intangible assets) which provide economic efficiency of mastered product and technological innovations.

These tools are quite relevant to be used in controlling and managerial accounting at the enterprise implementing the concept of digital transformation and Industry 4.0.

5. Conclusions
Tools to estimate innovation and investment activity of production enterprises have been developed. They represent the integrated information and analytical system of controlling production business processes increasing the share of added value of produced and sold products and services of business and territories life sustenance.

Digital transformation of production cycles to operational cycles of conversion of production capital to money capital enabled us to conclude that digitalization of production enterprises can be applied in strategic planning of development of territories ecosystems.

Further studies will be devoted to development of entropy methods of innovation projects design.

Reference:
[1] Shichkov A N, Kremlyova N A and Borisov A A 2016 New economic reality, luster initiatives and industry development (INPROM-2016): works of international scientific practical conference 74–88
[2] Tidd J 2014 Open Innovation Research, Management and Practice (Sussex: Imperial College Press) 445
[3] Egorov N E, Kovrov G S, Pavlova S N and Babkin A V 2010 Science-technical bulletin of Saint-Petersburg State Polytechnic University 3 126
[4] Suloeva S B 2005 *Strategic controlling at industrial enterprise: theory, methods, tools* (Saint Petersburg: Peter the Great St. Petersburg Polytechnic University) 337

[5] Turovets O G and Rodionova V N 2017 *Modern problems of organization of machine building production* (Voronezh: Voronezh State Polytechnic University) 161

[6] Falko S G and Chugunov V S 2017 *Bulletin of South-Russian State Technical University (Novocherkassk Polytechnic Institute). Series: Social economy sciences* 3 4–11

[7] Babkin A V and Chistyakova O V 2017 *Russian entrepreneurship* 18 (24) 4087–4102.

[8] President of the Russian Federation 2017 On strategy of development of informational society in the Russian Federation in 2017, [http://www.garant.ru/products/ipo/prime/doc/71570570/](http://www.garant.ru/products/ipo/prime/doc/71570570/)

[9] Government of the Russian Federation 2017 Digital economy in the Russian Federation, [http://static.government.ru/](http://static.government.ru/)

[10] Gianiodis P T, Ellis S C and Secchi E 2010 *International Journal of Innovation Management* 14 (4) 531–572.

[11] Tukkel I L, Golubev S A, Surina A V and Tsevkova N A 2013 *Methods and tools to manage innovation development of industrial enterprises* (Saint Petersburg: BKhV Petersburg) 208

[12] Shichkov A N, Borisov A A and Kremlyova N A 2017 *Bulletin of South-Russian State Technical University (Novocherkassk Polytechnic Institute). Series: Social-economic sciences* 1 4–15

[13] Shichkov A N and Shichkov A N. 2018 Managerial accounting system of parameters of enterprise production cycle, Pat. 177964

[14] Shichkov A N, Kremlyova N A and Borisov A A 2018 *Formation of digital economy in industry: new challenges* (Saint Petersburg: Publishing house of Politechnical University) 660

[15] Borisov A A 2008 *Regional economy: theory and practice* 15 18–22

[16] Sorokin V S 2004 *Macroscopic irreversibility and entropy. Introduction to thermodynamics* (Moscow: FIZMATLIT) 176