

**MANAGING FOREIGN COLLABORATION IN ELECTRONICS
AND TELECOM SECTOR-A STUDY OF PROCESS AND
IMPACT IN ENTREPRENEURIAL ENTERPRISES**

by
DEEPAK DOGRA

***THESIS SUBMITTED
IN FULFILMENT FOR THE REQUIREMENTS
OF THE DEGREE OF
DOCTOR OF PHILOSOPHY***

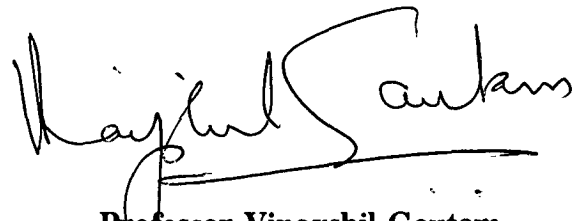


**Department of Management Studies
INDIAN INSTITUTE OF TECHNOLOGY, DELHI
INDIA**

OCTOBER 1995

CERTIFICATE

This is to certify that the thesis entitled **Managing Foreign Collaboration in Electronics and Telecom Sector - A Study of Process and Impact in Entrepreneurial Enterprises** being submitted by **Deepak Dogra** to the Indian Institute of Technology, Delhi, India for the award of the degree of **Doctor of Philosophy**, is a record of bonafide research work carried out by him under my supervision and guidance. The results obtained in this thesis has not been submitted, in part or in full, to any other university or institute for award of any degree or diploma.



Professor Vinayshil Gautam
Department of Management Studies,
Indian Institute of Technology, Delhi,
New Delhi-110 016

ACKNOWLEDGEMENT

My efforts in the research work were aided at various stages by many people. I owe my sincere gratitude to all of them.

I wish to express my deep and sincere indebtedness to Prof. Vinayshil Gautam, my supervisor, for his unfailing generosity, advice and help throughout the course of study.

My profound thanks to Dr. P.K.Jain, Professor and Head, Department of Management Studies and Dr. Sushil, Professor, Department of Management Studies for their interest and help rendered.

My grateful thanks to Mr. T.Somnath, Addl. Director, Department of Electronics, Govt of India, New Delhi and Mr. K.B. Lal, Director (Switching), Centre for Development of Telematics (C-DOT), Akbar Bhawan, New Delhi, who helped me readily, whenever approached.

I am also thankful all faculty members especially Dr. S. Kanungoo of Department of Management studies for their help. My thanks are due to all friends and research scholar of Department of Management Studies who made my stay at IIT Delhi a memorable one.

My thanks are due to Mr. C.G.Saji who by his extreme and sincere hardwork at odd hours could complete the task of typing this thesis.

Finally, regards to my mother for her continued encouragement and moral support in completion of study. Last but not the least, I am grateful to all those in the organisation who participated in my research work and spared their valuable time, though it may not be possible to acknowledge them individually.


DEEPAK DOGRA

ABSTRACT

Since the liberalisation policy announcements of 1991 there has been an understandable spurt in foreign collaborations in matters related to technology. Such collaborations need to be modulated with reference to the process and impact of technology transfer. This study focuses on these issues with reference to experiences of entrepreneurial enterprises in the electronics and telecom sector. The prevalent tendency has been to associate entrepreneurship with small business start-up and management. In this study however, an entrepreneurial electronic and telecom enterprise is defined as that enterprise which proactively supports four criteria i.e. introduction of new goods, introduction of new methods of productions, opening up of new markets and as an industrial organization.

The data for study were derived from a sample of 80 entrepreneurial electronic and telecom enterprises. Information was gathered with two structured questionnaires, one pertaining to technology transfer and the other to see the impact of transferred technology on organisational structural variables. The study has been carried out with focus on the organisational set up. The study attempts to estimate and analyze trends for manufacture of electronic equipments and components in India under Restructuring policy phase (before 1980). Partial liberalized policy phase (1981 to 1990) and Liberalized policy phase (1991 to 1994). Similarly for telecom equipments and components Partial liberalized policy phase was from the period 1984 to 1990 and Liberalized policy phase from 1991 to 1994. In case of the telecom sector, the

duration identified for partial liberalized policy phase was 1984 onwards to 1990 and for liberalized policy phase 1991 to 1994.

Given the nature of data which were not customised for the analysis of the foreign collaborations in electronic and telecom sector alone, an attempt was made to look at general trend of collaboration during three phases i.e., Restructuring policy phase, Partial liberalized policy phase and Full liberalized policy phase. It was identified that procedure of permission for foreign technology agreements which were complicated before the year 1991 now stand simplified and involve only seven steps. With the help of questionnaires, responses were also gathered on 12 issues considered important by Indian electronic and telecom entrepreneurial enterprises while negotiating for overseas technology. In order to see the impact of this overseas technology on organizational variables, for variable like Control information system and Delegation of Authority, ratings were obtained from the senior executives on the use of 24 controls in their firms. These 24 variables were subjected to factor analysis which resulted into six factors. It was found that all the six factors explained total variations of 70 percent.

Because electronic and telecom entrepreneurial enterprises do not operate only one technology, Khandwalla's technology classification of extent of mass production was applied in order to operationalize those technologies. Accordingly five technologies were identified as Custom, Small batch, Large batch, Mass Production and Continuous process technologies. This resulted into operation technology as one of the variable. These factored variables were then regressed in order to determine their influence on the dependent variable i.e., Operation technology. Influence of

factored variables was also seen on organisation size. Because influence of factored variables on operation technology was explained only upto 13 percent, regression analysis was also carried out with addition of more variables like, Changes Undergone in Operation Technology, Formal Competency of Supervisors, Computer Automation Support, Formalisation, Extent of Automation in Operation Technology, Interdependent Specialization, Extent of Backward Integration, Extent of Forward Integration.

This study, based exclusively on data collected in the Indian environment, is an initial attempt in making an original contribution to growing international literature on issues of foreign collaboration and technology structure relationship. It is hoped will prove useful to management experts and policy decision makers.

CONTENTS

	<i>Page</i>
Chapter I	
INTRODUCTION	
1.1 Indian technology policy: A historical perspective	1
1.2 Foreign collaboration and technology transfer	4
1.3 Operation technology	10
1.4 Organization size	10
1.5 Organization structure	11
1.6 Aim of study	12
1.7 Objective of the study	14
Chapter II	
REVIEW OF LITERATURE	
2.1 Need of foreign collaboration in third world countries	19
2.2 Foreign collaboration and technology imports	20
2.3 Organization structure and technology	23
2.4 Organization structure and size	41
2.5 Technology and other related issues	45
2.6 Research in India	57
Chapter III	
METHODOLOGY OF STUDY AND TOOLS OF ANALYSIS	
3.1 Sampling procedure	60
3.2 Pilot study and pre-testing	63
3.3 Data collection	64
3.4 Scales applied in questionnaires	65
3.5 Tools of analysis	65
3.6 Weighted averages	67
3.7 Trend fitting	67
3.8 Factor analysis	68
3.9 Factor scores	68
3.10 Multiple regression analysis	68
3.11 Operational Definitions	70
3.11.1 Entrepreneurial Enterprise	70
3.11.2 Operations technology	70
3.11.3 Organization size	70
3.11.4 Control information system	70
3.11.5 Delegation of authority	71

Chapter IV

INDIAN ELECTRONIC AND TELECOM SECTOR - EVOLUTIONARY TREND ANALYSIS

4.1	Indian electronic sector	72
4.2	Growth trend for electronic equipments and components during partial liberalized policy phase	74
4.2.1	Growth trend for consumer electronics under partial liberalized policy phase	76
4.2.2	Growth trend for industrial electronics under partial liberalized policy phase	77
4.2.3	Growth trend for computers under partial liberalized policy phase	78
4.2.4	Growth trend for strategic electronics under partial liberalized policy phase	79
4.2.5	Growth trend for electronic components under partial liberalized policy phase	81
4.3	Growth trends for electronic equipments and components during full liberalized policy phase	82
4.3.1	Growth trend for consumer electronics under full liberalized policy phase	84
4.3.2	Growth trend for industrial electronics under full liberalized policy phase	85
4.3.3	Growth trend for computers under full liberalized policy phase	86
4.3.4	Growth trend for strategic electronics during full liberalized policy phase	87
4.3.5	Growth trend for electronic component during full liberalized policy phase	88
4.4	Indian telecom sector	91
4.4.1	Strowger technology	91
4.4.2	Crossbar case technology	92
4.4.3	The electronic switching technology	93
4.4.4	Telecom technology shift before liberalized policy phase	94
4.4.5	Growth trend for telecom electronics equipment during partial liberalized policy phase	96
4.4.6	Growth trend for telecom electronics equipments during liberalized policy phase	97

Chapter V

TECHNOLOGY COLLABORATION AGREEMENT - PROCESS AND FLOWS

5.1	Foreign collaboration trends	104
5.1.1	Trend for foreign collaboration approvals during restructuring policy phase	105
5.1.2	Trend for foreign collaboration approvals during partial liberalized policy phase	107
5.1.3	Trend for foreign collaboration approvals during liberalized policy phase	110
5.2	Approach of government for approvals after new industrial policy	114
5.2.1	Foreign collaboration process for electronic and telecom enterprises	114
5.3	Negotiating for technology	120
5.3.1	Inclusion of engineering and technical services	124
5.3.2	Patenting issues	125
5.3.3	Marketing rights	125
5.3.4	Spade work done before finalising agreement	125
5.3.5	Restraints imposed on licensee	126
5.3.6	Date for commencement of agreement	126
5.3.7	After lapse of agreement rights of licensee	126
5.3.8	Guarantees by licensor	126
5.3.9	Arbitration	127
5.3.10	Obligation on part of licensee for setting up of R&D or ISO 9000	127
5.3.11	Training by licensor	127
5.3.12	Start up services by licensor	127

Chapter VI

TECHNOLOGY TRANSFER AND ORGANISATION STRUCTURE - IMPACT AND IMPLICATIONS

6.1	Index of operation technology	132
6.2	Control and information systems (CIS)	136
6.3	Delegation of authority	138
6.4	Factor analysis model	139
6.4.1	Steps in factor analysis	141
6.4.2	Factor extraction	142
6.5	Factor scores	147
6.6	Correlation analysis	149
6.7	Effect of organizational variables on operation technology and organization size	152

6.8	Role of organizational variables in electronic and telecom organizations	157
6.8.1	Changes undergone in operation technology	157
6.8.2	Formal competency of supervisors	158
6.8.3	Computer automated support	159
6.8.4	Formalization	161
6.8.5	Extent of automation in operation technology	162
6.8.6	Interdependent specialization	163
6.8.7	Backward integration	164
6.8.8	Forward integration	165
6.8.9	Working as a team	167

Chapter VII

SUMMARY AND CONCLUSION

7.1	Objectives of study restated	169
7.2	Methodology	171
7.3	Duration of the Survey	172
7.4	Results of the Study	172
7.4.1	Electronics sector	172
7.4.2	Telecom sector	176
7.4.3	Foreign collaboration in electronic & Telecom sector	180
7.4.4	Index of operation technology	184
7.4.5	Organizational aspects	184
7.4.6	Regression analysis	188
7.5	Limitations of study	189
7.9	Suggestions for future research	190

REFERENCE	192
------------------	------------

APPENDIX A - QUESTIONNAIRE I	206
-------------------------------------	------------

APPENDIX B - QUESTIONNAIRE II	216
--------------------------------------	------------