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Sumy State University (Sumy, Ukraine)***PRACTICAL ASPECTS OF THE TECHNICAL AND TECHNOLOGICAL  
DEVELOPMENT LEVEL DETERMINING THE MACHINE-BUILDING  
ENTERPRISE**

*The proposed and methodical approach is aimed at the efficient use of existing fixed assets and technological innovations introduction. The article deals with technical and technological components of the technical and technological machine-building enterprise «Turbomash Ltd» development. On the basis of partial indicators for the technical and technological components integrated indicators are calculated. Analyzed enterprise is positioned in the two-dimensional matrix based on integral indicators for the technical and technological components. Recommendations concerning measures to increase the technical and technological development level of the enterprise are offered.*

Keywords: technical and technological development, two-dimensional matrix, integral index, expert estimations method, relative importance weights.

**Problem statement.** The growth of modern industrial enterprises has an immediate impact on various aspects in their activity. To keep the stable positions and enhance enterprise competitiveness is possible only with the use of new technologies and new or improved equipment. The acquisition and use of high technology products and technologies will enhance competitive advantage of domestic producers. All of the above mentioned measures underline urgency of the industrial enterprises technical and technological development. The effective enterprise management entails the need for quantitative evaluation of the industrial enterprises resulting economic indicators. The determination of technical and technological development level allows to define the enterprise position in the competitive environment.

**Analysis of recent researches and publications.** Subject to evaluate the technical and technological potential and technical and technological base of industrial enterprises are investigated in the works of such scientists as Hontareva I.V. [1], Yevdokimov Ph.I., Lysiakov V.P. [2], Koverha S.V., Peredereeva O.S., Kuzmenko Sv.P. [3; 4] and others. The issues of technological development are investigated in the works of Efremov O.S. [5], Rachinskaya G.V. [6]. The issues of innovation activity in general and technological innovations are investigated by such foreign scientists as Arranz N., Arroyabe J. [7], Smith K., Estibals A. [8]. Despite the large number of different approaches to estimate the technical and technological potential of industrial enterprises, the question of evaluation the technical-technological development level is insufficiently investigated, in particular, its practical aspect. It should be noted that the term “technical and technological development” has not acquired sufficient spread in the economic literature. Therefore, in addition to common features of technical and technological base and technical and technological potential, it has its own characteristics.

**The aim of the article** is to determine the technical-technological development level of the machine-building enterprise, based on the proposed methodological approach, positioning “Turbomash Ltd” in the two-dimensional matrix “Integral indicator for the technical component – integral indicator for the technological component” and providing recommendations to increase it.

**Main material.** According to the offered methodical approach we will determine the technical and technological development (TTD) level of machine-building enterprise “Turbomash Ltd”. Analyzed enterprise operates in the market of pumping and compressor equipment, repairing and modernization for the chemical, petrochemical industries, power engineering and metallurgy. “Turbomash Ltd” has its own construction bureau and manufacturing base, where the parts for various compressors and pumps are made, repair and production of rotors, gearboxes and compressors and so on is performed [9].

The partial indicators calculation results of “Turbomash Ltd” for technical component during 2009-2013 years are presented in the Table 1.

*Table 1 – The results of partial indicators calculation for TTD technical component*

Indicator	2009	2010	2011	2012	2013
Indicators of enterprise providing fixed assets estimation					
Capital intensity	0,30	0,21	0,16	0,11	0,09
Capital availability	38,41	44,75	53,51	61,9	58,1
Indicator of fixed assets value in enterprise property	0,43	0,42	0,23	0,27	0,12
Indicators of state fixed assets assessment					
Indicator of fixed assets wear	0,40	0,42	0,39	0,38	0,43
Indicator of fixed assets suitability	0,60	0,58	0,61	0,62	0,57
Indicator of fixed assets updating	0,03	0,06	0,16	0,18	0,17
Indicator fixed assets disposals	0	0	0	0	0
Indicator fixed assets increasing	0,03	0,06	0,16	0,18	0,17
Indicators of the fixed assets efficiency estimation					
Capital productivity	3,38	4,66	6,31	9,04	11,70
Profitability	0,01	0,06	0,04	0,17	0,72
The absolute amount of profit per 1 hrn of fixed assets	0,07	0,11	0,05	0,21	0,88

Following the methodic proposed in [10] in order to create unified measurement system of partial quantitative and qualitative indicators the qualitative ones are converted into relative:

$$I_q = \frac{Km_p}{K_{\max}}, \quad (1)$$

$$I_q = \frac{K_{\min}}{Km_p}; \quad (2)$$

where  $I_q$  – relative qualitative indicators;  $Km_p$  – value of  $m$ -partial indicator, received by enterprise;  $K_{\min}$  and  $K_{\max}$  – the lowest and largest value of  $m$ -partial indicator respectively.

In the first case, the higher value indicator indicates a higher level of TTD technical

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component, while in the second one – less value indicator indicates a higher level of TTD technical component.

The generalized partial indicators for TTD technical component in 2009-2013 years are presented in the Table 2.

**Table 2 – The results of generalized partial indicators calculation for TTD technical component**

Indicator	2009	2010	2011	2012	2013
Indicators of enterprise providing estimation concerning fixed assets					
Capital intensity	0,30	0,43	0,56	0,82	1
Capital availability	0,62	0,72	0,86	1	0,94
Indicator of fixed assets value in enterprise property	1	0,98	0,53	0,63	0,28
Indicators of fixed assets state assessment					
Indicator of fixed assets wear	0,95	0,9	0,97	1	0,88
Indicator of fixed assets suitability	0,97	0,94	0,98	1	0,92
Indicator of fixed assets updating	0,17	0,33	0,89	1	0,94
Indicator fixed assets disposals	0	0	0	0	0
Indicator fixed assets increasing	0,17	0,33	0,89	1	0,94
Indicators of fixed assets efficiency estimation					
Capital productivity	0,29	0,4	0,54	0,77	1
Profitability	0,01	0,08	0,06	0,24	1
The absolute amount of profit per 1 hrn of fixed assets	0,08	0,13	0,06	0,24	1

The results of partial indicators calculation of “Turbomash Ltd” for technological component in 2009-2013 years are presented in the Table 3.

**Table 3 – The results of partial indicators calculation for TTD technological component**

Indicator	2009	2010	2011	2012	2013
Indicator of technologies progressivity	0,1	0,1	0,15	0,2	0,2
Indicator of production updating	0,42	0,51	0,54	0,62	0,70
Indicator of production technological novelty	0,28	0,32	0,32	0,42	0,48
Indicator of equipment progressivity	0,04	0,04	0,05	0,07	0,1

To calculate the integral indicators it is necessary to determine the relative importance weights of indicators for technical and technological components. Relative importance

weights are determined by the expert estimations method [11, p. 98]. 12 experts are involved for this purpose.

They are professionals from “Turbomash Ltd” and other researchers, who are experts in the field of engineering.

For technical component experts set estimation parameters for each indicator of three groups: enterprise indicators providing estimation of fixed assets, indicators of state assessment of fixed assets, indicators of efficiency estimation of fixed assets. Experts set assessment from 1 to 3 to each indicator of technical component for enterprise indicators providing estimation of fixed assets, from 1 to 5 to each indicator for indicators of state assessment of fixed assets, from 1 to 3 to each indicator for indicators of efficiency estimation of fixed assets in ascending order of their importance. The highest evaluation more meaningful indicator has got. Each evaluation is exhibited only to one indicator. The amount of relative importance weights for each group is equal to 1.

To calculate relative importance weights for the technological component, an experts’ survey has been similarly conducted. Experts set assessment from 1 to 4 to each indicator of technological component in ascending order of their importance. The amount of relative importance weights for indicators is equal to 1.

The results of the experts’ survey show that the calculated concordance coefficients have a value greater than 0,5 that is experts’ opinion is conciliated. Verification the result by calculating the coefficient of concordance by Pearson criterion has showed that  $X_p^2 > X_T^2$ , therefore, our calculations of concordance coefficients are statistically significant.

According to the formulas given in [12] we will calculate the integral indicators for the TTD technical component for 2009-2011 years for three groups.

$$K_{i1}(2009)=0,3 \cdot 0,5+0,62 \cdot 0,306+1 \cdot 0,194 = 0,534;$$

$$K_{i2}(2009)=0,95 \cdot 0,189+0,97 \cdot 0,317+0,17 \cdot 0,139+0 \cdot 0,072+0,17 \cdot 0,283 = 0,559;$$

$$K_{i3}(2009)=0,29 \cdot 0,347+0,01 \cdot 0,486+0,08 \cdot 0,167 = 0,12.$$

Integral indicator for the TTD technical component:

$$K_{it}(2009)=0,534 \cdot 0,559 \cdot 0,12 = 0,035;$$

$$K_{i1}(2010) = 0,43 \cdot 0,5+0,72 \cdot 0,306+0,98 \cdot 0,194 = 0,625;$$

$$K_{i2}(2010) = 0,9 \cdot 0,189+0,94 \cdot 0,317+0,33 \cdot 0,139+0 \cdot 0,072+0,33 \cdot 0,283 = 0,607;$$

$$K_{i3}(2010) = 0,4 \cdot 0,347+0,08 \cdot 0,486+0,13 \cdot 0,167 = 0,199;$$

$$K_{it}(2010)=0,625 \cdot 0,607 \cdot 0,199 = 0,076;$$

$$K_{i1}(2011) = 0,56 \cdot 0,5+0,86 \cdot 0,306+0,53 \cdot 0,194 = 0,646;$$

$$K_{i2}(2011) = 0,97 \cdot 0,189+0,98 \cdot 0,317+0,89 \cdot 0,139+0 \cdot 0,072+0,89 \cdot 0,283 = 0,87;$$

$$K_{i3}(2011) = 0,54 \cdot 0,347+0,06 \cdot 0,486+0,06 \cdot 0,167 = 0,227;$$

$$K_{it}(2011)=0,646 \cdot 0,87 \cdot 0,227 = 0,127.$$

Similar way indicators for 2012-2013 years have been calculated. The integral indicators for the TTD technological component for 2009-2013 years:

$$K_T(2009)=0,1 \cdot 0,384 + 0,42 \cdot 0,308 + 0,28 \cdot 0,183 + 0,04 \cdot 0,125 = 0,224;$$

$$K_T(2010)=0,1 \cdot 0,384 + 0,51 \cdot 0,308 + 0,32 \cdot 0,183 + 0,04 \cdot 0,125 = 0,259;$$

$$K_T(2011)=0,15 \cdot 0,384 + 0,54 \cdot 0,308 + 0,32 \cdot 0,183 + 0,05 \cdot 0,125 = 0,289;$$

$$K_T(2012)=0,2 \cdot 0,384 + 0,62 \cdot 0,308 + 0,42 \cdot 0,183 + 0,07 \cdot 0,125 = 0,353;$$

$$K_T(2013)=0,2 \cdot 0,384 + 0,7 \cdot 0,308 + 0,48 \cdot 0,183 + 0,1 \cdot 0,125 = 0,393.$$

The results of integral indicators calculation for TTD technical and technological components are presented in Table 4.

**Table 4 – The results of integral indicators calculation for TTD technical and technological components**

Year	The integral indicators value		
	Technical component		Technological component
2009	0,534	0,035	0,224
	0,559		
	0,12		
2010	0,625	0,076	0,259
	0,607		
	0,199		
2011	0,646	0,127	0,289
	0,87		
	0,227		
2012	0,838	0,330	0,353
	0,928		
	0,424		
2013	0,842	0,72	0,393
	0,855		
	1		

Integral value indicators of the TTD level estimation of industrial enterprises for the technical and technological components are located in a two-dimensional matrix “Integral indicator for the technical component – integral indicator for the technological component” (Fig. 1).

The figure shows that the enterprise “Turbomash Ltd” is on the growth level of technical and technological development, which during the analyzed period consistently moves from quadrant 1 (zone of unacceptably low TTD level) through quadrant 5 (zone of unacceptably low TTD level) to quadrants 6 and 7 (zone of average TTD level).

In 2009-2011 enterprise had low TTD level of two components. Then it has been started growing. In 2012-2013 TTD level was average. In order to increase the enterprise TTD level it is necessary to analyze more detailed the partial indicators of technological component. To increase the both components of TTD it is proposed to use in the production process new advanced technology and equipment. Their usage needs to be more efficient from the position of the production process.

Optimal usage of investment funds will allow directing them quickly in required directions.

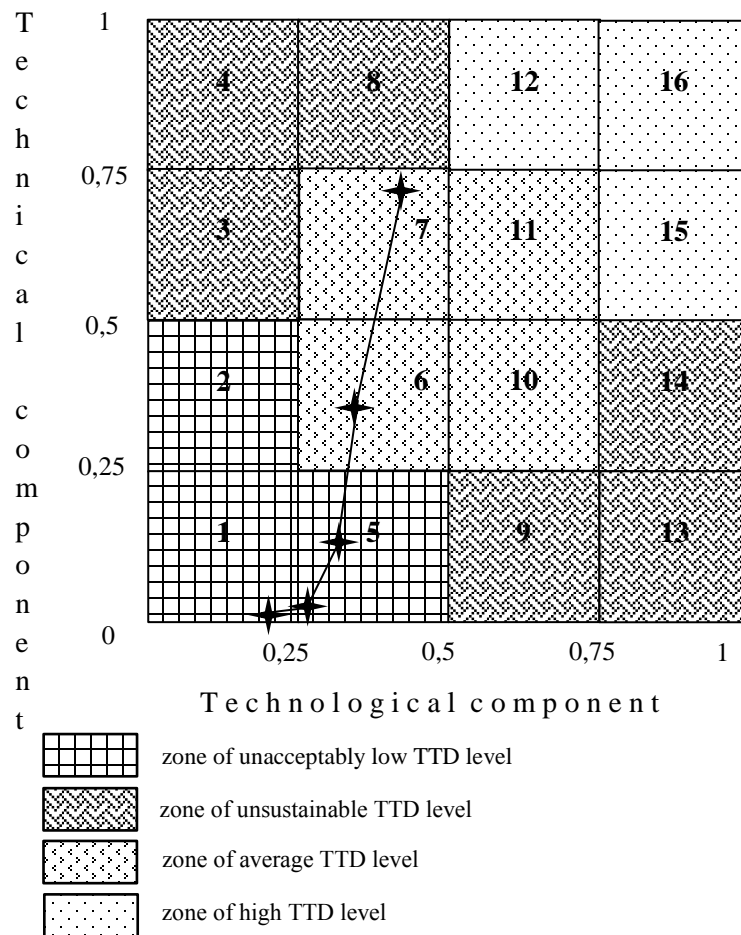


Figure 1 – Positioning the “Turbomash Ltd” in a two-dimensional matrix assessing the TTD level «Integral indicator for the technical component – integral indicator for the technological component

**Conclusions and directions for further researches.** The calculation results show that the enterprise «Turbomash Ltd» is on the growth level of technical and technological development. It is positioned in the two-dimensional matrix based on integral indicators for the technical and technological components. Recommendations concerning measures for increasing the technical and technological development level of the enterprise are offered. In order to increase it, it is proposed more detailed analysis of partial indicators in order to identify weak points. Further research is aimed to build an optimization model to increase the technical and technological development level at the machine-building enterprises.

1. Гонтарева І.В. Оцінка потенціалу техніко-технологічної бази промислового підприємства / І.В. Гонтарева // Вісник СумДУ. Серія «Економіка». – 2011. – №4. – С. 133-139.

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2. Євдокимов Ф.І. Механізм оцінки техніко-технологічного потенціалу підприємства [Електронний ресурс] / Ф.І. Євдокимов, В.П. Лисяков. – Режим доступу : [http://library.donntu.edu.ua/fem/vip97/97\\_04.pdf](http://library.donntu.edu.ua/fem/vip97/97_04.pdf).
  3. Коверга С.В. Ефективність діагностики техніко-технологічного потенціалу машинобудівного підприємства / С.В. Коверга, О.С. Передерєєва, С.П. Кузьменко // *Маркетинг і менеджмент інновацій*. – 2010. – №4, Т. 2. – С. 205-209.
  4. Передерєєва О.С. Дослідження сутності економічної складової техніко-технологічного потенціалу промислових підприємств [Електронний ресурс] / О.С. Передерєєва. – Режим доступу : [www.nbu.gov.ua/portal/soc\\_gum/Dtr\\_ep/2012.../EC212\\_25.pdf](http://www.nbu.gov.ua/portal/soc_gum/Dtr_ep/2012.../EC212_25.pdf).
  5. Єфремов О.С. Теоретичні засади управління інноваційним технологічним розвитком підприємства [Електронний ресурс] / О.С. Єфремов. – Режим доступу : [www.nbu.gov.ua/portal/soc\\_gum/vsunu/2011.../Efremov\\_O.pdf](http://www.nbu.gov.ua/portal/soc_gum/vsunu/2011.../Efremov_O.pdf).
  6. Рачинська Г.В. Оцінювання рівня технологічного розвитку підприємств / Г.В. Рачинська, Л.С. Лісовська [Електронний ресурс]. – Режим доступу : <http://ena.lp.edu.ua:8080/bitstream/ntb/11116/1/40.pdf>.
  7. Arranz N. Technological cooperation: a new type of relations in the Progress of national innovation systems / N. Arranz, J Arroyabe // *The Innovation Journal: The Public Sector Innovation Journal*. – 2009. – №14(2). – – P. 1-11.
  8. Smith K. Innovation and Research Strategy for Growth / K. Smith, A. Estivals // *BIS Economics Paper*. – 2011. – №15. – P. 1-162.
  9. Офіційний сайт ТОВ «Турбомаш» [Електронний ресурс]. – Режим доступу : <http://turbomash.sumy.ua/>.
  10. Ілляшенко С.М. Маркетингова товарна політика : підручник. – Суми : ВТД «Університетська книга», 2005. – 234 с.
  11. Грабовецький Б.С. Методи експертних оцінок : теорія, методологія, напрямки використання : монографія / Б.С. Грабовецький. – Вінниця : ВНТУ, 2010. – 171 с.
  12. Шевлюга О.Г. Формування системи показників оцінки складових техніко-технологічного розвитку промислового підприємства / О.Г. Шевлюга // *Наука й економіка*. – 2014. – №1(33). – С. 176-180.
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1. Hontareva, I.V. (2011). Otsinka potentsialu tekhniko-tekhnologichnoi bazy promyslovoho pidpriemstva [Estimation of potential technique and technological base of industrial enterprises]. *Visnyk SumDU. Seriya «Ekonomika» – Bulletin of SSU. Series of economy*, 4, 133-139 [in Ukrainian].
  2. Yevdokymov, F.I., & Lysiakov, V.P. (n.d.). Mekhanizm otsinky tekhniko-tekhnologichnoho potentsialu pidpriemstva [Mechanism of evaluation of technical and technological potential of the company]. Retrieved from [http://library.donntu.edu.ua/fem/vip97/97\\_04.pdf](http://library.donntu.edu.ua/fem/vip97/97_04.pdf) [in Ukrainian].
  3. Koverha, S.V., Perederieieva, O.S., & Kuzmenko S.P. (2010). Efektyvnist diahnostryky tekhniko-tekhnologichnoho potentsialu mashynobudivnoho pidpriemstva [The efficiency of diagnostics technical-technological potential machine-building enterprises]. *Marketing i menedzhment innovatsii – Marketing and Management of Innovations*, 4(2), 205-209 [in Ukrainian].
  4. Perederieieva, O.S. (2012). Doslidzhennia sutnosti ekonomichnoi skladovoi tekhniko-tekhnologichnoho potentsialu promyslovykh pidpriemstv [Essence research of the economic component of the technical and technological potential of industrial enterprises]. Retrieved from [www.nbu.gov.ua/portal/soc\\_gum/Dtr\\_ep/2012.../EC212\\_25.pdf](http://www.nbu.gov.ua/portal/soc_gum/Dtr_ep/2012.../EC212_25.pdf) [in Ukrainian].
  5. Yefremov, O.S. (2011). Teoretychni zasady upravlinnia innovatsiinym tekhnologichnym rozvytkom pidpriemstva [The theoretical basis of innovative technology development management of enterprise]. Retrieved from [www.nbu.gov.ua/portal/soc\\_gum/vsunu/2011.../Efremov\\_O.pdf](http://www.nbu.gov.ua/portal/soc_gum/vsunu/2011.../Efremov_O.pdf) [in Ukrainian].
  6. Rachynska, H.V., & Lisovska, L.S. (n.d.). Otsiniuvannia rivnia tekhnologichnoho rozvytku pidpriemstv [Estimation of level of technological development of enterprises]. Retrieved from <http://ena.lp.edu.ua:8080/bitstream/ntb/11116/1/40.pdf> [in Ukrainian].
  7. Arranz, N., J Arroyabe, J. (2009). Technological cooperation: a new type of relations in the

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progress of national innovation systems. *The Innovation Journal: The Public Sector Innovation Journal*, 14(2), 1-11 [in English].

8. Smith, K., & Estivals, A. (2011). Innovation and Research Strategy for Growth. *BIS Economics Paper*, 15, 1-162 [in English].

9. Ofitsiinyi sait TOV «Turbomash» [Official site of «Turbomash Ltd»]. Retrieved from <http://turbomash.sumy.ua/> [in Ukrainian].

10. Iliashenko, S.M. (2005). *Marketynhova tovarna polityka [Marketing product policy]*. Sumy: VTD «Univrsytetska knyha» [in Ukrainian].

11. Hrabovetskyi, B.Ye. (2010). *Metody ekspertnykh otsinok: teoriia, metodolohiia, napriamky vykorystannia [Methods of expert evaluations: theory, methodology, directions of use]*. Vinnytsia: VNTU [in Ukrainian].

12. Shevliuha, O.H. (2014). Formuvannia systemy pokaznykiv otsinky skladovykh tekhniko-tekhnolohichnoho rozvytku promyslovoho pidpriemstva [Indicators system formation of an estimation components of industrial enterprise technical-technological development]. *Nauka y ekonomika – Science and Economics*, 1(33), 176-180 [in Ukrainian].

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**Практичні аспекти визначення рівня техніко-технологічного розвитку машинобудівного підприємства**

*У статті визначено рівень техніко-технологічного розвитку машинобудівного підприємства ТОВ «Турбомаш», підприємство позиціоноване у двовимірній матриці «Інтегральний показник за технічною складовою – інтегральний показник за технологічною складовою» та надані рекомендації щодо його підвищення.*

Ключові слова: техніко-технологічний розвиток, двовимірна матриця, інтегральний показник, метод експертних оцінок, вагові характеристики.

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**Практические аспекты определения уровня технико-технологического развития машиностроительного предприятия**

*В статье определен уровень технико-технологического развития машиностроительного предприятия ООО «Турбомаш», предприятие позиционировано в двухмерной матрице «Интегральный показатель по технической составляющей – интегральный показатель по технологической составляющей» и предложены рекомендации по его повышению.*

Ключевые слова: технико-технологическое развитие, двухмерная матрица, интегральный показатель, метод экспертных оценок, весовые характеристики.

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