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Fuzzy Decision Support System to Enhance Productivity in Indian Coal Mining Industry

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ABSTRACT

Coal powers the Indian economy. Over 70% of the entire power generated in the country is coal based. Coal India produces over 84% of the entire country's coal. As coal mining is a capital intensive industry, it is important to maximize productivity. This paper explores how adoption of "Kayakalp" Model of e- governance in CCL, a subsidiary of Coal India, resulted in complete transformation of the company in terms of production and productivity. The fuzzy based decision support system has investigated this fact.

KEYWORDS

CCL, Coal, DSS, Fuzzy System

INTRODUCTION

Production is a process of converting an input into a more valuable output. The analysis of demand is mainly used for planning the production process and determining the level of production. For equilibrium, supply should be equal to demand. Thus, production is an aspect of the supply side of the market (Maheshwari, Y., 2012). The production process is shown in Figure 1.

In Figure 1, an input is anything that the firm buys for use in its production process. The goods produced for sale through such a process are known as output. The major production decisions of any firm are related to the budget for the purchase of inputs, the distribution of the budget among the inputs, allocation of inputs to each output and combination of outputs. The overall concept can be well explained in production function. A production function is the technological relationship between the output and its inputs. These inputs are also known as the factors of production. Thus, a production function in case of a mining company can be described as follows:

$$Q = f(Ld, L, K, M, T, S)$$

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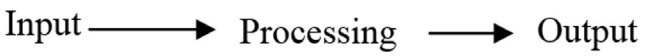
Figure 1. Production process (Maheshwari, 2012)



where:

Q = Output
Ld = Land employed in production
L = Labor employed in production
K = Capital employed in production
M = Management employed in production, Motivation level of stakeholders
T = Technology employed in production
S = Statutory clearances like environmental clearance, forestry clearance etc.

This manuscript is organized as follows: at first the problems and the issues of the Indian energy scenario followed by the challenges of Indian coal mining industry has been focused. After that the existing work had been discussed and thereafter the major steps adopted to enhance productivity in Indian coal industry, namely Central Coal Field Limited (CCL) has been presented. Next, a fuzzy based decision support system has been proposed and finally the conclusion part is given.

INDIAN ENERGY SCENARIO: AN OVERVIEW

India is the 6th largest economy of the world with a GDP of $ 2.1 trillion. The economy grew by 7.3% in 2014-15 and 7.6% in 2015-16 to become the fastest growing economy in the world (Annual Report & Accounts, Central Coalfields Limited, India, 2015-2016, http://www.centralcoalfields.in/ind/). The sharp growth in GDP has also increased the energy consumption in India. India is today the third largest consumer of energy in the world after China and US. In 2015 India surpassed Russia to become the third largest energy consumer of the world. However, India's per capita energy consumption is only 535 kg of oil equivalent (KGOE), about a third of the world average and even less than a tenth of per capita consumption of USA. The Table 1 shows the per capita energy consumption of

Table 1. Per capita energy consumption of some of the industrialized countries and their per capita GDP

Country	Primary Energy Consumption 2015 (MTOE)	Energy Consumption per Capita 2015 (KGOE)	GDP per Capita 2015 ($)	Times India's per Capita Income
US	2281	7084	55837	35
South Korea	277	5540	27222	17
France	239	3734	36248	23
Germany	321	3963	41221	26
Japan	449	3563	32477	21
UK	191	2938	43733	28
Russia	667	4664	9202	6
China	3042	2211	7925	5
India	701	535	1582	1
World	**13147**	**1789**	**9997**	**6**