http://doi.org/10.24867/JPE-2023-01-019

Journal of Production Engineering

Vol. 26 No. 1

JPE (2023) Vol.26 (1) Original Scientific Paper

Todić, V., Bojanić, R.

PRODUCT PROFITABILITY ASSESSMENT

Received: 10 June 2023 / Accepted: 2 July 2023

Abstract: *Product profitability assessment is one of the strategic management tools used in planning and managing product costs, or target profit. Product cost planning and management unfold as early as the development phase, as well as during the adoption of modern production processes. Target profit and product competitiveness on the market require continuous monitoring of market prices, as well as managing costs incurred in the production process. The paper presents the methodology used for product profitability assessment, which is based on the evaluation of product costs and maintaining competitive market prices.*

Key words: *Profitability, product.*

Procena profitabilnosti proizvoda. *Procena profitabilnosti proizvoda je jedan od alata strategijskog menadžmenta koji se koristi u planiranju i upravljanju troškovima proizvoda, odnosno ciljnog profita. Planiranje i upravljanje troškovima proizvoda vrši se još u fazi razvoja, kao i pri usvajanjusavremenih procesa proizvodnje. Ciljni profit i konkurentnost proizvoda na tržištu zahtevaju kontinualno praćenje tržišnih cena, kao iupravljanje troškovima koji nastaju u procesu proizvodnje proizvoda. U radu je prikazana metodologija za procenu profitabilnosti proizvoda, koja je bazirana na proceni troškova proizvoda i održavanju konkurentnih tržišnih cena.*

Ključne reči: *Profitabilnost, proizvod.*

1. INTRODUCTION

Product profitability is the primary imperative of any production, whether it is about developing and adopting the production of a new product or improving an existing one.

In maintaining product continuity, which determines the recognition of production companies in the market, there is a need for constant improvement of existing products and the development of new products, as well as the application of modern production processes. These requirements determine the strategy of investing in new production capacities as well as the need for continuous monitoring of changes in the market.

Planning and managing the target profit, i.e., profitability, especially of new products, is one of the most important instruments of business policy, which refers to the management of product costs and sustainable competitiveness on the market. Therefore, cost assessment and cost management are key instruments for managing the profitability of a new or improved product. Quality product cost assessment, i.e., production costs and the competitiveness of market prices, form the basis for assessing product profitability.

Numerous traditional and modern approaches are in use to assess product costs. These are classified as quantitative and qualitative methods. Some of the qualitative modern methods that have been applied to assess product or manufacturing costs are shown in a number of available papers, such as [1], [2], [3], [4], and [5].

The paper [1] highlights the fact that the combination of ANN and GA improves the learning process and provides a better cost assessment for a new product. The paper [2] presents a sensitive analysis for the assessment of production costs using regression analysis and ANN, while the paper [3] estimates the costs of specific products using reverse ANN and regression analysis. The paper [4] shows the results of a comparison of two types of ANN for the assessment of production costs of certain products, with the conclusion that the assessment of costs using ANN is more accurate compared to the assessment using regression analysis. The paper [5] presents a comparative analysis of the application of the PBC and ABC methods, two well-known quantitative methods for assessing production costs. These methods are applied in cases where there is no large amount of data on the costs of similar products, in contrast to the application of ANN for product cost assessment, where more data is required on the costs of similar products.

One of the models that belong to the group of modern qualitative methods is the hybrid model of product life cycle cost management, which is based on the basic principles of group technology and the application of fuzzy neural networks. This model, which has been presented in some international and domestic magazines, can be applied to assess and manage product costs in all phases of the life cycle in manufacturing and service companies with the preparation of the necessary data.

This paper sets up and develops a methodology for assessing product profitability, the application of which is shown in the example of assessing the profitability of single-row needle bearings within the framework of research into the possibility of expanding the production programme in the observed company engaged in the production of rolling bearings.

2. DEVELOPMENT AND APPLICATION OF THE METHODOLOGY

This methodology includes the following three basic activities:

- *Selection and preparation of the model for assessing product costs,*

- *Product cost assessment, and*
- *Assessment of the profitability of a new product.*

2.1 Selection and preparation of the model

For assessing the costs of single-row needle roller bearings as a group of new products, the hybrid model of product life cycle cost management was chosen. The basic task in preparing this model includes the collection and systematisation of experiential data in the observed company, which is necessary for training the fuzzy neural network. These data are selected from the database for similar bearings, which form a standard part of the production programme of the observed company. The similarity between these and needle bearings is based on their design similarity, which is characterised by the same parameters, such as:

- *Opening diameter – d,*
- *Outer diameter – D,*
- *Bearing width – B, and*
- *Bearing mass – m,*

as well as the similarity of the technological processes for producing these bearings.

The group of radial ball bearings, which are similar to needle bearings, consists of six types of radial single-row ball bearings (Figure 1) and one group of radial double-row and single-row ball bearings that are used in agricultural technology (Figure 2).

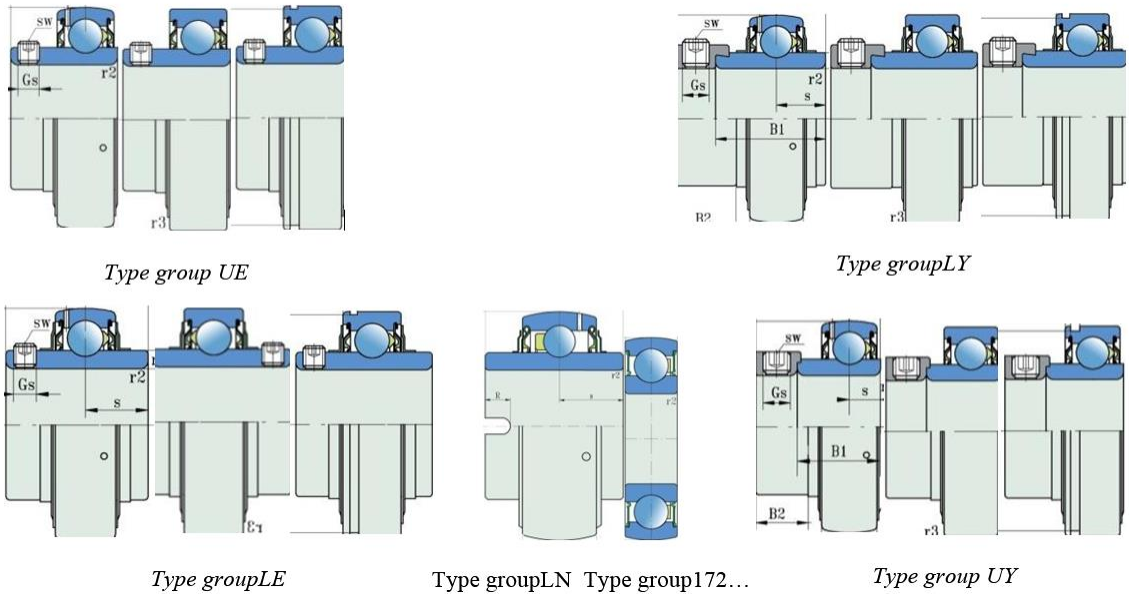


Fig.1. Group of radial single-rowball bearings

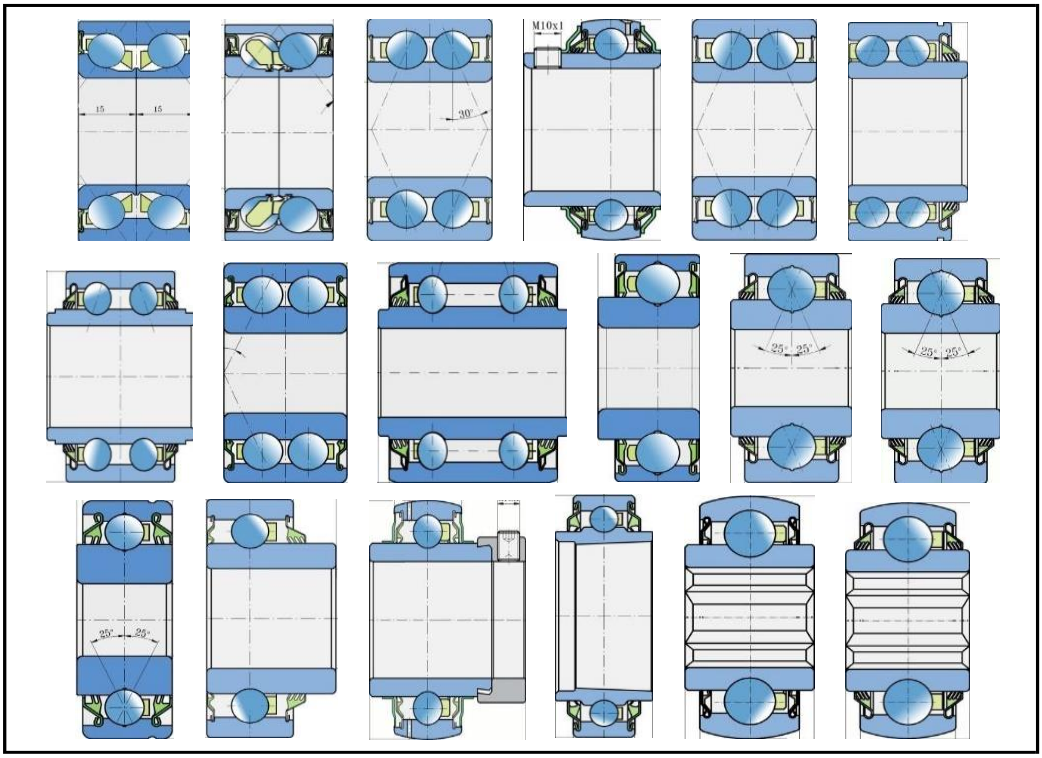


Fig. 2. The group of radial single and double row ball bearings

The values of the aforementioned design parameters, as well as the costs of these bearings, are shown in Table 1. These data are used as input for training the fuzzy neural network. The cost-related data for these bearings is regularly updated in the product database.

BEARING DIMENSIONS AND MASS				MARK	PRODUCTION COSTS
d	D	B	m		
15	35	11	0.04	1726202-2RSI	3.159
17	40	12	0.06	1726203-2RS1	4.303
20	47	14	0.10	1726204-2RS1	6.695
25	52	15	0.11	1726205-2RS1	9.451
30	62	16	0.18	1726206-2RS1	12.207
35	72	17	0.25	1726207-2RS1	13.936
40	80	18	0.32	1726208-2RS1	15.704
45	85	19	0.37	1726209-2RS1	5.096
50	90	20	0.41	1726210-2RS1	5.876
55	100	21	0.56	1726211-2RS1	8.684
60	110	22	0.75	1726212-2RS1	11.596
65	120	23	0.94	1726213-2RS1	17.056
12	40	22.1	0.09	UE203/122S	26.286
20	47	25.5	0.11	UE2042S	55.016
25	52	27.2	0.14	UE2052S	89.414
30	62	33	0.23	UE2062S	110.136
35	72	33	0.31	UE2072S	5.421
40	80	36	0.43	UE2082S	5.954
45	85	37	0.48	UE2092S	7.709
50	90	38.8	0.54	UE2102S	11.388
12	40	27.4	0.09	LE203/122F.SH	14.625
25	52	34.1	0.17	LE2052F	23.491
30	62	38.1	0.28	LE2062F	5.408
35	72	42.9	0.41	LE2072F	9.425
40	80	49.2	0.55	LE2082F	11.271
45	85	49.2	0.60	LE2092F	13.234
50	90	51.6	0.69	LE2102F	15.743
55	100	55.6	0.94	LE2112F	16.991
60	110	65.1	1.30	LE2122F	22.347
65	120	68.3	1.70	LE2132F	28.977
70	125	69.9	1.90	LE2142F	34.866
75	130	73.3	2.10	LE2152F	41.691
80	140	77.8	2.80	LE2162F	55.016
85	150	81	3.30	LE2172F	65.767
90	160	89	4.10	LE2182F	5.148
100	180	98.4	5.65	LE2202F	6.89
110	240	117	15.1	LE3222F	8.294
120	215	73.5	6.20	LE2242F	11.466
12	40	28.6	0.09	UY203/122S.SH	13.104
20	47	31	0.11	UY2042S	36.504
25	52	31	0.14	UY2052S	5.434
30	62	35.7	0.23	UY2062S	8.385
35	72	38.9	0.31	UY2072S	6.487
40	80	43.7	0.43	UY2082S	9.997
45	85	43.7	0.48	UY2092S	5.187
50	90	43.7	0.54	UY2102S	5.46
55	100	48.4	0.98	UY2112S	11.115
60	110	53.3	1.30	UY2122S	3.51
12	40	37.3	0.162	LY203/122F	4.368
20	47	43.7	0.19	LY2042F	3.159
25	52	44.4	0.23	LY2052F	3.276
30	62	48.4	0.43	LY2052F	3.328
35	72	51.1	0.68	LY2062F	5.044
40	80	56.3	0.8	LY2072F	5.408
45	85	56.3	1.08	LY2082F	19.396
50	90	62.7	1.44	LY2092F	14.144
55	100	71.4	1.86	LY2102F	23.66
60	110	77.8	2.34	LY2112F	22.919
65	120	85.7	2.95	LY2122F	2.6
70	125	85.7	3.67	LY2132F	2.288
75	130	92.1	4.40	LY2142F	2.392
80	140	100	2.90	LY2152F	3.445
90	150	106	3.54	LY2162F	4.706
100	180	75	4.35	LY2202F	3.575
110	240	141.3	17.20	LY2222F	3.38
120	215	81	6.70	LY2242F	3.926
20	47	34.1	0.16	LN2042F	6.097
25	52	34.9	0.17	LN2052F	7.943
30	62	36.5	0.30	LN2062F	9.958
35	72	37.7	0.49	LN2072F	11.024
40	80	42.9	0.58	LN2082F	11.947
45	85	42.9	0.66	UE2082F	5.174
50	90	42.9	0.76	LN2092F	6.981
60	110	61.9	1.52	LN2102F	9.529
70	125	68.2	2.25	LN2142F	16.51
30	62	30	0.39	FKL306230	28.873
35	72	34	0.54	FKL357234A	32.552
30	62	23.8	0.285	3206B.2RS1	34.424
50	90	51.6	0.70	LE2102TB	156.156
20	47	20.6	0.16	3204B.2RS1	89.557
20	47	25.2	0.185	3204T	4.654
30	62	50	0.50	5206KPP3	6.266
17	47	24.2	0.20	SL33032S	9.113
16	40	43.88	0.218	SL52032T	12.909
16	45	18.67	0.23	06C04-2Z	3.445
16	40	18.29	0.08	Q203 PP.AH02	5.291
13	40	18.29	0.091	Q203 PP.AH05	5.564
16	53	19.4	0.28	SL53162T	60.684
19	52	21.1	0.28	205KRP2	72.501
60	130	68.4	2.97	LY3122F	89.557
50	81	30	0.42	209KRRK/50.135	4.16
38	90	30	0.80	210RRB6	8.177
31	80	36.5	0.67	W208 PPB16	9.958

Table1. Parameter and cost values for the group of similar bearings

For training the selected fuzzy neural network, the shifted Gaussian membership function with parameters (1 3 3 4) was chosen. A graphic representation of the costs of needle bearings depending on individual parameters is given in Figure 3.

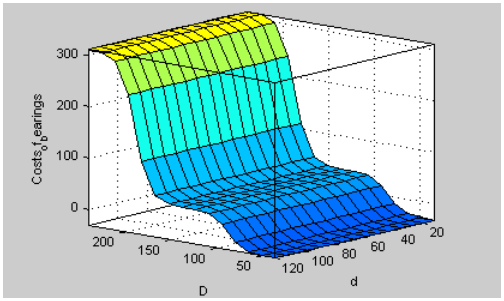
2.2 Assesing the costs of single-row needle bearings

Costs of this group of needle bearings were assessed using a trained fuzzy neural network, with design parameter values d, D, B, m being the input data (Table 2).

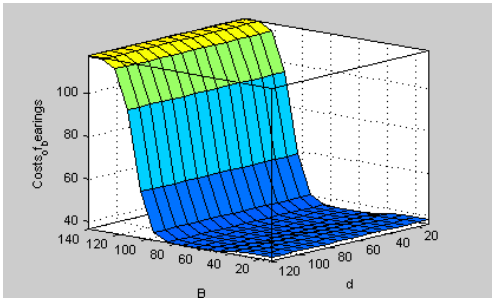
2.3 Assesing the costs of single-row needle bearings

The profit for individual bearings of this group is determined based on the respective market prices C_T and the estimated costs of bearings T_P, that is:

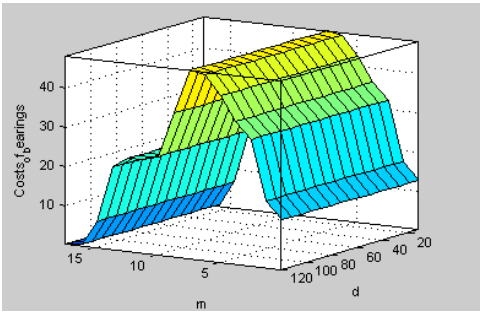
$$p = C_T - T_P \quad (1)$$



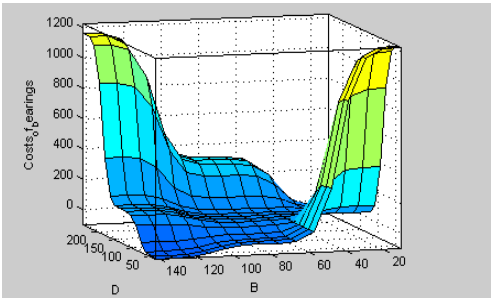
a)Tp=f(D, d)



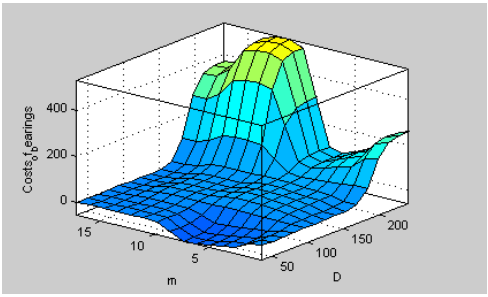
b) Tp=f(B, d)



c)Tp=f(m, d)



d)Tp=f(D, B)



e)Tp=f(m, D)

Fig.3. (a, b, c, d, e) Graphical presentation of costs of needle bearings ($T_{P)}$

No.	BEARING DIMENSIONS AND MASS				MARK	PRODUCT COSTS	MARKET PRICE	PROFIT
	d	D	B	m		T_P (€/pcs)	C_T (€/pcs)	(€/pcs)
1	55	85	28	0,650	Na55V	16,4	17.914	1,514
2	60	90	28	0,705	Na60V	17,7	18.226	0,526
3	65	95	28	0,735	Na65V	17	19.032	2,032
4	70	100	28	0,785	Na70V	17,2	19.11	1,91
5	80	115	32	1,24	Na80V	24,5	26.832	2,332
6	85	120	32	1,29	Na85V	23,4	25.688	2,288
7	90	125	32	1,35	Na90V	23,7	25.987	2,287
8	95	130	32	1,41	Na95V	24,8	27.105	2,305
9	100	135	32	1,49	Na100V	27	29.432	2,432

Table 2. Profitability assessmentof single row needle bearings

The market prices of the observed group of single-row needle bearings differ significantly between individual manufacturers, from which lower market prices were adopted (Table 2).

The obtained results show that all observed single-row needle bearings realised a certain profit. To achieve higher profitability for these bearings, it is necessary to improve the existing or apply new production processes.

Certain illogicalities related to the estimated cost values for the individual bearings are caused by the inaccuracy of the collected data related to the costs of similar bearings, as well as possible shortcomings of the software used.

3. CONCLUSIONS

The effectiveness of the methodology for assessing product profitability, which is based on the evaluation of the costs of similar products in the observed company and sustainable market competitiveness, depends mostly on the accuracy of experience data for the costs of similar realised products.

Product cost management, which ensures the target profit with sustainable market competitiveness, implies the application of modern production processes and technological solutions in the production of new or improved products.

The development of a quality database for products within the company's production programme requires the collection, verification, and systematisation of experiential data related to product manufacturing, especially regular updating of data on product costs, that is, production and market prices.

4. REFERENCES

[1] Hasangholipour, T, Khodayar F.: *A Novel Optimized Neural Network Model for Cost Estimation using Genetic Algorithm, Journal of Applied Sciences*, Vol.10 (6), pp. 512-516, 2010.

[2] Heping L.: *Cost Estimation and Sensitivity Analysis on Cost Factors: A Case Study On Taylor Kriging, Regression and Artificial Neural Networks*, The Engineering Economist, Vol.55, pp. 201–224, 2010.

[3] Deng, S., Yeh, T.-H.: *Using least squares support vector machines for the airframe structuresmanufacturing cost estimation*, Int. J. Production Economics, Vol. 131, pp.701–708, 2011.

[4] Suzhou T.,Delun, W., Fong-Yuen, D.: *A new process-based cost estimation and pricing model considering the influences of indirect consumption relationships and quality factors*, Computers & Industrial Engineering, Vol. 63, pp. 985–993, 2012.

[5] Duran, O., Maciel, J., Rodriguez, N.: Comparisons between two types of neural networks for manufacturing cost estimation of piping lements Expert Systems with Applications, Vol.39 ,pp.7788–7795,2012.

[6] Todic, V., 2016, Hybrid model of product lifecycle cost management, PhD Thesis, University of Novi Sad, Faculty of Technical Sciences, Novi Sad.

Authors: **PhD Vladimir Todić, Assoc. Professor Bojanić Ranko PhD**, University of Novi Sad, Faculty of Technical Sciences, Trg Dositeja Obradovica 6, 21000 Novi Sad, Serbia,

E-mail: vladimir.todic@uns.ac.rs
bojanic@uns.ac.rs