

STUDIES IN PRODUCTIVITY MEASUREMENT THROUGH PERFORMANCE OBJECTIVES : A GOAL PROGRAMMING APPROACH

by

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DEPARTMENT OF MECHANICAL ENGINEERING

**Thesis submitted in fulfilment
of the requirements for the degree of
DOCTOR OF PHILOSOPHY**



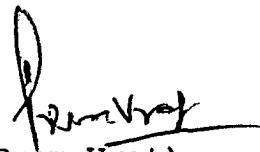
to the

INDIAN INSTITUTE OF TECHNOLOGY, DELHI

August 1986

CERTIFICATE

The thesis entitled, "STUDIES IN PRODUCTIVITY MEASUREMENT THROUGH PERFORMANCE OBJECTIVES : A GOAL PROGRAMMING APPROACH" being submitted by Mr. G.D. Sardana to the Indian Institute of Technology, New Delhi, for the award of the degree of 'Doctor of Philosophy', is a record of bonafide research work carried out by him. He has worked under my guidance and supervision, and has fulfilled the requirements for the submission of this thesis, which has attained the standard required for a Ph.D. degree of the Institute. The results presented in this thesis have not been submitted elsewhere for the award of any degree or diploma.



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ACKNOWLEDGEMENTS

I am obliged to Mr. K.N. Shenoy, President and Managing Director, Hindustan Brown Boveri Ltd. for having permitted me to engage in this research.

I am greatly indebted to Dr. Prem Vrat, Professor, Industrial Engineering, Mechanical Engineering Department, who supervised this research, inspired, encouraged and guided the work throughout. I am sincerely grateful to him for his invaluable suggestions, advice and patient guidance in making the thesis possible. In spite of his busy academic schedule and other preoccupations, he went through the drafts and provided comments, observations and suggestions for a better orientation of the work. His task was more difficult than normal, partly due to the external nature of this study as also because of his posting as visiting faculty at Asian Institute of Technology, Bangkok during a part period of my research.

My thanks are accorded to managements of Small Fabricators, Small Switch Controls, Medium Electricals Ltd. and Heavy Electro-Mechanicals Ltd. (all names in disguise) who have rendered all possible assistance in collection of data, in interacting with their key personnel and to hold participative group discussions.

I am thankful to Dr. N. Singh, Assistant Professor, Industrial Engineering, Mechanical Engineering Department

from whose sage counsel I have benefitted immensely, to Mr. M.M. Naidu, Research Scholar, who assisted me during the computer runs and Mr. K.M. Mital, Research Scholar as also Mr. S.N. Wig, Librarian, National Productivity Council New Delhi who helped me in locating reference material.

Many others have contributed to this work in an indirect manner and I am sincerely obliged to them:

- . a large number of my colleagues and work associates who during 25 years of my working in the Public and Private Sector have moulded and influenced my thinking on Productivity so as to crystallise in a new perspective;

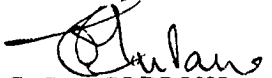
- . my parents, brothers, sister, who have inspired me and provided a constant encouragement;

- . my wife Jyoti, who has assisted in unenviable task of proof-reading; she deserves my appreciation for suffering long working hours and short tempers that accompanied study and writing;

- . my little daughter Sweta who permitted safe upkeep of all of my papers and study materials;

- . Mr. V.P. Gulati for the excellent job he has carried out in typing and Mr. P.R. Gauba for the neat figures he has prepared.

I alone am responsible for the views and opinions expressed in the pages that follow and these, in no way, are a reflection on any individual, company or organisation. I alone am also responsible for any judgement as may be found.


G.D. SARDANA -

ABSTRACT

This research work aims at developing a strong theoretical foundation and a model to measure productivity. An attempt has been made to examine the concept in its true and broader perspective as an index of accomplishment of total output against total inputs. A formal definition of 'Productivity' has been proposed.

An in-depth study and review of the state of the art and practice of productivity, its concepts and measurement has been carried out. The existing literature has been critically examined and inherent inadequacies and contradictions in various models of productivity measurement have been brought out. An overview of the basic objectives to measure productivity is presented. Concept of productivity has been considered from a systems point of view. Establishment of performance objectives is recommended as a necessary exercise to measure productivity. Drawing strength from Management By Objectives concept, the study details necessary steps to identify performance objectives for the organisational system. A paired-comparison methodology has been employed to arrive at the weightage factors to establish the inter-relationship amongst the sub-systems, as also the performance objectives.

The study introduces and recommends the concept of "Objectivated Output" to arrive at an optimal output which is possible to be achieved by the system and its sub-systems under the given constraints of resources. This is proposed to be

achieved by reconciliation of the conflicting interests through Goal Programming. The performance objectives are recommended generally to be of ratio type. The heterogeneous and the non-ratio type of performance objectives are required to be evaluated and converted to a common scale through the application of multi-attribute utility theory. The model, designated as "Performance Objectives-Productivity (PO-P)" has been developed to measure productivity at all levels of Organisational hierarchy through a common and easily understood language. The emphasis is on total performance as against only economic performance advocated by the conventional models on productivity measurement. The approach does not use the 'outputs' as commonly understood, because these are not representative of an Organisation's total performance to the accomplishment of which resources have been expended. Similarly, the conventional inputs do not represent all the efforts and variables which have gone in to achieve the performance.

The proposed approach is valid equally for a small undertaking as also for a medium sized company and a large organisation with multi sub-systems. The study has demonstrated its application through four case studies. Two case studies pertain to small engineering enterprises. The third case study pertains to a medium sized undertaking which has to face tough competition in the market. The fourth case study considers a large sized concern with its well organised sub-systems of production, marketing, technical materials, personnel, goals and values and financial (accounting). The study develops

a methodology to measure and monitor productivity from the operational level to the total organisational level in a three-level system structure.

The validity of the approach has been examined and it is found to meet the major objective of productivity measurement in identification of inefficient areas with potential for improvement. Its practical application in developing a productivity linked incentive scheme has been highlighted. An extensive use of Goal Programing has been resorted to carry out sensitivity analysis for determining the impact of the variations in sub-systems productivity indices and goal priorities on the system productivity index for the case of large undertaking. The versatility of PO-P approach has been demonstrated and the same can be used in diverse situations such as manufacturing or service, private or public sector undertakings.

The study examines the relevance of external environment on the performance and productivity of an organisation and brings out the impact of each of the sub-systems, socio-cultural, economic, political and technological. A model is developed to evaluate the comparative impact of external environment in order to know the 'net productivity' normalised of its impact. A case of the usefulness of evaluating the impact of E.E. is made out when there is a need of comparison of productivity of plants located in different external environments.

Major recommendations and inferences drawn from this study are summarized towards the end highlighting the important

contributions made by this research work. The limitations of this study alongwith suggestions for future work are also outlined. A detailed bibliography is appended at the end.

A major portion of this research study has been already published by the author.

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