Journal of Mineral Resources Engineering, 8(1): 55-69, (2023)

Imam Khomeini International University
Vol. 8, No. 1, Spring 2023

نشریه مهندسی منابع معدنی
Journal of Mineral Resources Engineering (JMRE)

Research Paper

Evaluation of the Economic Performance Index for Loading and Hauling Fleet in Open-Pit Mines

Akbarzadeh M.R.[1], Jalali S.E.[2*], Khademian A.[3], Nabizadeh M.A.[4]

1- M.Sc, Faculty of Mining, Petroleum & Geophysics Engineering, Shahrood University of Technology, Shahrood, Iran
2- Associate Professor, Faculty of Mining, Petroleum & Geophysics Engineering, Shahrood University of Technology, Shahrood, Iran
3- Assistant Professor, Faculty of Mining Engineering, Sahand University of Technology, Tabriz, Iran
4- M.Sc, Engineering Office Arman Gohar Sirjan Company Sirjan, Kerman, Iran

Received: 14 Dec. 2021 **Accepted: 15 Mar. 2022**

Abstract: Loading and hauling operations have the highest share of the production costs of open-pit mines. Therefore, in choosing the loading and hauling machines, paying attention to the economic aspects is necessary. For a better understanding of the financial performance of mining machinery, various performance indicators have been proposed by researchers. This research presents a special form of economic performance index, which indicates the ratio of each machine's revenue to its total cost. For this purpose, the cost and revenue of the transport fleet, including dump trucks, mining shovels, and backhoe excavators, were collected for two years (From September 2017 to September 2019) and determined. As the first step, the total cost and the amount of revenue from the operation of each machine then, the Economic Performance Index (EPI) for each of the loading and hauling machines is calculated and compared with each other. The results show that Backhoe excavators perform better than mining shovels. In addition, by examining different trucks from different manufacturers, it was found that C100 series trucks have the best performance among all trucks. Its average economic performance index value for each of those trucks is 2.82.

Keywords: Open-pit mines, loading and hauling machinery, Economic performance index, Revenue, Cost.

How to cite this article
Akbarzadeh, M. R., Jalali, S. E., Khademian, A., and Nabizadeh, M. A. (2023). *"Evaluation of the economic performance index for loading and hauling fleet in open-pit mines"*. Journal of Mineral Resources Engineering, 8(1): 55-69.
DOI: 10.30479/JMRE.2022.16637.1567

*Corresponding Author Email: *Jalalisme@shahroodut.ac.ir*

INTRODUCTION

The transport system is the most critical operational unit in mining and mineral industries, especially open-pit mines. Loading and hauling machinery in open-pit mines account for a significant share of costs. Therefore, in choosing mentioned machines, not only should it be necessary to ensure continuous production in the mine, but it is also necessary to select the machine to cost less. In this paper, the loading and hauling fleet of one of Iran's largest open-pit iron ore mines (with a mining capacity of about 100 million tons per year) were analyzed in terms of cost (ownership and operating costs) and revenue for two years. Then, the overall performance index of each transport unit was defined by dividing their revenue by their total cost [1-3].

METHODS

In this research, a particular form of the Economic Performance Index is presented, which indicates the ratio of each machine's revenue to its total cost. For this purpose, the cost and revenue of the transport fleet, including dump trucks, mining shovels, and backhoe excavators, were collected for two years (From September 2017 to September 2019). So first, the total cost and the amount of revenue from the operation of each machine are determined. Then, the Economic Performance Index for each of the loading and hauling machines is calculated and compared with each other. So, if the economic performance index of 1.42 is selected as a profit threshold indicator, values greater than this number indicate a profitable utilization, while a performance index less than 1.42 indicates that the mine is not profiting from the performance of the machine.

FINDINGS AND ARGUMENT

According to the total cost and revenue analysis, the Economic Performance Index for hauling and loading machinery is identified and evaluated. Figure 1 shows the average value of revenue and total cost for each machine, and also the economic performance of the mining transportation system is shown in Figure 2.

As can be seen in Figures 1 and 2, the highest cost and revenue among the trucks belong to C100 trucks, with an average total cost and two-year revenue of 49.58 and 139.06 billion rials, respectively. However, the C100 trucks have the best performance of all trucks, with an average Economic Performance Index of 2.82 for each of these trucks. For loading machines, it can be seen that excavators have lower costs and revenue than shovels due to their lower capacity and more straightforward repair system, but they have better economic performance.

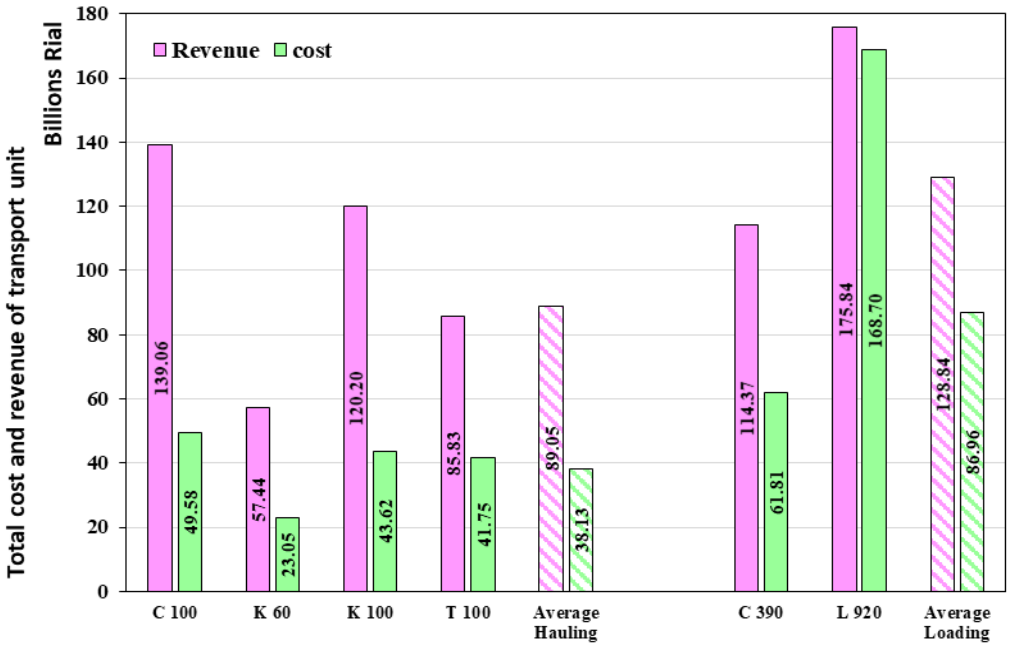

Figure 1. Average revenue and cost of all loading and hauling machinery over two years

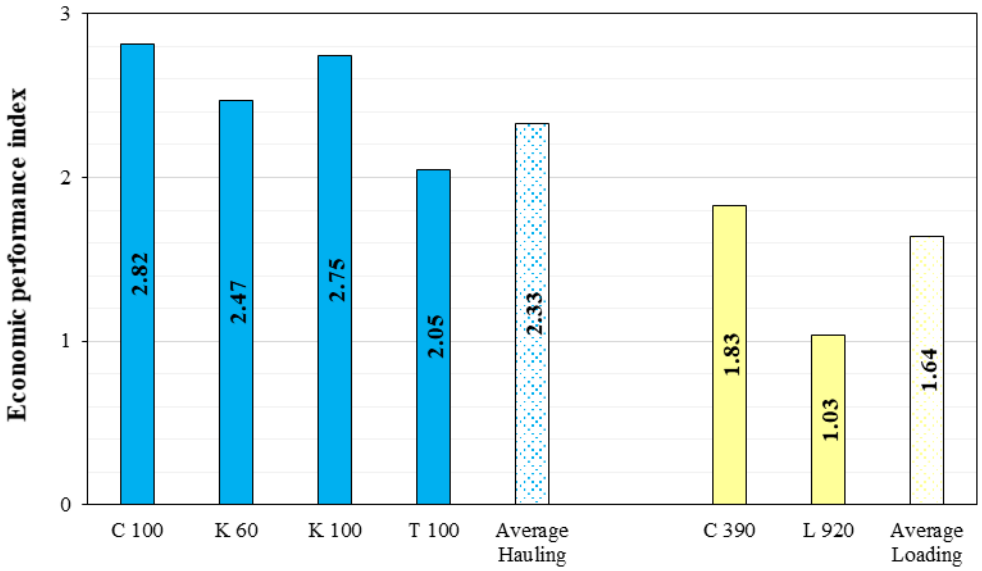

Figure 2. Economic performance index of loading and hauling machinery

CONCLUSIONS

Loading and hauling operations have the highest share of the production costs of open-pit mines. Therefore, in choosing the loading and hauling machines, paying particular attention to the economic aspects is necessary. This research presents a unique form of economic performance index, which indicates the ratio of each machine's revenue to its total cost. It should be noted that the type of hauling operation of each truck (ore and waste) has had an impact on the revenue, and also, the loading capacity has a direct influence on cost and revenue. According to the analysis of total cost and revenue, the economic performance index for hauling and loading machinery is identified and evaluated. Hauling trucks have almost the same total cost but different revenue, except K60 trucks, which have lower costs and revenue due to their lower capacity than other trucks. Specifically, any truck that works longer times at a specified given hour and is less repaired will earn more. The average value of the performance index for each truck equals 2.33, which is a moderate value and considered almost suitable performance. The average economic performance index of loading machines is 1.64, with poor performance and very little revenue, which requires more attention and technical management.

REFERENCES

[1] Hartman, H. L., and Mutmansky, J. M. (2002). *"Introductory mining engineering"*. John Wiley & Sons.

[2] Noakes, M., and Lanz, T. (1993). *"Cost estimation handbook for the Australian mining industry"*. Political Science. DOI: 10.1016/0148-9062(94)91320-x.

[3] Lowrie, R. L. (Ed.). (2002). *"SME mining reference handbook"*. Society for Mining, Metallurgy, and Exploration, pp. 464.