Volume -1

Study

On

Developing Indicators for Measuring Success of Research Projects

Supported & Catalyzed by:

GOVERNMENT OF INDIA

Ministry of Science & Technology
Department of Science & Technology
National Science & Technology Management Information System (NSTMIS)

Conducted by:

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PREFACE

National Science and Technology Management Information System **(NSTMIS),** Department of Science & Technology, Ministry of Science & Technology, Government of India entrusted National Foundation of Indian Engineers **(NAFEN)** to undertake the following study:

Developing Indicators for Measuring Success of Research Projects

The present study intends to develop various indicators for measuring success of Research Projects.1:1 meeting were held with leading **40** experts in the country having specialized knowledge of Research & Development from different organizations from Public Sector, Private Sector, Government Officials, R&D Labs., and Academic Institutes. In addition, five Brain Storming Sessions (BSSs) were organized, three at Delhi and two at Bangalore wherein **164** experts from various disciplines and different organizations participated. All the BSSs were chaired by Dr. Laxman Prasad, Advisor & Head, NSTMIS.

As a result of study of various national and international secondary literature ,1:1 meetings with experts and five BSSs, number of indicators for measuring efforts put in by **P I** and **S&T output** of a research project have been developed.

A Local Project Advisory Committee **(LPAC)** was constituted under the chairmanship of Dr. Laxman Prasad, Advisor & Head, NSTMIS DST, GoI. The members of the LPAC were from Industry, Academics and R&D organizations. Two meetings of the LPAC were held to solicit their expert guidance and advice in conducting the study.

This study is divided into *four* Volumes:

Volume -1 This volume identifies indicators for measuring efforts put in by Project Investigator (PI) and quantative and qualitative S&T out put indicators along with the procedure for measuring them. This volume also includes various suggestions for the consideration of the Funding Agency. This volume is divided in to **four sections** viz.

Section –I: **About the Study,** which includes Introduction, Objective, Scope and Methodology.

Section -2: **Identification of Indicators, "For Measuring efforts put in by PI"** and **"S&T output of research project"**.

Section -3: **Measuring Efforts / Research S&T Output.** This section deals with measuring efforts put in by PI and Research S&T output in terms of quantitative & qualitative parameters. This section also includes monitoring and evaluation system details, which are annexed in **Volume -2** of the report.

Section -4: **Suggestions for consideration of the Funding Agency**, which are categorized in terms of Technical, Financial and General points.

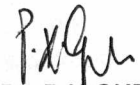
Volume -2 This volume includes various formats and other details for researchers like Hierarchy of Research Projects, Flow Diagram (Various Dimensions), Important Instructions for PI for filling the Research Project Proposal, Project Summary, Research Proposal, Researchers Qualifications and Experience, Academic Institute Profile / R&D Organization Profile, Mid Term Reviews by PI---Self Assessment and Final Review by PI (Self assessment) at the time of completion the project.

This volume also includes details for *Funding* Agency like Research Proposal Review by Experts of the Funding Agency, Mid Term review by Experts and Final project completion review by Experts.

Volume -3 This volume includes *overall response profile* emerging from various 1:1 meetings with the experts and Brain Storming Sessions (BSSs) organized during the course of the study and various Record Notes of the Discussions.

Volume -4 This volume includes originals of select National and International Research Schemes / Guidelines / Mechanisms studied while developing the indicators.

We sincerely hope that the results of this study will be useful to all the concerned funding agencies, policy planners, decision makers, academic institutions and above all to various researchers who wish to peruse R&D activities.



Dr. P K GUPTA
Project Investigator

New Delhi
20th March, 2005

ACKNOWLEDGEMENTS

At the outset, NAFEN would like to specially thank **Dr. Laxman Prasad**, Advisor & Head, NSTMIS, Department of Science & Technology (DST), for his guidance, motivation and spearing his valuable time for chairing all the Brain Storming Sessions held during the course of this study.

NAFEN is equally grateful to **Mr. Rakesh Chetal**, Advisor; **Mr. Parveen Arora**, Director and **Dr. A. N. Rai**, Principal Scientific Officer, Department of Science & Technology, Ministry of Science & Technology, Government of India. Without their coordination and guidance from time to time, it would not have been possible for NAFEN to complete this study.

NAFEN is also deeply obliged to all the members of the Local Project Advisory Committee (LPAC) and experts with whom 1:1 meetings were held and also to various other experts who participated in the Brain Storming Sessions, for giving their valuable suggestions for developing the indicators.

We are thankful to all our colleagues in NAFEN, who helped NAFEN in completing this study within the stipulated time.

Dr. P K GUPTA
Project Investigator

New Delhi
20th March, 2005

LOCAL PROJECT ADVISORY COMMITTEE

A Local Project Advisory Committee (LPAC) was constituted to advice and guide NAFEN from time to time during the execution of the study. The composition of the LPAC was as follows:-

Chairman

Dr. Laxman Prasad, Advisor & Head, **NSTMIS Division, DST**

Members

Mr. Rakesh Chetal, Advisor, **NSTMIS Division, DST**

Mr. Parveen Arora, Director, **NSTMIS Division, DST**

Dr. A. N. Rai, PSO, **NSTMIS Division, DST**

Dr. N. K. Sharma, Former CMD, **NRDC**

Dr. Jagdish Singh, Advisor, **DSIR**

Dr. Yogeshwar Rao, Scientist 'F', **CSIR**

Prof. A.K. Verma, Professor, **University of Delhi**

Prof. P. B. Sharma, Principal, **Delhi College of Engineering**

Dr. S.P. Agarwal, Professor, **IIFT**

Dr. A. P. Kulshreshtha, Director, **CSTNAM**

Prof. Vinayshil Gautam, Chairman Board Governors, **ISTE**

Dr. S.K. Gupta, Former Advisor, **DST**

Dr. U.C. Bahiri, Head, **Dabur Research Foundation**

Dr. K. Satyanarayana, DDG (Sr. Grade), **ICMR**

Dr. P.G. Mony, Director, **IFCAR**

Dr.Anil Chawla, Director (R&D), Panacea Biotech Ltd.

Dr. P.K. Gupta, PI & Secy. General, **NAFEN**

Mr. Rishi Kumar, Co-PI &Vice President, **NAFEN**

VOLUME -1

SECTION -1: ABOUT THE STUDY

- ✪ INTRODUCTION
- ✪ OBJECTIVE
- ✪ SCOPE
- ✪ METHODOLOGY

SECTION -2: IDENTIFICATION OF INDICATORS

SECTION -3: MEASURING EFFORTS/ RESEARCH OUTPUT

SECTION -4: SUGGESTIONS FOR CONSIDERATION OF THE FUNDING AGENCY

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Volume - 1

SECTION -1: ABOUT THE STUDY

1.0 INTRODUCTION

During the year 2001-2002, various scientific ministries of the Government of India fund more than **2300 projects** totaling to a value of **Indian Rs. 445 crores**. Funding proposals are received from various segments of scientific institutions like Universities, Deemed Universities, NGOs, Research Organizations from the private sector, public sector and various laboratories etc. Keeping in view the magnitude of funding in research projects, it is important to evaluate their success in quantifiable terms by identifying certain indicators. It is therefore necessary to know the factors, which influence the results. Both quantitative and qualitative indicators have to be evolved for measuring the research outcome. Process of moving downstream along the research continuum from the research component to the final destination of a useful outcome and its impacts & benefits particularly scientific and technological have to be evaluated.

The present study has attempted to reflect on the following issues:

- *To what extent committed goals / deliverables have been achieved?*
- *How to avoid infractuous expenditure and efforts?*
- *How do we measure the efforts put in by the PI?*
- *Whether the efforts put in by the PI were adequate and in the right direction?*
- *What useful findings have come out of the research work?*

2.0 OBJECTIVE

To develop suitable indicators for measuring success of research projects

3.0 SCOPE

Study covered following types of research:

- Applied Research
- Up scaling of Research

4.0 METHODOLOGY

Following methodology was adopted:

► *Desk Research*

Studied select national and international guidelines / schemes / mechanisms dealing with R&D Projects such as **(i) National** - Bhabha Atomic Research Centre *(BARC)* / Nuclear Power Corporation *(NPC)*, Indian Space Research Organization *(ISRO)*, Science Engineering Research Council *(SERC)*, Department of Science & Technology), National Agriculture Technology Project, ICAR *(NATP)*, **(ii) International** - Indo French Centre for Advanced Research *(IFCAR)*, Third World Academy of Sciences *(TWAS)*, International Foundation for Science *(IFS)* and World Bank *(WB)*.

► *Meetings*

Held 1:1 Meetings **(40 Nos.)** with leading experts in the country in various disciplines having specialized expertise in research and development activities from different organizations. Organizations covered were from Public sector, Private sector, Government Departments, R&D Labs., Academic Institutions etc.

► *Brain Storming Sessions (BSSs)*

Organized five *Brain Storming Sessions (BSSs)*, two at Bangalore and three at Delhi where experts from the following areas were invited to participate and give their considered views on the subject. **164 experts** participated in these BSSs comprised Government Officials, Project PIs and experts from disciplines like Management, Finance, Industry and Academia.

SECTION -2 : IDENTIFICATION OF INDICATORS

Continuous Monitoring & Evaluation is very important for the success of any research project. A close watch has to be kept at all stages to ensure that the committed objectives are achieved and that the research project is a success. With this objective in view, as a part of this study, we held 1:1 meetings with leading R&D experts in the country from different organizations and also organized five Brain Storming Sessions (BSSs). As a result of these meetings and also study of various secondary literature, the main thrust points, which emerged for the various stages of the research project life cycle are divided in the *two steps*:-

STEP -I

Meeting the committed objective is the sole criteria of success. There may be situations where the objectives are not met or partially met. To take care of such situations, at the start of the project itself, Funding Agency and PI should clearly identify various indicators for measuring efforts put in by PI. This would help to assess whether PI had put in adequate efforts and in the right direction.

- Identify various indicators for measuring efforts put in by PI

STEP –I I

It is also essential to identify various indicators for measuring quantitative & qualitative S&T output of research projects at the completion stage. This covers the entire process of moving from commencement of the research project to the final destination to ensure successful outcome.

- Identify various output indicators / impact factors / milestones for measuring Quantitative and Qualitative S&T output of R&D Projects

The indicators for measuring efforts put in by PI and S&T output should be integrated with the respective milestones / activities during various stages of the research project life cycle in terms of the commitments given by the PI in the research project proposal. While identifying various indicators, the nature and scope of the research project must be kept in mind.

I. INDICATORS FOR MEASURING EFFORTS PUT IN BY PI

- Display in Exhibitions
- Implementation of various suggestions given by the experts in their reviews.
- Meetings / Consultations held with Experts / Stakeholders – Nationally/ Internationally
- New initiatives to resolve the problem(s)
- Seminars / Workshops Organized
- Tests / Experiments Conducted
- Visits for Data Collection
- Any other indicator(s) Pl. specify .....

II. SCIENTIFIC & TECHNICAL (S&T) OUTPUT INDICATORS

S&T Output indicators have been categorized as:

- Quantitative S&T Indicators
- Qualitative S&T Indicators

QUANTITATIVE S&T INDICATORS

a. Research Publications

- Citations
- International Refereed Journals
- National Refereed Journals
- Papers Presented in Conferences / Seminars
- Technical Reports

b. Technology

- Demonstrated/ Awareness Created
- New Materials
- Processes
- Products
- Prototypes
- Scale of Development
- Transferred

c. Other Indicators

- ☞ Awards – National / International
- ☞ Capacity Building (Facilities)
- ☞ Commercial & Marketing Potential
- ☞ Cost Cutting / Savings achieved
- ☞ Experts Trained at International Level
- ☞ Experts Trained at National Level
- ☞ Any other Infrastructure Development which has relevance to R&D (Established / Upgraded)
- ☞ Import Substitution
- ☞ Industrial Queries Generated
- ☞ Industrial Tie-ups
- ☞ New e-applications
- ☞ New Teaching Methods Developed
- ☞ Patents—National / International ----Applied / Granted
- ☞ Ph.D. Awarded
- ☞ Any other indicator(s) Pl. specify .....

QUALITATIVE S&T INDICATORS

- Experience Gained useful for further R&D
- Linkages with National Priorities
- Socio-Economic & Societal Benefits
- Any other indicator(s) Pl. specify .....

SECTION -3 : MEASURING EFFORTS / RESEARCH OUTPUT

Based on various discussions held with 40 leading technology, management & finance experts (1:1 meetings) and suggestions given by 164 participants in five Brain Storming Sessions (BSSs) and also study of select national & international secondary literatures, detailed procedure for measurement of efforts put in by PI and research S&T out put is given below. Experts in 1:1 meetings and BSSs comprised of Govt. Officials, Project PIs and disciplines like Management, Finance, Industry and Academia.

I. Measuring Efforts put in by PI

Stage(s) of Review: Mid Term / Completion *(Tick ✓ appropriate)*

Period under Review ---------- *to* ----------

Note: *- Funding Agency Experts and PI should first jointly identify the following details in the beginning of the project keeping in view the nature and type of the research project under review:-*

- *Stages of review like Quarterly / Mid Term / Annual / Completion etc.*
- *Applicable Impact factors / Indicators / Milestones / Activities.*
- *Weightage and Priority to be allocated to each selected indicator / impact factor / milestone / activity.*
- *Type (Fixed or Sliding) and Range of Scale to be used for giving score to each indicator / impact factor / milestone / activity.*

S.No. (1)	Impact Factors Tick ✓ applicable impact factors / indicators for the project under review (2)	Weightage / Priority (3)	Score given by Funding Agency Expert (4)
1.	Display in Exhibitions		
2.	Implemented various suggestions given by the experts in their reviews.		
3.	Meetings / Consultations held with experts/ stakeholders -- Nationally / Internationally		
4.	New initiatives to resolve the problem(s)		
5.	Seminars / Workshop organized		
6.	Tests / Experiments Conducted		
7.	Visits for Data Collection		
8.	Any Other Indicator (s) (Pl. Specify) _____		

(a) Total Score .....

(b) Score Obtained by P I .....

(c) % Score obtained *{b/a}* .....

II. Measuring Scientific & Technical (S&T) Output

Stage of Review: *At the Completion of the Project*

Note:- *Funding Agency Experts and PI should first jointly identify the following details in the beginning of the project keeping in view the nature and type of the research project under review:-*

- *Applicable Impact factors / Indicators / Milestones / Activities.*
- *Weightage and Priority to be allocated to each selected indicator / impact factor/ milestone /activity.*
- *Type (Fixed or Sliding) and Range of Scale to be used for giving score to each indicator / impact factor / milestone / activity.*

S.No (1)	Impact Factors (Research Output leading to:--------) Tick (✓) the applicable impact factor(s) for the project under review (2)	*Weightage / Priority* (3)	Score given by Funding Agency Expert (4)
	I. QUANTITATIVE S&T INDICATORS		
A.	**RESEARCH PUBLICATIONS**		
	1 Citations		
	2 International Refereed Journals		
	3 National Refereed Journals		
	4 Papers presented in Conferences/ Seminars		
	5 Technical Reports		
B.	**TECHNOLOGY**		
	6 Demonstrated/ Awareness Created		
	7 New Materials		
	8 Products		
	9 Processes		
	10 Prototypes		
	11 Scale of Development		
	12 Transferred		
C.	**OTHER INDICTORS**		
	❋ **Patents**		
	a. Applied		
	13 National		
	14 International		

	b. Granted		
	15 National		
	16 International		
	❋ **Awards**		
	17 National		
	18 International		
	19 Commercial & Marketing Potential		
	20 Cost Cutting/ Savings achieved		
	21 Experts Trained at National Level		
	22 Experts Trained at International Level		
	23 Import Substitution		
	24 Industrial Queries Generated		
	25 Industrial Tie-ups		
	26 Any other Infrastructure Development which has relevance to R&D (Established/ Upgraded)		
	27 New e-applications		
	28 New Teaching Methods Developed		
	29 Ph.D. Awarded		
	30 Any Other Indicator(s) (Pl. Specify) ----------		
	II. QUALITATIVE S&T INDICATORS		
	31 Experience Gained useful for further R&D		
	32 Linkages with National Priorities		
	33 Socio-Economic & Societal Benefits		
	34 Any Other Indicator(s) (Pl. Specify) ----------		

(a) Total Score .....

(b) Score Obtained by P I .....

(c) % Score obtained *{b/c}* .....

In case, review is undertaken by more than one expert, then the *average* of %age score given by each expert can be taken as the final score both for efforts put in by P I and or S&T output and judged as follows: -

Score (%)	Rating
0-40	**Unsatisfactory**
41-50	**Fair**
51-70	**Good**
71-80	**Very Good**
81-100	**Excellent**

If at the time of any review, the score is **<41%,** the project needs critical examination by the funding agency for continuation of the support. The %age range for **"each rating"** can be modified by the funding agency, if desired.

III. Monitoring & Evaluation System

The above findings have to be implemented by the funding agency. These will supplement the normal monitoring, evaluation and review systems already followed by various funding agencies from time to time. In order to effectively measure the efforts put in by PI and research S&T output, in line with the inputs received during the course of this study (1:1 meetings with experts & BSSs), *various formats for monitoring, evaluation and reviews have also been designed and developed, which are annexed in* ***Volume -2*** *of the report.*

SECTION -4 : SUGGESTIONS FOR CONSIDERATION OF FUNDING AGENCY

During 1:1 meetings with the experts and various Brain Storming Sessions (BSSs), participants also mentioned many other important points for the consideration and implementation by the funding agency. These points are summarized below in three categories viz., Technical, Financial & General :-

A. TECHNICAL

- Final results of each project must be put on the *web site* of the Funding Agency.
- Two stage offer system i.e. First 2-3 pages concept note by PI for peer review and if acceptable then detailed proposal by PI.
- Funding agency to give funds for preparing the offer and for detailed literature review in case two-stage offer submission is accepted.
- Right from the proposal submission, proposal review, monitoring and final completion / evaluation report to be made *electronic on line* i.e. funding agency should develop suitable *e-tracking systems.*
- Identified end user in the proposal by the PI should be a member of the review/ monitoring committee.
- In case P I have to undertake national / international patent search, the cost of the same should be given by the Funding Agency to the PI or PI should be permitted to include the same in the project estimates.
- A representative of the finance department of the funding agency should be nominated on the expert monitoring and review committees.

B. FINANCIAL

- Funding Agency must give all approvals and release all payments in time.
- In case funds are not released in time at any stage by the funding agency, cost escalation may be allowed provided PI has submitted all the documents like Progress Report, SE, and U/C in time.

- Overheads in the budget can be allowed to cover the following expenses:-
    - (i) Sundry payments to casual workers / supporting staff.
    - (ii) Other petty unforeseen expenses.
- Expenses of the visit of Experts / Referees to be built in as Administrative Over Heads.
- There should be also a provision for giving suitable honorarium {*say Rs. 2000/- per day*} to the experts / referees/ peers for utilizing their services for evaluation, review and monitoring, in addition to the traveling, boarding and lodging costs.
- Funds should not be reduced arbitrarily at any stage.
- With in the approved Budget, PI must be given freedom to operate. He can be deemed to be *self-controlling* by the funding agency as well as by the institute head.
- In case due to any reasons, PI is not able to buy the equipment/ hire man power in the first year, then PI should be allowed to utilize the funds in the 2nd year, but for the purpose for which it was approved.

C. GENERAL

- At the time of evaluating a new proposal, performance report of the PI for the previously executed projects should be kept in mind by the Funding Agency experts.
- Peers / Experts' comments and results at all stages must be communicated to the PI.
- Close the project if it is not progressing satisfactorily. Debar the PI / Co-PI / Institute for -----years for applying for funding.
- Proposals must be processed in a time bound schedule, may be every quarter.
- Project should not be extended for more than six months that too without any cost impact.
- *The results of the above study i.e. developing indicators for measuring success of research projects should be reviewed after a period of two years from implementation on the basis of feed back received from the experts and funding agency.*