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Report of the Comptroller and Auditor General of India on Network Projects of Council of Scientific and Industrial Research for Tenth Five Year Plan

Union Government
Department of Scientific and Industrial Research
Report No. 29 of 2013
(Performance Audit)

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Contents

PREFACE

This Report of the Comptroller and Auditor General of India has been prepared for submission to the President under Article 151 of the Constitution for being laid before the Parliament.

The report, covering the period upto March 2012, contains significant results arising from performance audit of Network Projects of Council of Scientific and Industrial Research for Tenth Five Year Plan (2002-07).

The observations in this Report are those which were noticed by Audit during 2011-12. For completeness, the observations relating to earlier years, not covered in previous Reports have also been included, wherever pertinent. Similarly, results of audit subsequent to March 2012 have also been mentioned, wherever relevant.

Audit has been conducted in conformity with the Auditing Standards issued by the Comptroller and Auditor General of India.

Executive Summary

Why did we decide to examine this issue?

Government formulated the Tenth Five Year Plan with high expectations from Science and Technology sector in contributing to growth rate of the economy. As Council of Scientific and Industrial Research (CSIR) had developed knowledge networks across its constituent laboratories, the Planning Commission suggested that Research and Development (R&D) efforts of CSIR should be consolidated and inter-institutional R&D projects should be taken up. Consequently, in Tenth Five Year Plan, CSIR adopted a new approach in selection and implementation of in-house R&D projects in its constituent laboratories by introducing network projects.

Network project was defined as a project, where more than one CSIR laboratory collectively source inputs and implement the identified objectives together. Emphasis was laid on networking of resources and capabilities of CSIR. According to the guidelines for network projects, the projects aimed at 'generation of knowledge, usable knowledge and useful knowledge as products. Therefore, those projects which target usable and useful knowledge as products are exacted to afford commercialisable results'.

During Tenth Five Year Plan, CSIR took up 54 network projects/programmes at estimated cost of ₹1860 crore. The emphasis of Planning Commission on consolidation of R&D efforts of CSIR laboratories and new methodology adopted by CSIR for implementing R&D projects in networking mode, together with significant financial outlay involved, prompted us to undertake performance audit of network projects.

What were our audit objectives?

Audit was conducted with a view to examine:

- whether these projects were planned and executed efficiently and effectively in accordance with the guidelines laid down for network projects;
- whether monitoring and evaluation mechanism of network projects was effective; and
- whether expected benefits from projects in terms of generation of external cash flow, publishing of research papers and filing of patents were achieved.

What did Performance Audit reveal?

Audit selected 27 network projects for detailed examination. Performance Audit revealed that:

Planning, execution and monitoring of network projects

CSIR formulated the guidelines for network projects only in September 2004, more than two years after commencement of Tenth Five Year Plan. By then, 26 out of 27 selected projects had already been sanctioned.

There were delays in sanctioning projects, due to which actual commencement of the projects was delayed by periods ranging from 12 to 34 months from the scheduled date of commencement i.e. April 2002.

Project proposals of 10 projects did not include any details of targeted outputs and measurable deliverables viz. financial, economical, technological and societal benefits over the five year period, as was required under the guidelines. Absence of deliverable parameters made defining the success of network projects more abstract rather than concrete.

In five projects, laboratories failed to identify and involve industry at any stage during implementation of projects, even though it was stated in the guidelines that it was necessary to involve industry at some convenient stage of the project.

38 items of equipment (each costing more than ₹10 lakh) costing ₹48.73 crore from 15 projects, were received/installed/commissioned either after completion of project or at the fag end of project duration. This resulted in non-utilisation of equipment for the intended purpose.

There was shortfall in meetings of Task Force (TF) and Monitoring Committee (MC) against prescribed frequency, in 15 and 19 projects respectively, ranging between one to 90 *per cent*. Recommendations made by MC during its review of projects were not followed in two projects.

Although network projects was a new initiative and was viewed as providing a new learning experience to CSIR, it neither carried out impact assessment of network projects on its own nor did it engage an external agency for the same.

(Paragraphs 2.1 to 2.7)

Outcome of network projects	A total of 399 technologies were developed from 27 network projects, of which 51 technologies were transferred to end users, 38 technologies were commercialised and revenue of ₹3.83 crore was realised as of July 2012. The research carried out with a total expenditure of ₹621.80 crore resulted in commercialisation of only 10 *per cent* of the technologies developed and revenue generation of less than one *per cent* of the total expenditure on network projects. 264 patents were filed out of which 103 patents were granted. Out of 264 patents, only 41 patents constituting 16 *per cent* were filed jointly in networked mode. A total of 2,008 research papers were published. There were no joint publications in 17 out of 27 network projects. 677 papers (34 *per cent*) out of 2,008 had a journal impact factor of zero. 1,298 papers (65 *per cent*) had journal impact factor below 2 and 1,902 (95 *per cent*) papers had journal impact factor below 5. Total external cash flow (ECF) from 27 network projects was ₹79.74 crore. There was no ECF from nine network projects. Total expenditure incurred on these projects was ₹199.16 crore. ***(Paragraphs 3.1 to 3.4)***
Audit findings from specific projects	Animal models developed by CDRI under a project executed at a cost of ₹30.56 crore could not be submitted to international agencies as the tests were carried out in facilities of CDRI that did not have GLP[1] accreditation, which was a necessary pre-condition. Equipment procured at cost of ₹14.05 crore under a project taken up by CRRI remained unutilised, due to delay in procurement and injudicious procurement. Five single molecules developed by CSIR Headquarters under a project executed at a cost of ₹32.77 crore could not be taken to IND[2] stage, as CSIR could not establish facilities for testing the single molecules. ***(Paragraphs 4.1 to 4.3)***

[1] Good Laboratory Practices
[2] Investigational New Drug

What do we recommend?

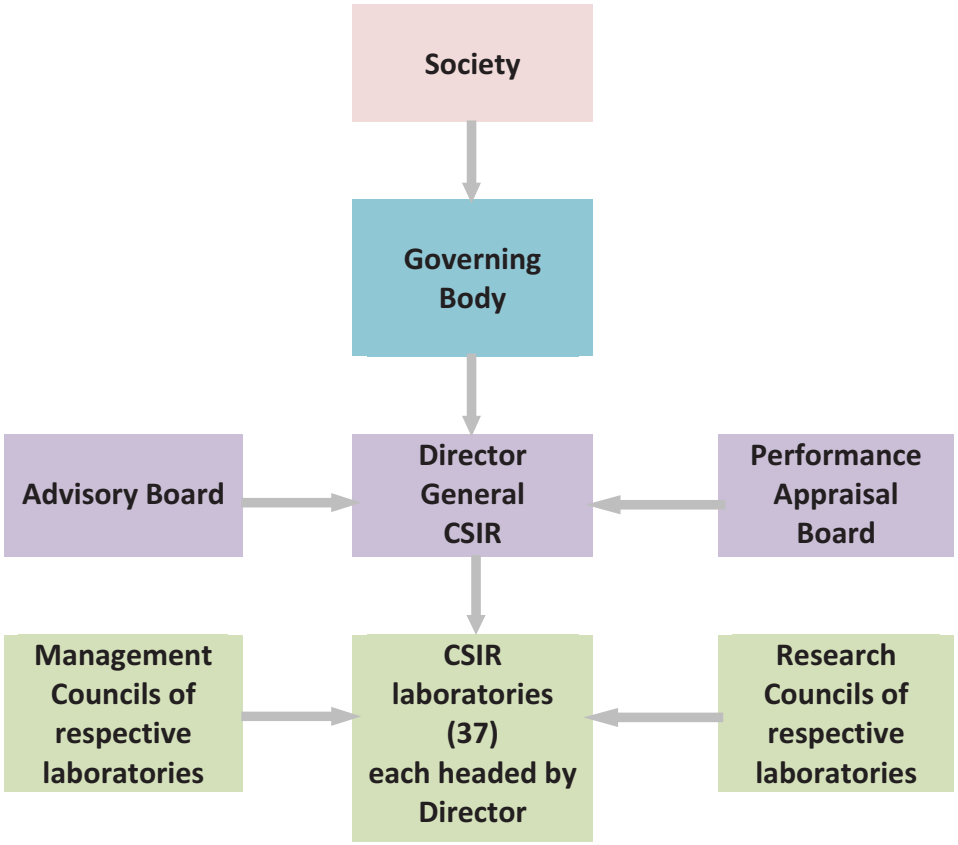
- CSIR may ensure timeliness in sanctioning plan projects having a definite time frame of implementation.
- CSIR may ensure that in future, comprehensive project proposals containing defined and measurable deliverables expected to be achieved from the project are prepared.
- The objective of CSIR being scientific and industrial research, adequate and minimum interaction with appropriate industry leading to commercialisation of its research should be formalised and monitored, for its projects.
- CSIR may ensure timely procurement of equipment and their installation so that equipment are utilised in projects under which they were procured.
- CSIR may ensure that meetings of various monitoring committees are held as per prescribed frequency.
- In future, formal impact assessment of important projects may be done by involving outside experts along with CSIR's own experts.
- CSIR may ensure that targets are set in a judicious manner after assessing the available resources and associated risks of research, so as to present a realistic picture.
- CSIR may ensure that resources required for a particular project are planned in advance and optimally utilised so as to avoid adverse impact on outcome of project.

Chapter 1 - **Introduction**

Council of Scientific and Industrial Research (CSIR) was established in 1942 as an autonomous body registered under Societies Act, 1860 for scientific and industrial research and development (R&D). It is under administrative control of Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology, Government of India.

1.1 Organisation structure of CSIR

The Society of CSIR comprises of 28 members and is headed by the Prime Minister of India, with the Minister, Science and Technology as its Vice President and Director General (DG), CSIR as the ex-officio Secretary. Functions of the Society include reviewing progress and performance of CSIR, giving policy directions and approving the annual report and yearly accounts of CSIR. The affairs of CSIR are administered, directed and controlled by a Governing Body (GB), which is headed by DG, CSIR. The DG, CSIR is also the Secretary, DSIR. The structure of CSIR is as under:



GB is assisted by Advisory Board and Performance Appraisal Board. Advisory Board provides science and technology inputs, reviews major R&D areas of CSIR and suggests new R&D, Networked/Mission oriented programmes. Performance Appraisal Board reviews the performance of CSIR laboratories and suggests remedial measures for improving their performance.

There are 37 laboratories/Institutes under CSIR, each headed by a Director, who in turn is assisted by Research Council and Management Council.

1.2 Network Projects

Government formulated the Tenth Five Year Plan[1] with high expectations from Science and Technology sector in contributing to the growth of the economy. The responsibility of CSIR, as one of the largest research organisations in industrial sector, in helping the industry to achieve higher growth rates and become competitive globally was duly recognised. As CSIR had developed knowledge networks across its constituent laboratories, the Planning Commission suggested that R&D efforts of CSIR should be consolidated and inter-institutional R&D projects should be taken up. Consequently, in Tenth Five Year Plan, CSIR adopted a new approach in selection and implementation of in-house research and development projects in its constituent laboratories by introducing network projects.

[1] Period from 2002 to 2007

Network project was defined as a project, where more than one CSIR laboratory collectively source inputs and implement the identified objectives together. The salient features of such a project were:

- Emphasis on networking of resources and capabilities of CSIR.
- Both competence and resources were pooled and tasks were undertaken by participating laboratories.
- Each network project was coordinated by one lead laboratory designated as the Nodal laboratory.
- Selected network R&D projects were multi-disciplinary in nature.
- The projects targeted substantial increases in value through inputs of science and technology in knowledge driven areas.
- The output of network projects was expected to generate new areas of business.

Planning Commission recommended a budgetary support of ₹2,430 crore for implementation of network projects, against which CSIR took up 54 network projects/programmes during Tenth Five Year Plan at estimated cost of ₹1,860 crore.

The list of 54 network projects along with nodal and participating laboratories is given at **Appendix I**.

1.3 Scope of Audit

The emphasis of Planning Commission on consolidation of R&D efforts of CSIR laboratories and new methodology adopted by CSIR for implementing R&D projects in networking mode, together with significant financial outlay involved, prompted us to undertake performance audit of network projects.

Performance Audit of network projects was conducted under Section 20(1) of Comptroller and Auditor-General's (Duties, Powers and Conditions of Service) Act, 1971. Of total 54 projects, three infrastructure development[2] projects with cost of ₹700 crore and four basic research[3] projects with cost of ₹105 crore were excluded from the scope of audit. Of the remaining 47 projects, 27 projects, all relating to applied research, with total expenditure of ₹622 crore were selected for audit. Projects were selected based on their estimated cost, also giving preference to projects executed by different nodal laboratories. Activities of

[2] These projects related to setting up world class facility in drug research, development and manufacture of small civilian aircraft and acquisition of oceanographic research vessel.

[3] The projects related to comprehensive traditional knowledge digital documentation and library, mathematical modelling and computer simulation, National Science Digital Library and consortium access to Electronic Journals

projects which could not be completed during Tenth Five Year Plan and were extended in the Eleventh Five Year Plan were also examined. Projects selected for audit are also given in **Appendix I**.

1.4 Audit objectives

Audit was conducted with a view to examine:

- whether these projects were planned and executed efficiently and effectively in accordance with the guidelines laid down for network projects;
- whether monitoring and evaluation mechanism of network projects was effective; and
- whether expected benefits from projects in terms of generation of external cash flow[4], publishing of research papers and filing of patents were achieved.

1.5 Audit criteria

The criteria used to assess performance of network projects of CSIR were drawn from the following sources:

- Guidelines for Financial, Administrative, Scientific, Monitoring and MIS of Networked Projects (September 2004), referred to as the Guidelines hereafter;
- Targets, wherever set by CSIR for deliverables such as number of technologies developed, intellectual property generated, research papers published and amount of external cash flows generated, etc.;
- Minutes of meetings of various monitoring committees;
- Rules and regulations of CSIR e.g. Guidelines for Technology Transfer and Utilisation of Knowledgebase-2005; and
- Government of India rules and regulations.

1.6 Audit methodology

The Entry conference with CSIR was held on 21 November 2011. Audit was conducted between October 2011 and March 2012 during which records and documents at Nodal laboratories as well as participating laboratories were examined. Preliminary audit findings were issued to CSIR for their comments in April 2012. The audit conclusions after taking into

[4] External cash flow is the total amount from various external sources like royalties, licensing, awards, contract R&D, consultancies, etc.

consideration replies of CSIR were discussed with the audited entity in an exit conference held on 19 October 2012. This report has been prepared after including results of discussions held in the exit conference. The revised report was issued to DSIR/CSIR on 30 October 2013 for their comments. Replies of CSIR on revised report were awaited (30 November 2013).

1.7 Structure of Audit Report

The findings, observations and recommendations of audit on selected network projects of CSIR are given in succeeding chapters, arrangement of which is as follows:

Chapter 2 contains an overview of audit findings in planning, execution and monitoring of network projects by nodal laboratories and participating laboratories.

Chapter 3 contains observations of audit on outcome of network projects, in terms of generation and commercialisation of technologies, generation of patents, publication of research papers, generation of external cash flow and capacity building.

Chapter 4 contains audit findings from specific projects, such as delays in establishment of infrastructure required for the projects, injudicious procurements, inadequate planning, incomplete activities, etc.

Chapter 5 contains conclusion of the report.

1.8 Acknowledgement

We acknowledge the cooperation extended by CSIR Headquarters and various laboratories during conduct of the performance audit.

Chapter 2 – Planning, execution and monitoring of network projects

As discussed in Chapter 1, Network projects were projects in which more than one laboratory collectively sourced inputs in implementing the identified objectives. The projects were to be executed during Tenth Plan period. Network projects were envisaged as target oriented projects and their output was expected to generate new areas of business.

For selection and implementation of network projects, CSIR formulated 'Guidelines for Financial, Administrative, Scientific, Monitoring and MIS of Networked Projects' (Guidelines) in September 2004 for guiding its constituent laboratories for successful execution of the projects. The Guidelines contained detailed mechanisms for identification and project formulation, preparation of project proposal, implementation of the project, financial arrangements, monitoring and MIS.

The details of 27 selected projects including names of the nodal and participating laboratories, date of sanction, date of completion, number of activities taken up under the project and completed, sanctioned cost and expenditure of projects, outputs from projects, etc. is given in **Appendix II**. This chapter presents an overview of deficiencies observed by audit in selection, implementation and monitoring of 27 selected projects.

2.1 Delay in preparation of Network Project Guidelines

Audit observed that CSIR formulated the Guidelines for network projects only in September 2004, after more than two years of commencement of Tenth plan. By then, 26 of the 27 selected projects had already been sanctioned. Thus, applicability of Guidelines of CSIR regarding identification of the project and process of preparation of detailed project proposals were rendered redundant in most of the projects.

CSIR did not offer comments on the observation (November 2013).

2.2 Delays in sanctioning and completion of projects

According to Para 2.1 of the Guidelines, laboratories were required to identify R&D areas for network projects and submit detailed project proposals to CSIR at the beginning of the Five Year Plan. Para 2.4.1 of the Guidelines stipulated that the date on which financial sanction was issued was deemed to be the date of start of each project. Para 2.4.1.2 (iv) further

stated that since network projects were a planned activity, laboratories had agreed to complete the same during Tenth Five Year Plan period.

Audit observed delays in sanctioning projects, which affected the schedule of activities of network projects and their completion within the plan period. Actual commencement of these projects was delayed by periods ranging from 12 to 34 months from the scheduled date of commencement i.e. April 2002, as given in Table 1:

Table 1: Delays in sanctioning of Network Projects

Delay in years	Number of projects
Upto one year	1
More than one year and upto two years	24
More than two years	2

The detailed list of these projects is given in **Appendix III**. The delays in sanctioning of projects also led to consequential delay in their completion. Examination revealed that of 27 projects, 14 were completed in time and 13 were completed after delays ranging from six to 48 months. The details are given in **Appendix IV**.

CSIR did not comment on the observation (November 2013).

Recommendation 1:

CSIR may ensure timeliness in sanctioning plan projects having a definite time frame of implementation.

2.3 Deficiencies in identification and project formulation

Para 2.1 of the Guidelines stipulated that laboratories of CSIR would identify, through internal exercise, discussions, meetings with peers and users, R&D areas of importance and project proposals would be prepared on the basis of the key areas identified through these discussions. The project proposals were to be complete with specific details and time schedules of activities and projects, user involvement (if any), target outputs, milestones, etc. Para 2.1.1 further stated that project proposals should detail the activities by including deliverables over the five year period in terms of financial, economical, technological, societal benefits, etc.

Prior to issue (September 2004) of the Guidelines for network projects, Ministry of Finance (MoF) had also introduced (May 2003) guidelines for formulation, appraisal and approval of

Government funded plan schemes/projects. The MoF guidelines stated that terms of reference of project proposals should indicate development objectives in order of importance and deliverables/ outputs for each development objective should be spelt out clearly. Success criteria for each deliverable/output of the project should be specified in measurable terms to assess achievements against the goals.

Audit observed deficiencies in identification of project objectives and project formulation, which are discussed below:

2.3.1 Project deliverables not identified in project proposals

As stated above, project proposals were required to include targeted outputs and deliverables over the five year period. Audit observed that project deliverables for all parameters viz. financial, economical, technological and societal benefits were quantified in only one out of 27 projects examined by audit. Project proposals of 10 projects did not contain deliverables for any of the above measurable parameters and 16 project proposals contained only some of the project deliverables.

The number of projects in which measurable deliverables were not found in their project proposals is given in Table 2. The detailed position is given in **Appendix V**.

Table 2: Project deliverables not defined in project proposals

Measurable deliverable	No. of projects in which deliverable was not defined out of 27 projects	Percentage of projects in which deliverable was not defined
Number of technologies	20	74
Number of patents	14	52
Number of publications	18	67
Generation of revenue from sale of technology	26	96
Generation of External Cash Flow (ECF)	18	67
Generation of import substitution	24	89
Generation of societal benefits	24	89
Generation of employment	24	89

Absence of deliverable parameters indicates that projects were taken up without definite targets, thereby leaving no criteria for measurement of achievements against any of the above parameters. This made defining the success of network projects more abstract rather than concrete.

CSIR did not offer comments on the observation (November 2013).

Recommendation 2:

CSIR may ensure that in future, comprehensive project proposals containing defined and measurable deliverables expected to be achieved from the project are prepared.

2.3.2 Deficiency in project formulation

In two projects, audit noticed that unrealistic project objectives and targets were set, which resulted in incomplete activities under the projects. In another project, it was seen that though participating laboratories were asked to rectify deficiencies in project proposals submitted by them, revised proposals were not received and the project was nevertheless sanctioned. The cases are detailed below:

Projects having deficiencies in project formulation

Exploration and exploitation of microbial wealth of India for novel compounds and biotransformation process- IMTECH

IMTECH took up (January 2004) above project at sanctioned cost of ₹20.47 crore with a view to collect and isolate micro-organisms from various parts of the country and exploit them as a major source of biotechnological products and processes. It was seen that work on exploitation of microbial cultures was not completed because focus was restricted during the project tenure towards only exploration of microbial diversity.

CSIR stated (July 2012) that it was realised that it was not possible to explore and exploit the microbial diversity simultaneously. CSIR also stated that the targets set in the project were part of CSIR's ambitious delivery strategy and were of an indicative range.

Development of medicinal plant chemotypes[5] for enhanced marker and value added compounds-CIMAP

The project envisaged development of 20 chemovars from 10 identified medicinal plants which were to be released to farmers for commercial cultivation. The project was completed (March 2007) after incurring an expenditure of ₹21.66 crore. Audit observed that as against target of at least 20 chemovars only five were developed, reportedly due to over ambitious targets.

CSIR stated (July 2012) that it always put ambitious targets and that not all scientific endeavours provided anticipated results.

[5] A chemotype or chemovar is a chemically distinct entity in a plant or microorganism.

Design analysis and health assessment of special structures including bridges- SERC

SERC took up (March 2004) above project at a sanctioned cost of ₹16.70 crore to be implemented with six[6] other CSIR laboratories. Based on a review of operation of network project by CSIR, SERC impressed upon (January 2004) all participating laboratories to furnish inputs clearly defining scope of work of participating laboratory, correlation of inputs with specific outputs and deliverables and commitment on measurable performance in terms of papers, patents and technology transfer, etc. Audit observed that revised project proposals were received from only three laboratories namely AMPRI, CMERI and CECRI. Audit further observed that AMPRI made no commitment in respect of transfer of technology in its project proposal and CMERI did not indicate any target on development of technology or generation of patents. In spite of non-receipt of revised project proposals from three out of six participating laboratories, consolidated project proposal was finalised and sanction obtained.

CSIR stated (July 2012) that output of the project was commendable as was evident from publications, developing knowledgebase, developing a few advanced courses, imparting trainings for capacity building of engineers, evolving patents and producing PhD thesis and M. Tech dissertations. The reply of CSIR may be viewed in the context that output of the project could not be measured in quantifiable terms in absence of targets. Further, of 24 technologies developed, none was transferred, no patents were granted and all the papers published had zero impact factor[7].

2.4 Deficiencies in involving industry with projects

Para 6.1 of the Guidelines stated that 'network projects of CSIR aim at the generation of knowledge, usable knowledge and useful knowledge as products. Therefore, those projects which target usable and useful knowledge as products are exacted to afford commercialisable results. In these projects, it was necessary to involve industry at some convenient stage'. The para further stipulated that when emergence of a process or product with potentials for commercialisation was recognised, an interested industry was to be invited to meeting of the monitoring committee, a suitable presentation made to the potential client and a business led model adopted for further work under the project.

A total of 399 technologies were developed from 27 network projects, of which 51 technologies were transferred and 38 technologies were commercialised. The sale of technologies generated revenue of ₹3.83 crore. As such, very limited knowledge generated by CSIR in the form of technologies were utilised for societal benefits. While examining the projects, audit found that in case of five projects, laboratories failed to identify and involve industry at any stage during implementation of projects, due to which the final product/process developed failed to find commercial use in the industry, as discussed below:

[6] CBRI, CMERI, CRRI, NML, AMPRI and CECRI

[7] An indication of quality of a research paper is impact factor of the journal in which the paper is published.

Failure to involve industry with projects during implementation

Developing capabilities in advanced manufacturing technology- CMERI

CMERI took up (January 2004) above project at a sanctioned cost of ₹17.85 crore. The project envisaged development of indigenous manufacturing technologies with a view to reduce dependence on imported technologies, promote self reliance in manufacturing of speciality components for strategic sectors, import substitution, improve product quality, etc. The project proposal stated that certain industries were consulted for their involvement in the project. However, there was no further involvement of industry with the project. Out of six technologies developed from the project, only one was transferred and one commercialised.

CSIR stated (July 2012) that Indian industries needed some more time to reach maturity to provide the essential inputs both from design side as well as from process technology side for product development. Therefore transfer of technology to the industry did not take place.

Developing capabilities & facilities for Micro-electromechanical systems (MEMS) and sensors-CEERI

CEERI undertook above project (January 2004) at a sanctioned cost of ₹31.71 crore. The project was completed (March 2007) after incurring total expenditure of ₹31.89 crore.

The project proposal envisaged that the technologies and products developed under this programme would be transferred to the industry for production. It was however seen that industry was not involved at any stage of the project. Monitoring Committee (MC) had also recommended (February 2005) that potential customers may be identified and invited to the next MC meeting to be informed of development under the project. MC further recommended (April 2007) that market survey of the polymer gas sensor should be done to ascertain the status of use of the sensors. Audit however observed that neither any potential client was invited to meetings of the MC nor was any formal market survey conducted by CEERI. Out of 16 technologies developed under the project, only two were commercialised.

CSIR stated (July 2012) that there were no real MEMS labs in the country. Also the Indian market was not taking risk and relied on imported technologies rather than investing in R&D. CSIR further added that in MC meetings, interim results were discussed which were sometimes confidential in nature and it was not appropriate to expose those to the industry.

The reply of CSIR is contrary to the Guidelines of network project which provide for interested industries to be invited to MC meetings.

Positioning Indian nutraceuticals[8] and neutrigenomics[9] on a global platform-CFTRI

CFTRI took up (August 2003) the above project at a sanctioned cost (revised) of ₹14.74 crore. The project was expected to result in development of globally competitive and cost effective technologies for the production of diverse groups of nutraceuticals from foods. One of the activities of the project was to develop effective active ingredients from oils and fats having nutraceutical and nutrigenomic properties. It was stated in the project proposal that efforts would be made to network with agencies like Technology Mission for Oils and Pulses (TMOP) and industry

[8] Neutraceuticals are food products which have health and medical benefits e.g. ayurvedic medicines such as 'Çhyavanprash'.

[9] Neutrigenomics is a study focusing on the health benefits from a variety of plant resources and their ingredients.

for commercialisation of the process after generating initial results. Audit observed that neither TMOP nor industry was involved during implementation of the project. Although four processes were developed from this activity, only one process was stated to be commercialisable.

CFTRI accepted (January 2012) that no efforts were made for ensuring participation of agencies like TMOP and industry at the beginning of the project and that commercialisation was initiated only after getting the outcome of the project.

Environment friendly leather processing technology-CLRI

The project was sanctioned (January 2004) by CSIR for implementation by CLRI based on the request of Ministry of Environment and Forests (MoEF) for support from CSIR laboratories in addressing problems viz. TDS[10] and colour water recycle in tanneries and desired that cost effective solutions be found in a time-bound manner (before December 2005) for enabling the industry to comply with the demands of Corporate Charter[11]. In the project proposal, CLRI envisaged that implementing the improved technologies developed through the project would lead to a saving of ₹40-60 crore per year for Indian leather sector and stated that this saving was possible only if CSIR was able to influence at least 75 *per cent* of the industry in leather sector. The project was completed (March 2007) after incurring an expenditure of ₹17.44 crore.

At the time of initiating the project, it was supported by the All India Skin and Hide Tanners and Merchants Association (AISHTMA). Audit observed that there was no further interaction between CLRI/CSIR and the Association either during tenure of the project or after its completion. Thus, though the project was designed for industry, CLRI did not make adequate efforts to involve industry during implementation of the project. Out of 13 technologies developed, four were transferred, two were commercialised and revenue of ₹25 lakh[12] was earned. Audit observed that one technology[13] stated to be transferred under network project was already being delivered by CLRI in the form of consultancy services since 2004-05 onwards.

CSIR did not offer comments on the issue (November 2013).

Development of catalysis and catalysts-NCL

NCL took up (August 2003) above project at a sanctioned cost of ₹23 crore with a view to providing indigenous technologies for the chemical manufacturing industry. The project was completed (September 2007) after incurring total expenditure of ₹23 crore. Audit observed that there was no association with industry at any stage of the project. Out of five technologies developed, one was transferred and one was commercialised. Audit further observed that though outputs were achieved under three activities[14], scaling up work for possible commercialisation was not done in any of the activities as of July 2012.

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[10] Total Dissolved Solids

[11] Tanneries are one of the 17 red category industries which have entered into a Charter (March 2003) for Corporate Environmental Commitment for Pollution Prevention and Control with the Central Pollution Control Board (CPCB) under Ministry of Environment and Forests. The Charter included action points for the tanneries for waste management, reduction of pollution and compliance to environmental standards.

[12] Figures as per project completion report

[13] Technology for design packages for secured land fill

[14] (i) Out of 15 mesoporous materials synthesised, characterised and standardised, 13 materials were not scaled up; (ii) Under the activity 'Catalysis for specialty chemicals', out of eight processes developed, seven processes were not scaled up and (iii) Though process for synthesis of chiral auxiliaries was developed, it was not scaled up.

CSIR stated (July 2012) that scaling up was out of the scope of the work as that would have involved an industrial partner and added that the processes would be scaled up as and when industry would show interest.

The reply of CSIR was in contradiction of the project proposal, in which scaling up was mentioned as an objective under each of above three activities.

Recommendation 3:

The objective of CSIR being scientific and industrial research, adequate and minimum interaction with appropriate industry leading to commercialisation of its research should be formalised and monitored, for its projects.

2.5 Non utilisation of equipment procured under projects

A sum of ₹375 crore was approved by CSIR for procurement of equipment for 27 projects, of which records relating to procurement of equipment of ₹172 crore were examined in audit. It was observed that 38 items of equipment (each costing more than ₹10 lakh) costing ₹48.73 crore from 15 projects, were received/installed/commissioned either after completion of project or at the fag end of project duration. The list of equipment is given in **Appendix VI**. As such, projects were declared completed without installing/utilising the equipment. The delayed procurement of equipment was injudicious, resulting in non-utilisation of equipment for the intended purpose.

Recommendation 4:

CSIR may ensure timely procurement of equipment and their installation so that equipment are utilised in projects under which they were procured.

2.6 Monitoring and evaluation

Provisions for monitoring and evaluation of network projects were contained in Para 4 of the Guidelines for network projects. Three levels of monitoring of network projects were defined, viz. laboratory level, Task Force (TF) level and Monitoring Committee (MC) level. The monitoring mechanism for each level as per the Guidelines was as follows:

Table 3: Monitoring mechanism for network projects

Level	Monitoring level	Composition	Scope of monitoring	Frequency of meeting
First	Laboratory	Director of concerned participating Laboratory	Monitoring of individual activities assigned to the Laboratory. Concerned scientists were required to make a presentation of the activity before the Director.	Monthly
Second	Task Force	Director of the nodal Laboratory, Directors/ nominees of participating laboratories and Head, R&D Planning Division, CSIR.	Monitoring of all the activities of the project. Participating laboratories were to present the progress of the activities to the Task Force.	Quarterly
Third	Monitoring Committee	Members of the Task Force and external experts with an eminent Scientist as Chairperson	To study critically approved project proposal, evolve suitable and monitorable parameters, monitor timely delivery of goals and milestones and make suitable recommendations for further actions and course changes.	Half yearly

Audit evaluated second and third levels of monitoring mechanism and our observations are given in subsequent paragraphs.

2.6.1 Shortfall in frequency of monitoring

Audit observed shortfall in the meetings of TF and MC against prescribed frequency. The extent of shortfall is given in Table 4:

Table 4: Shortfall in frequency of meetings of Monitoring Committee and Task Force

Range of shortfall (in *per cent*)	No. of projects having shortfall in meetings of Monitoring Committee	No. of projects having shortfall in meetings of Task Force
No shortfall	5	1
1 to 30	5	1
31 to 60	10	7
61 to 90	4	7
Details not available	3	11
TOTAL	**27**	**27**

It is seen that MC met at prescribed frequency in only five projects and TF in the case of only one project. In the remaining projects, shortfall ranged between one to 90 *per cent*. Project wise details of shortfall in meetings of the two committees are given in **Appendix VII**.

The substantial shortfall in holding meetings of monitoring bodies reflected inadequate internal controls in monitoring mechanism.

While accepting the observation, CSIR stated (July 2012) that besides full fledged MC meetings, several other meetings and field demonstrations were conducted as per advice of MC.

Recommendation 5:

CSIR may ensure that meetings of various monitoring committees are held as per prescribed frequency.

2.6.2 Non-compliance with recommendations of MC

Audit further observed that recommendations made by MC during its review of projects were not followed in two projects, as detailed below:

Non-compliance with recommendations of MC

Industrial waste minimisation and clean up-NEERI

NEERI took up (April 2004) above project with the objective of studying the problems of at least 10 categories of highly polluting industries and providing cost effective environmental solutions for treatment of air emissions, waste and waste water. The project was completed (September 2007) after incurring expenditure of ₹13.93 crore.

During review of the project, MC felt (December 2004) that detailed milestones for pilot projects, field tests for commercialisation and utilisation of technology in the industry should be prepared and accordingly it circulated certain monitorable parameters[15] to all participating laboratories. The monitorable parameters were again circulated (August 2005) in MC meeting. However, audit observed that no further progress against the same was furnished in the next four meetings of MC.

Subsequently MC recommended (March 2007) closure of 11 activities, completion of 22 activities and carrying forward of four activities. MC also recommended that project reports with techno economic feasibility, lab scale demonstration, field demonstration and industrial demonstration should be prepared in respect of the closed projects. Though this was reiterated (September 2007) in the final MC meeting NEERI did not prepare project reports.

[15] Execution of pilot projects and testing them in field for commercialisation and utilisation of technology by the industry, identifying the technologies, benchmarking them and finding industrial partner for fine tuning the solution, delineation of milestones with an emphasis on commercialisation and utilisation of technology, studying technology on a pilot scale at a user site , etc.

CSIR stated (July 2012) that out of 37 activities, objectives of 27 activities were achieved completely. CSIR, however, did not comment on the issues of non-preparation of detailed milestones and project reports as directed by MC.

Coal preparation for quality enhancement-CIMFR

CIMFR took up (May 2004) above project at a sanctioned cost of ₹14 crore. While reviewing the project, MC recommended (June 2006) that techno-economic feasibility study may be conducted. However, this was not done by CIMFR. In its next meeting (December 2006) MC, while expressing its dissatisfaction, recommended extension of the project duration by six months for preparation of the techno-economic feasibility report. Audit, however, observed that techno-economic feasibility report was not prepared by CIMFR. The project was closed (September 2007) after incurring total expenditure of ₹7.31 crore.

CSIR did not offer any comment on the issue (November 2013).

2.7 Impact assessment not conducted

The Guidelines of network projects stated that an impact assessment mechanism for each network project would be designed and implemented by CSIR both as an internal alert during execution and in final outcome analysis (para xxii of summary recommendations). The Guideline however, did not specify how or by whom impact assessment would be carried out. It was observed that CSIR neither carried out impact assessment of network projects on its own nor did it engage an external agency for the same.

CSIR confirmed (August 2012) that as the Guidelines did not provide for external-body evaluation of outcome of the projects, no external-body evaluation was conducted.

Audit is of the opinion that impact assessment of network projects was significant as it was a new initiative and was viewed as providing a new learning experience to CSIR. Further, an unbiased impact assessment would be possible only by involving outside experts in the field along with CSIR's own expertise.

Recommendation 6:

In future, formal impact assessment of important projects may be done by involving outside experts along with CSIR's own experts.

Chapter 3 – Outcome of network projects

The activities of CSIR during the Tenth Five Year Plan provided for target oriented network R&D. As per para 2.1.1 of the Guidelines, the project proposals should detail out the deliverables/outcome over a five year period in terms of financial, economical, technological, societal benefits, etc. Audit evaluated the outcome of research from network projects on the following parameters:

- number of technologies developed;
- intellectual property in terms of number of patents;
- publishing of research papers in scientific journals;
- generation of external cash flows[16];
- extent of inter laboratory cooperation[17]; and
- development of human resources.

Based on these parameters, the outcome of 27 selected projects is discussed in the succeeding paragraphs.

3.1 Development and commercialisation of technology

As stated earlier in para 2.4 of this report, network projects of CSIR aimed at generation of knowledge, usable knowledge and useful knowledge as products. Therefore, those projects that targeted usable knowledge and useful knowledge as products were to be exacted to afford commercialisable results.

A total of 399 technologies were developed from 27 network projects examined in audit, of which 51 technologies were transferred to end users and 38 technologies were commercialised and revenue of ₹3.83 crore was realised as of July 2012. The detailed position of project wise development and commercialisation of technologies is given in **Appendix VIII**. The summarised position is given in Table 5:

[16] External cash flow is the total amount from various external sources like royalties, licensing, awards, contract R&D, consultancies, etc.

[17] During Entry Conference (November 2011), CSIR suggested that Audit should evaluate the outcome of the networked R&D efforts of CSIR Laboratories by covering both tangible and intangible benefits. The suggestion was agreed to and CSIR was requested to provide adequate inputs for evaluation of intangible benefits. However, no such input was received from CSIR.

Table 5: Summarised position of total number of technologies developed and transferred from 27 selected network projects

Range of technologies developed through a single project	Number of projects in which range of technologies in col. 1 were developed	Total number of technologies			Expenditure incurred on the projects (₹ in crore)	Revenue generated on transfer/ commercialisation of technologies (₹ in crore)	Number of technologies commercialised as percentage of number of technologies developed	Revenue generated from sale of technologies as a percentage of expenditure incurred on the project
		Developed	Transferred	Commercialised				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0	3	Nil	Nil	Nil	41.84	Nil	Nil	Nil
1-10	12	67	21	9	280.45	0.90	13	0.32
11-20	3	40	5	4	68.20	2.28	10	3.34
21-30	5	115	3	3	118.86	0.13	3	0.10
31-40	1	33	19	19	19.34	0.01	58	0.05
41-50	2	82	3	3	44.49	0.51	4	1.15
51 and above	1	62	0	0	48.62	0	0	0
Total	**27**	**399**	**51**	**38**	**621.80**	**3.83**	**10**	**0.62**

Audit observed that:

- The research carried out with a total expenditure of ₹621.80 crore through the 27 projects resulted in commercialisation of only 10 *per cent* of the technologies developed and revenue generation of ₹3.83 crore (till July 2012) which was less than one *per cent* of the total expenditure on network projects.
- Of ₹3.83 crore revenue generated from 27 projects, only two[18] projects contributed ₹2.28 crore and ₹51 lakh respectively.
- There was 'nil' technology development in case of three projects costing ₹41.84 crore.
- Three projects developed 144 technologies, but were able to commercialise only three technologies which generated revenue of ₹51 lakh.
- In the case of two projects, although more than 20 technologies were developed from each project, none of them were transferred or commercialised.

[18] (i) Environment friendly leather processing technology and (ii) Industrial waste minimisation and clean up

The above statistics indicate that although CSIR was able to increase the stock of knowledge, it failed to transfer the same for larger benefits to society.

As already mentioned in Chapter 2 of this report, the nodal laboratories were required to detail out the measurable deliverables/outcome of their projects over a five year period in terms of financial, economical, technological, societal benefits, etc. in the project proposals of the network projects. Audit, however, observed that out of 27 projects, targets for generation of technologies were defined in seven projects only. The status is as under:

Table 6: Targets and achievements of projects in which measurable deliverables in terms of generation of technologies were defined.

Name of Project	Nodal laboratory	Number of technologies targeted	Number of technologies developed	Shortfall (-)/ Excess(+)	Percentage of shortfall (-)/ Excess(+)
Industrial waste minimisation and clean up	NEERI	10	41	(+)31	(+)310
Developing new building construction materials	CBRI	10	33	(+)23	(+)230
Developing cells and tissue engineering	CCMB	3	2	(-)1	(-)33
Medicinal plant chemotypes for enhanced marker and value added compounds	CIMAP	20	7	(-)13	(-)65
Electronics for societal purposes	CSIO	30	11	(-)19	(-)63
New and improved road technologies	CRRI	36	21	(-)15	(-)42
Drug target development using in-silico biology	IGIB	250	62	(-)188	(-)75
Total		**359**	**177**	**(-)182**	**(-)51**

Thus, target of development of technologies was exceeded in the case of two projects and shortfall in five projects ranged from 33 *per cent* to 75 *per cent*. No targets were set in remaining 20 projects.

Further, target for revenue realisation from sale of technologies was set in only one project[19]. Against target of revenue realisation of ₹10 crore from the project, achievement was 'nil'.

[19] Drug target development using in-silico biology- nodal laboratory: IGIB

CSIR stated (July 2012) that direct economic impact of any project would need post project surveillance and assessment of the returns after a period of ten years of implementation of the project. CSIR added that its recent economic analysis of several past projects had shown that total direct benefit to CSIR plus licensee plus user beneficiary was on an average over thousand times higher than the revenue received/granted by CSIR over a 10 year period.

The reply of CSIR is not acceptable as (a) in many projects, targets were not defined; (b) targets were to be achieved over a five year period and (c) revenue realisation was less than one *per cent* of expenditure as of July 2012. Further no document to justify revenue realisation over thousand times over investment was on record.

3.2 Generation of intellectual property

Major achievements of scientific research are primarily reflected in intellectual property rights (patents) and research publications. The Guidelines also encouraged culture of multi-lab and multi-author patents/papers under the network projects (para 3.9 (iv)). This was reiterated by CSIR in the entry conference (November 2011) wherein it was stated that involvement of scientists of more than one laboratory in filing patents together was very important.

CSIR's achievement as of July 2012 in generation of intellectual property in terms of filing and grant of patents from 27 projects is given below (patents filed both in India and abroad):

Table 7: Patents filed and granted from 27 selected network projects

Range of patents filed under a single network project	Number of network projects in which patents in col. 1 were filed	Total number of patents		Number of joint patents		Number of patents filed from earlier R&D projects but marked under network projects	Net patents filed from network projects (Col. 3-Col.7)	Patent granted to patent filed in percentage
		Filed	Granted	Filed	Granted			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0	3	0	0	0	0	0	0	0
1-10	15	73	31	2	0	6	67	46
11-20	5	78	13	20	2	12	66	20
21-30	3	75	50	13	6	0	75	67
31-40	1	38	9	6	0	0	38	24
TOTAL	**27**	**264**	**103**	**41**	**8**	**18**	**246**	**42**

It can be seen from the above table that:

- In all 264 patents were filed out of which 103 patents were granted.
- Out of 264 patents, only 41 patents constituting 16 *per cent* were filed jointly in networked mode.
- Of 41 patents filed jointly only eight patents (20 *per cent*) were granted.
- Three projects implemented at a cost of ₹61 crore did not generate any patent.

Audit further observed that out of 264 patents stated to have been filed, 18 patents were actually generated from earlier R&D projects but were exhibited under network projects.

Further, out of 27 network projects selected, only 13 project proposals contained measureable deliverables for generation of intellectual property in terms of number of patents. The achievement of these 13 projects is given in Table 8:

Table 8: Achievements in terms of generation of patents for projects in which targets were set

Name of Project	Nodal laboratory	Number of patents targeted to be obtained	Actual number of patents filed	Shortfall	Percentage of shortfall
Developing new building construction materials	CBRI	20	19	1	5
Developing capabilities & facilities for Micro-electromechanical systems (MEMS) and sensors	CEERI	50	16	34	68
Positioning Indian nutraceuticals and neutrigenomics in a global platform	CFTRI	60	7	53	88
Medicinal plant chemotypes for enhanced marker and value added compounds	CIMAP	25	10	15	60
Capacity building for coastal placer mineral mining	CIMFR	20	2	18	90
Developing capabilities in advanced manufacturing technology	CMERI	12	2	10	83
Development and commercialisation of new bioactives and traditional preparation	CSIR Hq.	50	29	21	42
New and improved road technologies	CRRI	7	1	6	86
Drug target development using in-silico biology	IGIB	50	18	32	64
Newer scientific herbal preparations for global positioning	IIIM	7	5	2	29

Name of Project	Nodal laboratory	Number of patents targeted to be obtained	Actual number of patents filed	Shortfall	Percentage of shortfall
Exploration and exploitation of microbial wealth of India for novel compounds and biotransformation process	IMTECH	20	14	6	30
Industrial waste minimisation and clean up	NEERI	111	24	87	78
Design analysis and health assessment of Special structures including bridges	SERC	5	2	3	60
Total		**437**	**149**	**288**	**66**

Thus, it is seen from the table that none of the 13 projects in which targets for generation of patents were set, achieved the same. The shortfall ranged from five to 90 *per cent*.

CSIR did not offer any comment on above issue (November 2013).

3.3 Publishing of research papers

As mentioned in para 3.3 above, major achievements of a scientific research organisation are reflected in its research publications. Besides, para 3.9 (iv) of the Guidelines provided for promoting the culture of multi-lab and multi-author papers. The Guidelines further stipulated that acknowledgement in publications to the specific network program should be included as means of relating outputs of the project (para 2.5.3.3).

A total of 2008 research papers were published from 27 network projects selected for audit. The details are given in Table 9:

Table 9: Number of publications from 27 network projects

Number of publications from a single network project	Number of network projects from which the publications in col.1 were made	Total number of papers published	Number of papers published jointly	Names of the nodal laboratories that undertook the network projects
(1)	(2)	(3)	(4)	(5)
1-30	5	94	6	CIMFR, CFTRI, CSIO, IIIM and IIP
31-60	10	403	31	CCMB, CGCRI, CIMAP, CIMFR, CMERI, CSIR (HQ), CRRI, IICB, IMMT and NIO
61-90	4	288	7	CEERI, CLRI, IMTECH and NPL
91 and above	8	1,223	60	CBRI, CDRI, IGIB, NAL, NCL, NEERI, NML and SERC
TOTAL	**27**	**2,008**	**104**	

From the table it can be seen that although CSIR had achieved a noteworthy average of 74 publications per network project, only 104 publications constituting five *per cent* of the total were brought out jointly by participating laboratories. Audit further observed that

- There were no joint publications in 17 out of 27 network projects.
- Although 2008 papers were stated to be published from the 27 projects, there was no record to show acknowledgment in publications to the specific network project, as required under the Guidelines.

An indication of quality of a publication is impact factor[20] of the journal in which the paper is published. Impact factor indicates standing of the journal in the world and is used to evaluate research output of scientists. The value of impact factor generally lies between 0 and 50 but varies from subject to subject.

The journal impact factors of research publications from 27 network projects was as shown in Table 10:

Table 10: Impact factor of publications

Range of Impact Factor	Number of Publications
0	677
0 to 1	324
1 to 2	297
2 to 5	604
5 to 10	76
10 to 20	7
20 to 30	0
Above 30	1
Not available	22
Total	**2,008**

It can be seen from the table that

- 677 papers (34 *per cent*) out of 2,008 had a journal impact factor of zero and therefore were not quoted anywhere.

[20] Impact factor is defined as the ratio of the number of citations received by a research paper in a particular year to the number of research papers published over a fixed period of time (usually two years), in a particular periodic publication, i.e journal.

- Of 2,008 research papers published, 1,298 papers (65 *per cent*) had journal impact factor below 2 and 1,902 (95 *per cent*) papers had journal impact factor below 5.

- Only 84 papers (4.18 *per cent*) had journal impact factor above 5.

Thus, although network projects resulted into a large number of published research papers, a significant number of these (95 *per cent*) had impact factor of less than 2.

Audit also observed that targets for publications were set in only nine projects and no targets were fixed for joint publications. The achievements under these nine projects are given in Table 11:

Table 11: Achievements in terms of research papers published in nine projects where targets were set

Name of Project	Nodal laboratory	Number of papers proposed to be published	Actual number of papers published	Shortfall (-)/ Excess (+)	Percentage of shortfall (-)/ excess (+)
Medicinal plant chemotypes for enhanced marker and value added compounds	CIMAP	25	35	(+)10	(+)40
Capacity building for coastal placer mineral mining	CIMFR	40	47	(+)7	(+)18
Developing capabilities in advanced manufacturing technology	CMERI	25	44	(+)19	(+)76
Drug target development using in-silico biology	IGIB	100	129	(+)29	(+)29
Exploration and exploitation of microbial wealth of India for novel compounds and biotransformation process	IMTECH	12	69	(+)57	(+)475
Design analysis and health assessment of Special structures including bridges	SERC	50	357	(+)307	(+)614
Industrial waste minimisation and clean up	NEERI	295	115	(-)180	(-)61
Developing new building construction materials	CBRI	150	134	(-)16	(-)11
Positioning Indian nutraceuticals and neutrigenomics in a global platform	CFTRI	35	28	(-)7	(-)20
Total		**732**	**958**	**(+)226**	**(+)31**

It can be seen that targets for publishing of research papers were exceeded in six projects and there was shortfall in remaining three projects.

Thus, the overall achievement of CSIR in terms of number of research papers published was noteworthy, however, the efficacy of networking through involvement of more than one laboratory in writing scientific papers was insignificant.

CSIR did not offer comments on the issue (November 2013).

3.4 Generation of External Cash Flow

One of the performance indicators prescribed in the Guidelines was extent of external cash flow (ECF) realised through projects. The status of ECF from 27 selected projects as of July 2012 is given in Table 12:

Table 12: Status of External Cash Flow from 27 selected projects

ECF generated from a single network project	Number of projects from which ECF in Col.1 generated	Total ECF generated (₹ in crore)	Names of the nodal laboratories
(1)	(2)	(3)	(4)
No ECF	9	0	CCMB, CDRI, CFTRI, CSIO, CSIR Hq, IICB, IIIM, IMTECH and NIO
Upto ₹1 crore	4	0.52	CIMAP, IIP, NCL and SERC
₹1-2 crore	4	6.93	CGCRI, CIMFR, IMMT and NEERI
₹2-3 crore	1	2.27	CLRI
₹3-4 crore	Nil	Nil	-
₹4-5 crore	1	4.01	CMERI
₹5 -10 crore	5	38.75	CBRI, CIMFR, CRRI, IGIB and NML
More than ₹10 crore	3	142.26	CEERI, NAL and NPL
Total	**27**	194.74	

It can be seen from the above table that there was no ECF from nine network projects. Total expenditure incurred on these projects was ₹199.16 crore.

Audit further observed that out of ₹194.74 crore stated to have been generated by 18 projects, amount of ₹115 crore was not generated from network projects, but from sponsored and grant-in-aid projects. Thus, actual ECF from network projects was only ₹79.74 crore.

Further, it was seen that targets for generation of ECF were given in only nine projects. The achievement of these nine projects is given in Table 13:

Table 13: Achievements in terms of generation of ECF from nine projects where targets were set

(Amount in ₹crore)

Name of Project	Nodal laboratory	Amount of ECF proposed to be generated	Amount of ECF generated	Shortfall	Percentage of shortfall
Developing new building construction materials	CBRI	9.5	9.5	0	0
Developing capabilities & facilities for Micro-electromechanical systems (MEMS) and sensors	CEERI	15	10.5	4.5	30
Positioning Indian nutraceuticals and neutrigenomics in a global platform	CFTRI	2	0	2	100
Medicinal plant chemotypes for enhanced marker and value added compounds	CIMAP	2.5	0.21	2.29	92
Environment friendly leather processing technology	CLRI	40	2.275	37.725	94
Developing capabilities in advanced manufacturing technology	CMERI	16	4	12	75
New and improved road technologies	CRRI	9	8.1	0.9	10
Exploration and exploitation of microbial wealth of India for novel compounds and biotransformation process	IMTECH	2.5	0	2.5	100
Physico-mechanical, electrical and electronic standards	NPL	20.8	16.76	4.04	19
TOTAL		**117.30**	**51.35**	**65.95**	**56**

Thus ECF target was achieved in only one project. The shortfall in the remaining eight projects was between 10 *to* 100 *per cent*.

CSIR did not offer comments on the observation (November 2013).

Recommendation 7:

CSIR may ensure that targets are set in a judicious manner after assessing the available resources and associated risks of research, so as to present a realistic picture.

3.5 Other outcomes

3.5.1 Development of human resources

According to Para 4.2 of the Guidelines, Task Force was required to submit quarterly performance report of network projects to CSIR. One of the parameters for reporting significant scientific and technical achievements was human resource development. Although no targets were set for development of human resources, the position in terms of number of Ph.Ds awarded and number of Project Assistants trained from 27 selected network projects was as below:

Table 14: Number of Ph.Ds awarded from network projects

Number of Ph.Ds awarded from a single network project	No. of Projects from which Ph.Ds in Col.1 awarded	Total number of Ph.Ds.	Nodal laboratories
(1)	(2)	(3)	(4)
0	5	0	CCMB, CIMFR, CSIO, CRRI, NPL
1-20	20	135	CFTRI, IIIM, IIP, CGCRI, CIMAP, CIMFR, CMERI, CSIR (HQ), IICB, IMMT, NIO, CEERI, CLRI, IMTECH CBRI, NAL, NCL, NEERI, NML and SERC
21-40	1	30	CDRI
41-60	0	0	-
61 and above	1	66	IGIB
Total	**27**	**231**	

Table 15: Number of Project Assistants trained from network projects

Number of Project Assistants trained from a single network project	No. of Projects in which Project Assistants in Col.1 trained	Total number of Project Assistants	Nodal laboratories
(1)	(2)	(3)	(4)
0	5	0	CDRI, CFTRI, NAL, NCL and NPL
1-30	13	219	CCMB, IIIM, CGCRI, CIMAP, CIMFR, CMERI, CSIO, IMMT, NIO, CEERI, CLRI and NML
31-60	4	178	CRRI,IIP,IMTECH and SERC
61-90	1	81	CSIR (HQ)
91 and above	4	580	CBRI, IGIB, NEERI and IICB
Total	**27**	**1058**	

It would be seen from the above data that:

- A total of 231 Ph.Ds were awarded and 1058 Project Assistants trained through network projects.
- No Ph.D was awarded in five projects.
- No trained Project Assistant developed in five projects.

Audit further observed that of 231 Ph.Ds stated to have been produced, in six cases the thesis of Ph.D had already been accepted prior to commencement of the projects.

CSIR did not offer any comment on the issue (November 2013).

Chapter 4 – Audit findings from specific projects

This Chapter highlights some of the significant audit findings from specific projects, such as delays in establishment of infrastructure required for the projects, injudicious procurements, inadequate planning, incomplete activities, inadequate co-ordination, etc.

4.1 Unproductive expenditure in executing a project without requisite infrastructure

CDRI took up (October 2003) a network project titled 'Animal models and animal substitute technologies' with a sanctioned cost of ₹33.43 crore. One of the objectives of the project was development of internationally acceptable models to study human genes/diseases. Development of new drugs involved mandatory pharmacology and toxicology studies, which have to be done on internationally acceptable models and guidelines. For this, Good Laboratory Practices[21] (GLP) accreditation of its laboratories was a necessary condition.

The project was completed (March 2007) after incurring an expenditure of ₹30.56 crore. Audit observed that though 41 technologies were developed under the project, none could be submitted to international agencies as the tests were carried out in facilities of CDRI that did not have GLP accreditation. Although CDRI had planned (May 2003) to set up a world class drug institute (duly GLP accredited) through another network project during 2004 to 2008, but the project on development of animal models and animal substitute technologies was already completed before the said institute could be developed. The new drug research institute was still under development (July 2012).

Central Drug Research Institute, Lucknow

Thus, injudicious decision to take up the project without having required GLP accredited facilities rendered expenditure of ₹30.56 crore unproductive from international acceptance perspective.

[21] Many international regulatory agencies require GLP accreditation from international agencies such as Organisation of Economic Co-operation and Development, France. Good Laboratory Practices include factors such as proper recording of data, proper maintenance of equipment, proper sample collection and preservation, purity of reagents, proper laboratory safety and analytical quality control.

CSIR stated (July 2012) that effective use of these models for the ongoing drug development programme of CSIR would enable development of new drugs. The reply needs to be viewed in the context that for getting international acceptance, the models would need to be re-developed in GLP accredited laboratory.

4.2 Unfruitful expenditure due to non-utilisation of equipment

CRRI undertook (August 2003) a project titled 'New and improved road technologies' at a sanctioned cost of ₹23.92 crore. The project had four[22] activities further sub divided into 12 components. Audit observed that equipment procured at cost of ₹14.05 crore remained unutilised, as discussed below:

4.2.1 Under the activity on road materials and construction techniques, CRRI was to establish Accelerated Pavement Testing Facility[23] (APTF). CRRI had initially proposed (2002) to establish stationery type APTF, but a High Power Expert Committee recommended (October 2004) procurement of Mobile type APTF instead of stationary type, for its advantages.

Accelerated Pavement Test Facility

CRRI placed (February 2007) purchase order for equipment at a cost of ₹13.37 crore. The equipment was delivered in January 2010 and commissioned in April 2010. In the meantime the project was declared as completed (January 2010). Audit observed that APTF was not deployed on site for testing of pavements even as of July 2012.

Thus APTF procured at a cost of ₹13.37 crore could not be established till closure of the project and even beyond, thereby rendering expenditure of ₹13.37 crore as unfruitful for the project.

CSIR accepted the delay and stated (July 2012) that delay was on account of deployment of teams for pre-shipment factory acceptance test and training, re-tendering in selection of transporter and creation of infrastructural facilities.

[22] (i) Road materials and construction techniques; (ii) Highway system planning and management; (iii) Environment and Transport management and (iv) Indigenous development of instrumentation for road transport.

[23] APTF is a facility to evaluate performance of a pavement in reduced time duration. Desired specifications could be tested within three to six months as compared to 10 to 20 years in normal conditions.

4.2.2 CRRI installed (August 2006) Advanced Parking Lot Management System (APMS) costing ₹67.90 lakh at NDMC[24] parking lot in Palika Bazar, New Delhi. Audit observed that APMS was installed without receiving any formal request from NDMC or any formal agreement with NDMC.

NDMC subsequently requested (March 2009) CRRI to allow it to retain APMS at said parking lot free of cost. As CSIR procedure did not allow the transfer of system free of cost, CRRI did not agree with the request of NDMC and removed the system from the Palika Bazar parking lot. The equipment was taken out but could not be used further and was eventually rendered unserviceable.

Thus, injudicious decision to install APMS at NDMC parking lot without obtaining its consent in advance resulted in wasteful expenditure of ₹67.90 lakh.

CSIR stated (July 2012) that concerted efforts were made by CRRI to sign MoU with NDMC but the same could not be achieved.

4.3 Poor planning of project leading to incomplete activity

CSIR took up (April 2004) the network project titled 'Discovery, development and commercialisation of new bio-actives and traditional preparations' at a cost of ₹39.60 crore. One of the main objectives of the project was to develop single molecules as drugs and take them to IND[25] state for diseases of interest to India and international community. Major components in this regard were collection of single molecules, *in vitro*[26] and *in vivo*[27] tests, fractionation, optimisation and regulatory pharmacology and toxicology investigations. In order to carry out these studies, CSIR planned to create test facilities such as automated microscopic facilities, super critical extraction facilities, molecular modelling workstations, automated fractionation facilities, *in vitro* and *in vivo* screening facilities, etc. under the same project during 2004-05 to 2006-07 at an estimated cost of ₹23.60 crore.

The project was completed (March 2008) after incurring expenditure of ₹32.77 crore. Audit observed that though CSIR developed five single molecules for conditions of dementia, hypertension, psychosis, cancer and immunostimulatory disease, none could be translated to IND stage as essential studies on the single molecules could not be completed due to lack of above specialised facilities or expertise.

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[24] New Delhi Municipal Corporation

[25] IND refers to Investigational New Drug, which is a new drug that is used in a clinical investigation. IND program is the means by which approval for clinical trials on the drug is obtained before it is cleared for marketing application.

[26] Related to processes taking place outside a living organism e.g. in a test tube

[27] Related to processes taking place within the living organism

The decision to include development of single molecules for IND stage in the network project when specialised facilities for conducting the studies were still under development reflected deficient planning.

CSIR stated (July 2012) that desired facilities were created and the molecules were under different stages of investigations. The reply of CSIR indicated that work was not completed as of July 2012, i.e. after more than four years of completion of the project.

4.4 Failure to take ethical clearance for studies on human subjects

In case of projects that require tests on human subjects, Government rules[28] stipulate that clinical trials on a new drug shall be initiated only after approvals have been obtained from the Ethics Committee.

CCMB undertook an activity under the project titled 'Asthma and Allergic Disorders Mitigation Mission' to carry out determination of the genetic basis of asthma and study of genetic interactions between causative agents and concerned genes with a view to adopting predictive measures and develop predictive medicines related to asthmatic and allergic disorders. The activity required collection of bronchoalveolar lavage fluid from patients.

Audit observed from the project proposal that CCMB did not take clearance from Ethics Committee prior to taking up the activity, which was in contravention of Government rules.

While carrying out studies, CCMB faced problems due to ethical considerations. The main objective of adopting predictive measures and development of predictive medicines for asthma and allergic disorders was not achieved, as functional validation of genes could not be completed, rendering expenditure of ₹2.21 crore incurred on the activity as unfruitful.

CSIR stated (July 2012) that CCMB faced problems with collection of bronchoalveolar lavage fluid from patients which could not be anticipated while formulating the project proposal. The reply of CSIR needs to be viewed in the context that genetic studies and development of medicines was a planned objective of the activity.

4.5 Incomplete activities under projects

Audit observed that status of completion of activities reported in the consolidated project completion reports of two projects was incorrect. In another project, objective of an activity was not achieved, reportedly due to deficient manpower, which was a fact already known to the laboratory. The cases are discussed below:

[28] Para 2 (1) of Drugs and Cosmetics (II Amendment) Rules 1945, which made (January 2005) approval from Ethics Committee mandatory in clinical trials on human subjects.

4.5.1 NAL undertook (February 2005) a project titled 'Developing and sustaining high science and technology for national aerospace programme' at a sanctioned cost of ₹80.70 crore. The objective of the project was to undertake planned research and technology development for national aerospace sector. The project work was divided into 48 activities, of which five[29] activities were implemented in networking mode along with four[30] participating laboratories. Audit reviewed all five activities that were executed in network mode. Though consolidated project completion report declared that only one networked activity viz. development of cockpit display systems had not been completed, audit observed that two more activities in addition to the above also remained incomplete. The cases are discussed below:

Incomplete activities under project on 'Developing and sustaining high science and technology for national aerospace programme'

Development of rolling element bearing standards for aerospace application

NAL and CMERI jointly undertook above activity at an estimated cost of ₹61 lakh with objective of developing reliable methodology to measure quality of rolling element bearings in terms of fatigue and wear life. CMERI received (August 2007) funds of ₹30 lakh for procurement of equipment. Due to late release of funds, CMERI requested CSIR to carry forward the funds up to September 2008. CSIR however did not respond to the request of CMERI. The project activity was closed (March 2008) and CMERI surrendered the amount of ₹30 lakh (March 2008). The Activity Completion Report stated that majority of the work experimentation could not be done as CMERI was unable to manufacture and integrate the test rig owing to late release of funds.

CSIR stated (July 2012) that the testimonials of the project required consideration before arriving at any conclusion on non-achievement of objectives. The reply of CSIR was interim and completion report of the activity clearly mentioned that the objective had not been achieved.

Process technology optimisation for aerospace application

NAL undertook (March 2005) above activity on design, synthesis and characterisation of light weight high performance alloys and composites for development of various aerospace components jointly with AMPRI at sanctioned cost of ₹2.01 crore. The project was completed (March 2008) after incurring an expenditure of ₹1.38 crore. Audit observed that die design, development and performance evaluation of components was not completed.

AMPRI stated (January 2012) that due to some practical difficulties, materials development took a long time during project implementation leaving no scope to conceive and develop suitable component. CSIR did not offer comments on the issue (November 2013).

[29] (i) Development of rolling element bearing standards for aerospace applications; (ii) Process technology optimisation for aerospace application; (iii) Development of wind tunnel models using time compression technologies; (iv) Development of cockpit display systems and (v) Multi instrument monitoring to improve prediction- GPS

[30] CMERI, AMPRI, CSIO and NPL

4.5.2 With a view to exploring secondary raw material and energy resources and development of innovative construction technologies for sustainable development of building sector, CBRI undertook a project titled 'Developing New Building Construction Materials' along with 11[31] participating laboratories at a sanctioned cost of ₹23 crore. The project was completed (March 2007) with expenditure of ₹19.34 crore.

Work under the project was divided into 36 activities. Audit observed that though consolidated project completion report stated that all activities were successfully completed, five activities actually remained incomplete, as discussed below:

Incomplete activities under project 'Developing New Building Construction Materials'

Bulk utilisation of industrial solid wastes for production of aggregates and cement clinker
The above activity was taken up jointly by CBRI and IMMT. The activity involved evaluation of raw materials like fly ash, pond ash, bottom ash and mill reject coal of thermal plant and process optimisation on five kg scale followed by up scaling to 50 kg scale and commissioning of pilot facility of 100 kg per batch. Audit observed that the activity could not be completed as quantity of samples produced by IMMT was only 35kg which was not sufficient.
Development of corrosion resistant coating system for reinforcing steel rebar
The activity was carried out by CECRI. It involved development of corrosion resistant coating system for protection of steel reinforcement bars embedded in concrete structures and its evaluation through short term and long term field exposure tests. CECRI stated in its activity completion report that the objective of long term field exposure tests for assessing the durability of coating could not be completed due to unforeseen delay in standardisation and selection of effective coating system.
Wood substitutes from agro industrial wastes with polymeric binder
The activity was taken up by NEIST with an objective to develop a technology for making building construction material from polymeric and agro-industrial wastes as a substitute for timber. It was seen from the activity report that process technology for developing wood substitutes was developed at laboratory scale, but pilot scale trials were not done due to non-availability of machines required for making bigger samples.
Cement/Polymer based building boards from bagasse
The activity was undertaken by CBRI with objectives of developing building boards using bagasse and developing door shutter from these building boards. It was seen from the activity report that the objective of development of door shutter was not achieved as the activity was foreclosed.
Development of high performance smart concrete
The activity was undertaken by CRRI with objectives of developing an alternate for silica fume and development of high performance smart concrete. Activity completion report of CRRI stated that the latter objective was not achieved due to time and manpower constraints.

[31] CGCRI, CIMFR, CECRI, CRRI, IICT, NML, AMPRI, IMMT, IIIM, NIIST and SERC

Thus the consolidated project completion reports showed inaccurate account of the status of completion of activities in above projects.

CSIR did not comment on the above issue (November 2013).

4.5.3 CEERI undertook (January 2004) a project titled 'Developing capabilities for micro electromechanical systems[32] and sensors' at a sanctioned cost of ₹31.71 crore. The project had six[33] activities. Under an activity, CEERI and AMPRI were to develop micro pump, valves, cells and micro channels of different kinds and to integrate them to realise a micro total analysis system on a chip.

It was seen from the project completion report that objective of this activity was not achieved as AMPRI was unable to develop micro pump, micro valves, reservoirs, mixing and PCR channels, reportedly due to death (August 2003) of the activity leader.

Audit, however, noticed that this fact was known to AMPRI much before the project actually commenced (January 2004).

CSIR stated (July 2012) that systems which were not developed by AMPRI, were not required as the analysis of fluids using electrophoresis was successfully done. The reply of CSIR was not acceptable because stated objective of the activity was to realise a micro total analysis system which was not achieved.

Recommendation 8:

CSIR may ensure that resources required for a particular project are planned in advance and optimally utilised so as to avoid adverse impact on outcome of project.

[32] Micro-electromechanical Systems (MEMS) consist of micro-components, which experience force due to physical, chemical or biological phenomena and produce electrical stimuli in response to the respective changes caused in their mechanical characteristics. This whole sequence is utilised in making a miniaturised sensor. Miniature sensors and actuators are emerging very fast because of their ever increasing applications in diverse fields.

[33] Development of Polymer Composite Gas Sensor, Ion Sensitive FET Sensor, MEMS Technologies, µ-heater Embedded Gas Sensor, µ-cantilever Beam Array, µ-TAS

Chapter 5 – **Conclusion**

Network Projects were conceived as part of Tenth Five Year Plan programme of CSIR to be taken up and completed during Tenth Plan period (2002-07). CSIR issued guidelines for network projects more than two years after beginning of the Tenth Plan. As such, applicability of the guidelines to project formulation and preparation of project proposals became redundant in most of the projects. There were delays of 12 to 34 months in commencement of the projects which impacted the completion of activities of the network projects. Audit also observed shortfall of 45 *per cent* in meetings of the TF and 56 *per cent* in meetings of the MC, which adversely affected monitoring of the projects.

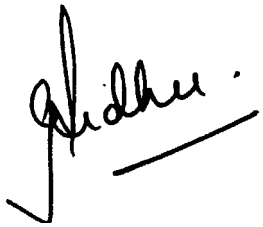
Equipment costing ₹48.73 crore from 15 projects were received/installed/commissioned either after completion of the project or at the fag end of the project duration and could not be utilised for the projects.

Project guidelines as well as the guidelines of Ministry of Finance for implementing high value projects emphasised the need for including measurable parameters in the project proposal. Measurable parameters were not defined in more than 60 *per cent* of the projects examined in audit. In the absence of defined criteria for project performance, extent of success of these projects could not be measured. In the few cases in which targets were set, actual achievement there against, except for a few noteworthy achievements in development of technologies and publication of research papers, was poor.

Outcome analysis of 27 projects implemented at cost of ₹621.80 crore revealed that projects could not generate commercialisable results in terms of development, transfer and return from sale of technologies. Out of 399 technologies developed, 51 technologies were transferred and 38 technologies were commercialised during the last 10 years. The total revenue earned through transfer/commercialisation of technologies was only ₹3.83 crore, which was less than one *per cent* of total expenditure incurred on implementation of the projects.

A fundamental element of network projects was effective networking by the scientists of CSIR laboratories in filing joint patents and publishing multi-laboratory and multi-author research papers. Out of 264 patents, only 41 patents constituting 16 *per cent* were filed jointly. Similarly out of 2008 research papers published, only 104 publications were brought out jointly.

No mechanism for impact assessment of network projects either by CSIR or by external agencies was established, even though it was a new initiative, expected to provide a learning experience to CSIR.



(GURVEEN SIDHU)
Principal Director of Audit,
Scientific Departments

New Delhi
Dated: 31 December 2013

Countersigned

(SHASHI KANT SHARMA)
Comptroller and Auditor General of India

New Delhi
Dated: 6 January 2014

APPENDICES

Appendix I (Refer Para 1.2)

List of network projects taken up by CSIR during Tenth Five year Plan

Projects selected for examination in the Performance Audit

Sl. No.	Title of the Project	Nodal Lab	Other participating Labs	Approved/estimated cost (₹ in crore)
1.	Spearheading small civilian aircraft design, development & manufacture	NAL	CMERI	297.70
2.	Exploration and exploitation of microbial wealth of India for novel compounds and biotransformation processes	IMTECH	IHBT, IICT, NBRI, NEERI, IGIB, NIO, IIIM, NEIST, NIIST, IMMT and NCL	20.47
3.	Molecular biology of selected pathogens for developing drugs targets	CDRI	IICB, IMMT, CCMB, IGIB, CIMAP and IIIM	24.88
4.	Study of mesozoic sediments for hydrocarbon exploration	NGRI	NIO	14.90
5.	Pollution monitoring mitigation systems and devices	NEERI	NGRI, NBRI, IGIB, NEIST, CRRI, CIMFR, AMPRI, CGCRI, NPL, IITR and CECRI	14.58
6.	Asthmatic and allergic disorders mitigation mission	IICB	IGIB, IICT, CCMB, IITR and IIIM	24.49
7.	Newer scientific herbal preparations for global positioning	IIIM	NBRI, CDRI, CIMAP, IITR, IICB, IICT, CFTRI, IHBT and IMMT	24.90
8.	Special electron tube technologies for large scale applications	CEERI	CMERI and CGCRI	8.65
9.	Comprehensive traditional knowledge digital documentation and library	NISCAIR	NBRI, IITR, CIMAP, URDIP, IMMT, IIIM, CBRI, CFTRI and IHBT	18.00
10.	Environment friendly leather processing technology	CLRI	NEERI, NML, NBRI, CSMCRI and CGCRI	18.20
11.	Development of specialised aerospace materials	NAL	CECRI, CGCRI, NML and NPL	16.87
12.	Developing cells & tissue engineering	CCMB	CIMAP, IHBT, IICB, NBRI, NCL and IIIM	24.50
13.	Toxicogenomics of polymorphism in Indian population to industrial chemicals for development of biomarkers	IITR	IICB, IGIB, CCMB and NEERI	23.49
14.	Designing animals and plants as bio-reactors for production of proteins & other products	CIMAP	IHBT, NBRI, IICB, NEIST, IICT and CFTRI	19.87
15.	Development of catalysis & catalysts	NCL	IICT, IIP, CIMFR, NEIST, IIIM, IICB, NIIST, CSMCRI and IMMT	23.00
16.	Developing green technology for organic chemicals	IICT	CIMAP, IHBT,IIIM, NEIST, NIIST, NCL, NEERI, CIMFR, CSMCRI, IIP, IMMT, IICT and CECRI	23.78
17.	Acquisition of oceanographic research vessel	NIO	Nil	226.51
18.	Impact of anthropogenic perturbations oceanographic atmospheric processes in	NIO	NGRI and NPL	14.01

Sl. No.	Title of the Project	Nodal Lab	Other participating Labs	Approved/estimated cost (₹ in crore)
	and around India in the context of global change			
19.	Development of key technologies for photonics and opto-electronics	CGCRI	CEERI, CSIO, IICT, NPL and NIIST	33.03
20.	Developing capabilities & facilities for microelectromechanical systems (MEMS) and sensors	CEERI	NCL, NPL, IICT, CECRI, CMERI, CCMB, AMPRI, CGCRI	31.71
21.	Coal resource quality assessment for specific end uses	CIMFR	NEIST, NML and NCL	13.32
22.	Developing new generation fuels & lubricants	IIP	NCL, CFRI, IIIM and NIIST	24.06
23.	Positioning Indian nutraceuticals and neutrigenomics on global platform	CFTRI	IICT, IHBT, CIMAP, NBRI, IIIM and CCMB	22.40
24.	Setting up a world class drug research institute (for preparing FR)	CDRI	Nil	176.14
25.	Predictive medicine using repeat and single nucleotide polymorphisms	IGIB	CCMB, IICB, CDRI, IITR, IGIB and IMTECH	24.47
26.	Drug target development using in-silico biology	IGIB	IICB, CDRI, IMTECH and IIIM	49.60
27.	Animal models and animal substitute technologies	CDRI	CCMB, CIMAP, IGIB, IICT, IITR and IMTECH	33.43
28.	Developing new building construction materials	CBRI	CECRI, CFRI, CGCRI, CRRI, IICT, NML, AMPRI, IMMT, NEIST, NIIST and SERC	23.00
29.	Mathematical modeling and computer simulation	C-MMACS	CBRI, CRRI, NEERI, NIO and IMMT	15.66
30.	Technologies standardisation of bioresources for and from leather	CLRI	CFTRI, IMTECH and CCMB	3.75
31.	Custom tailored special materials	CGCRI	CMERI, NML, NIO, AMPRI, IMMT and NIIST	24.03
32.	Capacity building for coastal placer mineral mining	CIMFR	CMERI, NIO, IMMT, AMPRI, NIIST and NML	15.41
33.	Upgradation of SI base units, national standards of measurements and apex calibration facilities	NPL	CFTRI, CIMFR, CMERI, CSIO, IIP, IITR, NAL, NEERI, NIO, NML, NEIST and SERC	21.21
34.	Developing and sustaining high science & technology for national aerospace programmes	NAL	CMERI, CSIO, NPL and AMPRI	80.70
35.	Development of medicinal plant chemotypes for enhanced marker and value added compounds	CIMAP	IHBT, IICB, IMMT, IIIM and NBRI	21.66
36.	Globally competitive chemicals processes and products	IICT	CFRI, CIMAP, CSMCRI, IHBT, IIP, NCL, NEERI, IMMT, IIIM and NIIST	16.63
37.	Development of novel polymeric materials	NCL	CSMCRI, NIIST, IICT, IIIM, CLRI, IIP, NEIST, CECRI and NPL	20.00

Sl. No.	Title of the Project	Nodal Lab	Other participating Labs	Approved/estimated cost (₹ in crore)
38.	Development of techniques and methodologies for exploration, assessment and management of ground water in hard rock areas	NGRI	IITR, AMPRI and NEERI	24.44
39.	Tectonic and oceanic processes along the Indian ridge system and backarc basins	NIO	NGRI	23.68
40.	Electronics for societal purposes	CSIO	CBRI, CFTRI, CEERI, CMERI, CRRI, NGRI and NPL	21.14
41.	Industrial waste minimisation and clean up	NEERI	CECRI, CGCRI, CLRI, CMERI, CSIO, IGIB, IICT, IIP, IITR, NBRI, NCL, NGRI, NML, AMPRI, IMMT, NEIST and NIIST	15.93
42.	Quality enhancement of coal for its efficient utilisation	CIMFR	NML, IMMT and AMPRI	14.00
43.	Natural, nature identical and nature similar biomolecules	CFTRI	IGIB, CIMAP, IHBT, IICB, NBRI, IIIM, IMMT and NIIST	22.10
44.	Infectious diseases handling, storage and research facilities	CCMB	CDRI, IMTECH, IIIM, IGIB and IICB	13.26
45.	Design analysis and health assessment of special structures including bridges	SERC	CBRI, CMERI, CRRI, NML, CECRI and AMPRI	16.70
46.	New and improved road technologies	CRRI	CBRI, CMERI, IIP and SERC	23.92
47.	Establishing National Science Digital Library (NSDL)	NISCAIR	Nil	44.54
48.	CSIR E-journals consortium	NISCAIR	All laboratories	26.90
49.	Establishment of genetically modified food referal facility	CFTRI	CCMB and IITR	17.15
50.	Establishing advanced facility for safety evaluation of genetically modified/engineered drugs	CCMB	IGIB, CDRI, IMTECH and IITR	22.97
51.	Biomineral processing for extraction of metal values from ores and concentrates	IMMT	IICB and NML	16.00
52.	Developing capabilities in advanced manufacturing Technology	CMERI	CGCRI, NML, CSIO, NAL, AMPRI, NIIST and SERC	17.85
53.	Technology for engineering critical assessment	NML	CBRI, CGCRI, CMERI, CRRI, NAL, AMPRI and SERC	14.98
54.	Discovery, development and commercialisation of new bioactives and traditional preparation	CSIR Hqs.	CBRI, CCMB, CDRI, CIMAP, CFTRI, CLRI, IHBT, IGIB, CSMCRI, IICB, IICT, IMTECH, IITR, NBRI, NCL, NIO, AMPRI, IMMT, IIIM, NEIST and NIIST	39.60
Total				**1860.01**

Appendix II (Refer Para 2)

Details of 27 projects selected for audit

(₹in crore)

Sl. No.	Name of project	Nodal Lab	Other participating Labs	Number of activities			Activities completed#			Sanc-tioned cost	Actual expr.
				Total	Net-work Mode	Non-Net-work Mode	Fully	Partially	Not achieved		
1.	Developing new building construction materials	CBRI	CGCRI, CFRI, CECRI, CRRI, IICT, NML, AMPRI, IMMT, IIIM, NIIST and SERC	36	30	6	36	Nil	Nil	23.00	19.34
2.	Developing cells & tissue engineering	CCMB	IIIM, NCL, IHBT, IICB, CIMAP and NBRI	13	13	Nil	12	Nil	1	24.50	22.59
3.	Animal models and animal substitute technologies	CDRI	IICT, IITR, IGIB, CCMB, CIMAP and IMTECH	7	7	Nil	6	1	Nil	33.43	30.56
4.	Developing capabilities for micro electromechanical systems and sensors	CEERI	CMERI, CCMB, NPL, AMPRI, CGCRI, IICT, CECRI and NCL	6	6	Nil	4	2	Nil	31.71	31.89
5.	Positioning Indian nutraceuticals and neutrigenomics on global platform	CFTRI	IIIM, CIMAP, NBRI, IHBT, IICT and CCMB	6	6	Nil	5	Nil	1	22.40	14.09
6.	Development of key technologies for photonics and opto-electronics	CGCRI	CEERI, NPL, CSIO, IICT and NIIST	4	4	NIL	4	NIL	NIL	33.03	31.93
7.	Development of medicinal plant chemotypes for enhanced marker and value added compounds	CIMAP	IIIM, IHBT, NBRI, IICB and IMMT	8	8	Nil	Nil	8	Nil	21.66	21.66
8.	Quality enhancement of coal for its efficient utilisation	CIMFR	AMPRI, NML and IMMT	3	3	Nil	3	Nil	Nil	14.00	7.31
9.	Capacity building for coastal placer mineral mining	CIMFR	CMERI, NIO, NML, AMPRI, IMMT and NIIST	5	5	Nil	5	Nil	Nil	15.41	5.29
10.	Environment friendly leather processing technology	CLRI	CGCRI, CSMCRI, NBRI, NEERI and NML	15	15	Nil	15	Nil	Nil	18.20	17.44
11.	Developing capabilities in advanced manufacturing technology	CMERI	NAL, NML, SERC, CGCRI, CSIO, AMPRI and NIIST	10	10	Nil	8	Nil	2	17.85	16.13
12.	New and improved road technologies	CRRI	CBRI, CMERI, IIP and SERC	4	4	Nil	4	Nil	Nil	23.92	24.30
13.	Electronics for societal purposes	CSIO	CRRI, CBRI, CFTRI, CEERI, CMERI, NGRI and NPL	10	10	Nil	8	1	1	21.14	18.87
14.	Discovery, development and commercialisation of new bioactives and traditional preparation	CSIR-Hq	AMPRI, CDRI, CBRI, IICT, IICB, IMTECH, IHBT, NIIST, NEIST, NIO, IIIM, CIMAP, NBRI, NCL, IITR, CFTRI, IGIB, CLRI, CCMB, IMMT and CSMCRI	10	10	Nil	Not indicated			39.60	32.77

(₹in crore)

Excess (-)/ Un-spent Balance (+)	Date of start	Date of finish	Delay* (months)	Outputs from project							
				Technologies developed		Patents filed and granted		Publications and impact factor		ECF earned	
				Target	Actual	Tar-get	Actual	Tar-get	Actual	Tar-get	Actual
(+)3.66	01-08-2003	31-03-2007	Nil	10	33 developed, 19 transferred and 19 commercialised	20	19 filed and none granted	150	134 with impact factor ranging from 0.114 to 2.216	9.5	9.5
(+)1.91	29-07-2003	31-03-2007	Nil	3	2 developed, none transferred and commercialised	Not set	5 filed and none granted	Not set	34 with impact factor 3.46 (aver-age)	Not set	Nil
(+)2.87	29-10-2003	31-03-2007	Nil	Nil	41 developed, none transferred and commercialised	Not set	5 filed and 5 granted	Not set	106 with impact factor ranging from 0.36 to 6.40	Not set	Nil
(-)0.18	06-01-2004	31-03-2007	Nil	Nil	16 developed, none transferred and 2** commercialised	50	16 filed and 2 granted	Not set	76 with impact factor ranging from 0.218 to 5.361	15.0	10.5
(+) 8.31	01-08-2003	31-03-2007	Nil	Nil	7 developed, 2 transferred and 2 commercialised	60	7 filed and 3 granted	35	28 with impact factor zero	2	Nil
(+) 1.10	01-08-2003	31-03-2007	Nil	Nil	26 developed, 1 transferred and 1 commercialised	Not set	Nil	Not set	55 with impact factor ranging from 0.160 to 9.60	Not set	2
Nil	29-07-2003	31-03-2007	Nil	20	7 developed, 1 transferred and 1 commercialised	25	10 filed and 9 granted	25	35 with impact factor ranging from 0.6 to 2.78	2.5	0.21
(+) 6.69	06-05-2004	30-09-2007	6	Nil	Nil	Not set	1 filed and none granted***	Not set	9 with impact factor ranging from 2.215 to 3.436	Not set	8.3
(+) 10.12	01-04-2003	31-03-2008	12	Nil	9 developed, 1 transferred and 1 commercialised	20	2 filed and none granted	40	47 with impact factor ranging from 0.29 to 3.22	Not set	1.66
(+) 0.76	19-01-2004	31-03-2007	Nil	Nil	13 developed, 4 transferred and 2 commercialised	Not set	7 filed and none granted	Not set	70 with impact factor ranging from 0 to 4.054	40	2.275
(+) 1.72	16-01-2004	31-03-2007	Nil	Nil	6 developed, 1 transferred and 1 commercialised	12	2 filed and none granted	25	44 with impact factor ranging from 0.22 to 2.86	16	4.01
(-) 0.38	01-08-2003	January 2010	34	36	21 developed, 1 transferred and 1 commercialised	7	1 filed and none granted	Not set	31 with impact factor ranging from 0.449 to 2.411	9	8.1
(+) 2.27	01-08-2003	31-03-2007	Nil	30****	11 developed, 1 transferred and none commercialised	Not set	7 filed and 4 granted	Not set	11 with impact factor ranging from 0 to 0.387	Not set	Nil
(+) 6.83	01-04-2004	31-03-2007	Nil	Nil	2 developed, 1 transferred and none commercialised	50	29 filed and 28 granted	Not set	33 with impact factor ranging from 0.702 to 9.771	Not set	Nil

Sl. No.	Name of project	Nodal Lab	Other participating Labs	Number of activities			Activities completed[#]			Sanc-tioned cost	Actual expr.
				Total	Net-work Mode	Non-Net-work Mode	Fully	Partially	Not achieved		
15.	Asthma and allergic disorders mitigation mission	IICB	IICT, IGIB, IIIM, IITR and CCMB	6	6	Nil	5	Nil	1	24.49	23.77
16.	Newer scientific herbal preparations for global positioning	IIIM	NBRI, CDRI, CIMAP, IITR, IICB, IICT, IHBT, IMMT and CFTRI	10	10	Nil	10	Nil	Nil	24.90	21.98
17.	Developing new generation fuels & lubricants	IIP	CIMFR, NCL, IIIM and NIIST	5	5	Nil	Nil	5	Nil	24.06	22.52
18.	Drug target development using in silico biology	IGIB	IICB, IIIM, IMTECH and CDRI	15	15	Nil	15	Nil	Nil	49.60	48.62
19.	Exploration of microbial wealth of India for novel compounds and bio-transformation process	IMTECH	IIIM, IHBT, IGIB, NBRI, NEIST, IMMT, NEERI, NIO, NCL, IICT and NIIST	2	2	Nil	2	Nil	Nil	20.47	20.53
20.	Bio-mineral processing for extraction of metal values from ores/concentrates/wastes	IMMT	IICB and NML	6	6	Nil	5	1	Nil	16.00	14.73
21.	Developing and sustaining high science & technology for national aerospace programmes	NAL	CMERI, AMPRI, CSIO and NPL	48	5	43	42	Nil	6	80.70	77.79
22.	Development of catalysis and catalysts	NCL	IIP, IICT, CSMCRI, CFRI, IICB, IMMT, IIIM, NEIST and NIIST	6	6	Nil	2	4	Nil	23.00	23.00
23.	Industrial waste minimisation and clean up	NEERI	CECRI, CGCRI, CLRI, CSIO, CMERI, IGIB, IICT, IIP, IITR, NBRI, NCL, NGRI, NML, AMPRI, IMMT, NEIST and NIIST	37	37	Nil	37	Nil	Nil	15.93	13.93
24.	Impact of anthropogenic perturbations[##] on oceanographic-atmospheric processes in and around India in the context of global change	NIO	NGRI and NPL	3	3	Nil	Nil	3	Nil	14.01	14.00
25.	Technology for engineering critical assessment	NML	CBRI, CGCRI, CMERI, CRRI, NAL, AMPRI and SERC	6	6	Nil	Not indicated			14.98	15.21
26.	Upgradation of SI base units, national standards of measurements and apex calibration facilities	NPL	CFTRI, CFRI, CMERI, CSIO, IIP, IITR, NAL, NEERI, NIO, NML, NEIST and SERC	23	23	Nil	15	4	4	21.21	15.21
27.	Design analysis and health assessment of special structures including bridges	SERC	CMERI, CRRI, NML, CECRI, AMPRI and CBRI	6	6	Nil	Not indicated			16.70	16.34

Disturbances caused due to human activities

Excess (-)/ Un-spent Balance (+)	Date of start	Date of finish	Delay* (months)	Outputs from project							
				Technologies developed		Patents filed and granted		Publications and impact factor		ECF earned	
				Tar-get	Actual	Tar-get	Actual	Tar-get	Actual	Tar-get	Act-ual
(+) 0.72	30-07-2003	31-03-2007	Nil	Not set	23 developed and none transferred and commercialised	Not set	7 filed and 3 granted	Not set	38 with impact factor ranging from 0.250 to 7.205	Not set	Nil
(+)2.92	01-08-2003	30-09-2010	42	Not set	5 developed, none transferred and commercialised	7	5 filed and 1 granted	Not set	24 with impact factor ranging from 0.385 to 4.044	Not set	Nil
(+) 1.53	August 2003	31-03-2007	Nil	Not set	21 developed, 1 transferred and 1 commercialised	Not set	38 filed and 9 granted	Not set	22 with zero impact factor	Not set	0.08
(+) 0.98	16-01-2004	31-03-2011	48	250	62 developed, 4***** transferred and 4 commercialised	50	18 filed and 5 granted	100	129 with impact factor ranging from 0.668 to 10.256	Not set	6.3
(-) 0.06	19-01-2004	31-03-2010	36	Not set	Nil	20	14 filed****** and none granted	12	69 with impact factor zero	2.5	Nil
(+) 1.27	18-03-2004	31-03-2007	Nil	Not set	1 developed, 1 transferred and none commercialised	Not set	Nil	Not set	32 with impact factor ranging from 0.350 to 4.360	Not set	1.38
(+) 2.91	03-02-2005	31-03-2010	36	Not set	9 developed, 3 transferred and 3 commercialised	Not set	11******* filed and 6 granted	Not set	145 papers published with impact factor ranging from 0.3042 to 3.745	Not set	Nil
Nil	01-08-2003	September 2007	6	Not set	5 developed, 1 transferred and 1 commercialised	Not set	22 filed and 4 granted	Not set	136 with impact factor ranging from 0.313 to 5.415	Not set	0.14
(+) 2.00	08-04-2004	30-09-2007	6	10	41 developed, 3 transferred and 3 commercialised	111	24 filed and 18 granted	295	115 with impact factor 0.199 to 20.01	Not set	1.89
(+)0.01	17-02-2004	31-03-2008	12	Not set	Nil	Not set	Nil	Not set	54 with impact factor ranging from 0 to 30.028	Not set	Nil
(+) 0.23	29-03-2004	31-03-2007	Nil	Not set	8 developed, 6 transferred and none commercialised	Not set	3 filed and none granted	Not set	101 with zero impact factor	Not set	6.5
(+) 6.00	29-03-2004	31-03-2008	12	Not set	6 developed, 4 transferred and none commercialised	Not set	9 filed and 6 granted	Not set	73 papers published with impact factor ranging from 0.09 to 7.18	20.80	16.76
(+) 0.36	01-03-2004	31-03-2007	Nil	Not set	24 developed and none transferred and commercialised	5	2 filed and none granted	50	357 with zero impact factor	Not set	0.08

*Taking into consideration scheduled date of completion as 31-03-2007.
** Though no technology was stated to be transferred, the statement of transfer of two technologies is contradictory.
*** Although no technology was developed from the project, one patent was stated to have been filed, which is contradictory.
****Although no target was indicated in the project proposal, CSIO stated in reply (December 2012) that 30 technologies were to be developed from the project.
***** Audit observed that four software were actually developed from a project under another scheme of CSIR and not from network project.
******Since no technology was developed from the project the statement of filing of 14 patents is contradictory.
*******This includes 4 copy rights and 7 patents.

Appendix III (Refer Para 2.2)

Delay in sanctioning of network projects

Sl. No.	Title of the Project	Nodal Laboratory	Date of commencement of Tenth Five Year Plan	Date of sanction of network project by CSIR	Delay (in months)
1	Developing new building construction materials	CBRI	April 2002	August 2003	16
2	Developing cells & tissue engineering	CCMB	April 2002	July 2003	15
3	Animal models and animal substitute technologies	CDRI	April 2002	October 2003	18
4	Developing capabilities & facilities for micro-electromechanical systems (MEMS) and sensors	CEERI	April 2002	January 2004	21
5	Quality enhancement of coal for its efficient utilisation	CIMFR	April 2002	May 2004	25
6	Positioning Indian nutraceuticals and neutrigenomics on global platform	CFTRI	April 2002	August 2003	16
7	Development of key technologies for photonics and opto-electronics	CGCRI	April 2002	August 2003	16
8	Development of medicinal plant chemotypes for enhanced marker and value added compounds	CIMAP	April 2002	July 2003	15
9	Environment friendly leather processing technology	CLRI	April 2002	January 2004	22
10	Capacity building for coastal placer mineral mining	CIMFR	April 2002	April 2003	12
11	Developing capabilities in advanced manufacturing technology	CMERI	April 2002	January 2004	21
12	Electronics for societal purposes	CSIO	April 2002	August 2003	16
13	Discovery, development and commercialisation of new bioactives and traditional preparation	CSIR Hqs.	April 2002	April 2004	24
14	New and improved road technologies	CRRI	April 2002	August 2003	16
15	Drug target development using in-silico biology	IGIB	April 2002	January 2004	21
16	Asthmatic and allergic disorders mitigation mission	IICB	April 2002	July 2003	15
17	Newer scientific herbal preparations for global positioning	IIIM	April 2002	August 2003	16
18	Developing new generation fuels & lubricants	IIP	April 2002	August 2003	16
19	Biomineral processing for extraction of metal values from ores and concentrates	IMMT	April 2002	March 2004	23

Sl. No.	Title of the Project	Nodal Laboratory	Date of commencement of Tenth Five Year Plan	Date of sanction of network project by CSIR	Delay (in months)
20	Exploration and exploitation of microbial wealth of India for novel compounds and biotransformation process	IMTECH	April 2002	January 2004	21
21	Developing and sustaining high science & technology for national aerospace programmes	NAL	April 2002	February 2005	34
22	Impact of anthropogenic perturbations oceanographic atmospheric processes in and around India in the context of global change	NIO	April 2002	February 2004	22
23	Development of catalysis & catalysts	NCL	April 2002	August 2003	16
24	Industrial waste minimisation and clean up	NEERI	April 2002	April 2004	24
25	Technology for engineering critical assessment	NML	April 2002	March 2004	23
26	Upgradation of SI base units, national standards of measurements and apex calibration facilities	NPL	April 2002	March 2004	23
27	Design, analysis and health assessment of special structures including bridges	SERC	April 2002	March 2004	23

Appendix IV (Refer Para 2.2)

List of projects that were completed beyond scheduled duration of Tenth Five Year Plan

Sl. No.	Name of project	Nodal Laboratory	Scheduled date of completion of project	Actual date of completion of project	Delay in months
1	Quality enhancement of coal for its efficient utilisation	CIMFR	March 2007	September 2007	6
2	Capacity building for coastal placer mineral mining	CIMFR	March 2007	March 2008	12
3	Electronics for societal purposes	CSIO	March 2007	September 2007	6
4	Discovery, development and commercialisation of new bioactives and traditional preparation	CSIR-Hq	March 2007	March 2008	12
5	New and improved road technologies	CRRI	March 2007	January 2010	34
6	Drug target development using in-silico biology	IGIB	March 2007	March 2011	48
7	Newer scientific herbal preparations for global positioning	IIIM	March 2007	September 2010	42
8	Exploration and exploitation of microbial wealth of India for novel compounds and biotransformation process	IMTECH	March 2007	March 2010	36
9	Developing and sustaining high science & technology for national aerospace programmes	NAL	March 2007	March 2010	36
10	Impact of anthropogenic perturbations oceanographic atmospheric Processes in and around India in the context of global change	NIO	March 2007	March 2008	12
11	Development of catalysis & catalysts	NCL	March 2007	September 2007	6
12	Industrial waste minimisation and clean up	NEERI	March 2007	September 2007	6
13	Up-gradation of SI base units, national standards of measurements and apex calibration facilities	NPL	March 2007	March 2008	12

Appendix V (Refer Para 2.3.1)

Statement showing measurable deliverables proposed in 27 selected network projects

Sl. No.	Name of the Project	Nodal Laboratory	Targets proposed for the deliverables							
			No. of Technologies to be developed	Amount of Revenue to be generated through sale of technology	No. of publications to be brought out	No. of Patents to be filed	Total amount of ECF to be earned (₹ in crore)	Value of Employment generation (₹ in crore)	Value of Import substitution (₹ in crore)	Societal/Employment benefits to be earned (mandays in crore)
1	Developing new building construction materials	CBRI	10	No target	150	20	9.50	No target	No target	No target
2	Developing cells & tissue engineering	CCMB	3	No target	No target	No target	No target	No target	No target	No target
3	Animal models and animal substitute technologies	CDRI	No targets set							
4	Developing capabilities & facilities for micro-electromechanical systems (MEMS) and sensors	CEERI	No target	No target	No target	50	15	No target	No target	No target
5	Quality enhancement of coal for its efficient utilisation	CIMFR	No targets set							
6	Positioning Indian nutraceuticals and neutrigenomics on global platform	CFTRI	No target	No target	35	60	2	12.50	27	0.11
7	Development of key technologies for photonics and opto-electronics	CGCRI	No targets set							
8	Development of medicinal plant chemotypes for enhanced marker and value added compounds	CIMAP	20	No target	25	25	2.50	13.52	38	0.12
9	Environment friendly leather processing technology	CLRI	No target	No target	No target	No target	40	No target	No target	No target

Sl. No.	Name of the Project	Nodal Laboratory	Targets proposed for the deliverables							
			No. of Technologies to be developed	Amount of Revenue to be generated through sale of technology	No. of publications to be brought out	No. of Patents to be filed	Total amount of ECF to be earned (₹ in crore)	Value of Employment generation (₹ in crore)	Value of Import substitution (₹ in crore)	Societal/Employment benefits to be earned (mandays in crore)
10	Capacity building for coastal placer mineral mining	CIMFR	No target	No target	40	20	No target	No target	No target	No target
11	Developing capabilities in advanced manufacturing technology	CMERI	No target	No target	25	12	16	No target	No target	No target
12	Electronics for societal purposes	CSIO	30	No target	No target	No target	No target	No target	No target	No target
13	Discovery, development and commercialisation of new bioactives and traditional preparation	CSIR Hqs.	No target	No target	No target	50	No target	No target	No target	No target
14	New and improved road technologies	CRRI	36	No target	No target	7	9	No target	No target	No target
15	Drug target development using in-silico biology	IGIB	250	10	100	50	No target	No target	No target	No target
16	Asthmatic and allergic disorders mitigation mission	IICB	No targets set							
17	Newer scientific herbal preparations for global positioning	IIIM	No target	No target	No target	7	No target	No target	No target	No target
18	Developing new generation fuels & lubricants	IIP	No targets set							
19	Biomineral processing for extraction of metal values from ores and concentrates	IMMT	No targets set							

Sl. No.	Name of the Project	Nodal Laboratory	Targets proposed for the deliverables							
			No. of Technologies to be developed	Amount of Revenue to be generated through sale of technology	No. of publications to be brought out	No. of Patents to be filed	Total amount of ECF to be earned (₹ in crore)	Value of Employment generation (₹ in crore)	Value of Import substitution (₹ in crore)	Societal/Employment benefits to be earned (mandays in crore)
20	Exploration and exploitation of microbial wealth of India for novel compounds and biotransformation process	IMTECH	No target	No target	12	20	2.50	2	23	0.12
21	Developing and sustaining high science & technology for national aerospace programmes	NAL	No targets set							
22	Impact of anthropogenic perturbations oceanographic atmospheric processes in and around India in the context of global change	NIO	No targets set							
23	Development of catalysis & catalysts	NCL	No targets set							
24	Industrial waste minimisation and clean up	NEERI	10	No target	295	111	No target	No target	No target	No target
25	Technology for engineering critical assessment	NML	No targets set							
26	Upgradation of SI base units, national standards of measurements and apex calibration facilities	NPL	No target	No target	No target	No target	23.40	No target	No target	No target
27	Design analysis and health assessment of special structures including bridges	SERC	No target	No target	50	5	No target	No target	No target	No target
Total			**359**	**10**	**732**	**437**	**119.90**	**28.02**	**88**	**0.35**

Appendix VI- *(Refer Para 2.5)*

List of equipment procured and installed at the fag end /after completion of the project

Sl. No	Title of the Project	Actual expenditure (₹ in crore)	Date of completion of the project	Sl. No. of items	Name of the equipment	Cost (₹ in crore)	Procured by	Date of issue of supply order	Date of receipt	Date of commissioning	Remarks
1.	Developing capabilities & facilities for micro-electromechanical systems (MEMS) and sensors	31.89	March 2007	1.	Deep Reactive Ion Etching	3.15	CEERI	September 2006	April 2007	July 2007	DRIE system could not be utilised during the tenure of the project due to delayed sanction and allocation of fund by CSIR and also due to prolonged purchase formalities. CSIR stated in July 2012 that DRIE was being used regularly for ongoing projects.
				2.	Acoustic Imager (Manual System)	0.87	CEERI	August 2004	April 2007	June 2007	CEERI failed to utilise the equipment during the project period due to delay in installation of the same. The description of the commodity as per the purchase order was not quoted in the application for opening of LC. There was delay in taking decision for sending a representative to USA for pre-dispatch inspection. CSIR stated in July 2012 that Acoustic Imager was being used regularly for ongoing projects
2.	Development of medicinal plant chemotypes for enhanced marker	21.66	March 2007	3.	GLP grade extraction unit	1.24	IIIM	February 2007	September 2008	February 2010.	Audit observed that three items of equipment procured by CIMAP could not be utilised for the project activities due to procurement of
				4.	Autopurification system	1.24	CIMAP	September 2005	April 2006	February 2007	

Sl. No	Title of the Project	Actual expenditure (₹ in crore)	Date of completion of the project	Sl. No. of items	Name of the equipment	Cost (₹ in crore)	Procured by	Date of issue of supply order	Date of receipt	Date of commissioning	Remarks
	and value added compounds			5.	Complete Automated Liquid handling System for DNA chip construction and detection	0.90	CIMAP	March 2005	November 2005	March 2009	equipment after closure of the activity in one case and installation of equipment after closure/at the tail end of the activity in the remaining two cases. In respect of two[1] of the above cases, CSIR stated (July 2012) that the absence of major equipments did not hamper the developmental work which was carried out with other existing facilities. Since the entire objective of network projects was about pooling of resources of various CSIR laboratories, the fact that facilities were available elsewhere for carrying out the work denotes faulty decision to procure the above equipment under this project. The reply of CSIR indicates that effectively, procurement of above equipment costing ₹3.38 crore, was avoidable.
3.	Developing capabilities in advanced manufacturing technology	16.13	March 2007	6.	SLS system	2.05	CMERI	Not available	Not available	After completion of the project	Though the actual date of receipt/installation/commissioning was not made available, CMERI stated in December 2011 that the system was procured after completion of the project. CSIR stated in July 2012 that as the

[1] (i) GLP grade extraction unit and (ii) Automated Liquid handling System for DNA chip construction and detection

Sl. No	Title of the Project	Actual expenditure (₹ in crore)	Date of completion of the project	Sl. No. of items	Name of the equipment	Cost (₹ in crore)	Procured by	Date of issue of supply order	Date of receipt	Date of commissioning	Remarks
											machine got damaged during transit, the system was procured after tenure of the project. However, the fact remained that activity relating to patient specific bio implants could not tried through rapid prototyping route using selective laser sintering process during tenure of the project.
4.	Electronics for societal purposes	18.87	September 2007	7.	Intelligent Electronic Nose	0.49	CSIO	March 2007	October 2007	February 2008	Of 53 items of equipment valuing ₹2.79 crore procured by CSIO for its activities under the project, it was seen that five items of equipment costing ₹1.21 crore could not be utilised for project activities as these items were either received/installed after completion of the project or installed at the tail end of completion. As the intended technology was treated as completed without the use of the equipment, the expenditure incurred on the equipment valued at ₹1.21 crore has resulted in avoidable expenditure to that extent. CSIR stated in July 2012 that equipment mentioned were part of the infrastructural facilities which were continuously utilised for
				8.	Gel Permeation Chromatography	0.26	CSIO	March 2007	July 2007	August 2007	
				9.	Multiproduct Calibrator	0.23	CSIO	August 2007	May 2008	January 2009	
				10.	Function Tester Incircuit	0.12	CSIO	March 2007	April 2007	May 2007	
				11.	Metlab Software	0.11	CSIO	October 2006	February 2007	May 2007	

Sl. No	Title of the Project	Actual expenditure (₹ in crore)	Date of completion of the project	Sl. No. of items	Name of the equipment	Cost (₹ in crore)	Procured by	Date of issue of supply order	Date of receipt	Date of commissioning	Remarks
											similar nature of R&D work. However the fact remained that the equipments were not utilised for the purpose for which they were procured.
5.	Drug target development using in-silico biology	48.62	March 2011	12.	SGI Altix ultraviolet system	0.83	IGIB	September 2010	December 2010	March 2011	The system costing ₹ 82.74 lakh for large scale integrative analysis of biological data was procured at the fag end of the project. CSIR stated that the endeavour was to utilise the resource available for the project most optimally and gainfully. The reply of CSIR needed to be viewed in light of the fact that procurement of equipment at the fag end of the project resulted in non-utilisation of the item for which it was procured.
				13.	Mid range server	0.12	IGIB	March 2011	August 2011	August 2011	Server costing ₹ 12.27 lakh was not utilised in the project due to delayed submission of placement of order. CSIR stated that the endeavour was to utilise the resource available for the project most optimally and gainfully. The reply of CSIR needed to be viewed in light of the fact that procurement of item at the fag end of the project resulted in non-utilisation of the item for which it was procured.

Sl. No	Title of the Project	Actual expenditure (₹ in crore)	Date of completion of the project	Sl. No. of items	Name of the equipment	Cost (₹ in crore)	Procured by	Date of issue of supply order	Date of receipt	Date of commissioning	Remarks
				14.	Six desk side supercomputers for analysis of high-throughput data for gene-gene interactions	1.16	IGIB	February 2011	May 2011	May 2011	Placement of purchase order at the fag end of a seven year project resulted in non-installation of the indented items costing ₹ 116.32 lakh within the tenure of project. CSIR stated that the endeavour was to utilise the resource available for the project most optimally and gainfully. The reply of CSIR needed to be viewed in light of the fact procurement of item at the fag end of the project resulted in non-utilisation of the item for which it was procured.
6.	Developing new generation fuels & lubricants	22.52	March 2007	15.	C 80 Calvet Calorimeter with adaptation for adsorption studies	0.46	IIP	29.03.06	10.07.06	13.10.06	Audit observed that procurement of equipment costing ₹ 5.32 crore was proposed to be made in 2002-03. Audit further observed that supply orders were issued after two years or more and the same were received/installed at the tail end or after completion of the project. CSIR stated in July 2012 that progress of the project did not
				16.	Host computer	1.23	IIP	24.03.06	29.08.06	25.02.09	
				17.	Full flow dilution tunnel for diesel vehicles	2.21	IIP	29.03.05	02.01.06	25.02.09	

Sl. No	Title of the Project	Actual expenditure (₹ in crore)	Date of completion of the project	Sl. No. of items	Name of the equipment	Cost (₹ in crore)	Procured by	Date of issue of supply order	Date of receipt	Date of commissioning	Remarks
				18.	Dynamic vehicle test bed	1.42	IIP	08.03.06	December 06	09.02.07	suffer as the old equipment was available. The new equipment were utilised to address future requirements. However the fact remained that the equipment were not utilised for the purpose for which they were procured.
7.	Bio mineral processing for extraction of metal values from ores and concentrates	14.73	March 2007	19.	Inductively Coupled Plasma Mass Spectrometer (ICPMS)	1.20	IMMT	March 2004	August 2004	September 2008	The delay was due to failure to arrange pre-requisites for installation of the equipment immediately after receipt. CSIR stated in July 2012 the equipment was being used for carrying of R&D projects. The fact remained that the equipment could not be used for the intended purpose in the project.
				20.	Upgradation of existing 'X-Pert' x-ray Diffractometer	0.68	IMMT	March 2007	August 2007	March 2008	The delay was due to injudicious decision of IMMT to issue work order at the fag end of the project in March 2007. CSIR stated in July 2012 the equipment was being used for carrying of R&D projects. The fact remained that the equipment could not be used for the intended purpose in the project.

Sl. No	Title of the Project	Actual expenditure (₹ in crore)	Date of completion of the project	Sl. No. of items	Name of the equipment	Cost (₹ in crore)	Procured by	Date of issue of supply order	Date of receipt	Date of commissioning	Remarks
				21.	CHN Analyser	0.29	IMMT	March 2006	September 2006	December 2007	The delay was due to failure of the supplier to commission the equipment immediately after receipt even after repeated attempts. CSIR stated in July 2012 the equipment was being used for carrying of R&D projects. The fact remained that equipment could not be used for the intended purpose in the project.
				22.	Transmission Electron Microscope (TEM)	2.54	IMMT	March 2006	December 2006	June 2008	Repeated defects developed in the equipment at the time of commissioning, due to which it could not be used in the project. CSIR stated in July 2012 the equipment was being used for carrying of R&D projects. The fact remained that the equipment was not used for the intended purpose in the project.
				23.	Potentiostat/ Galvanostat	0.13	IMMT	January 2007	August 2007	January 2008	The delay was due to issue of supply order at the fag end of the project in January 2007. CSIR stated in July 2012 the equipment was being used for carrying of R&D projects. The fact remained that the equipment could not be used for the intended purpose in the project.

Sl. No	Title of the Project	Actual expenditure (₹ in crore)	Date of completion of the project	Sl. No. of items	Name of the equipment	Cost (₹ in crore)	Procured by	Date of issue of supply order	Date of receipt	Date of commissioning	Remarks
				24.	Super Critical fluid extraction	0.36	IMMT	January 2007	June 2007	October 2007	The delay was due to issue of supply order at the fag end of the project in January 2007. CSIR stated in July 2012 the equipment was being used for carrying of R&D projects. The fact remained that the equipment could not be used for the intended purpose in the project.
8.	Developing and sustaining high science & technology for national aerospace programmes	77.79	March 2010	25.	High Pressure Compressed air supply system with dryer	3.67	NAL	March 2008	October 2009	March 2010	Under this project NAL procured these equipments under a particular activity titled "Ramjet/Scramjet Test Facilities" which was completed in March 2008. On being pointed out NAL stated in January 2012 that objectives of the project were met but after the specified completion date. However NAL did not furnish any documentary evidence showing achievement of the objectives and status of evaluation of achievement conducted by the MC constituted for this purpose. CSIR did not offer any comments in July 2012 regarding delay in procurement of equipment after completion of the project.
				26.	High Pressure 200 bar seamless gas cylinders of 2500 l water capacity, manifold system & support system	2.68	NAL	Not available	December 2009	June 2010	
				27.	NI Data acquisition & control system	0.15	NAL	Not available	Not available	August 2008	
				28.	Exciter, Ignitor, Leads and Connector	0.25	NAL	Not available	April 2008	May 2008	

Sl. No	Title of the Project	Actual expenditure (₹ in crore)	Date of completion of the project	Sl. No. of items	Name of the equipment	Cost (₹ in crore)	Procured by	Date of issue of supply order	Date of receipt	Date of commissioning	Remarks
9.	Upgradation of SI base units, national standards of measurements and apex calibration facilities	15.21	March 2008	29.	Ion Chromatography System	0.46	NPL	September 2007	December 2007	January 2008	Though the project was started in March 2004, supply order was issued on January 2007 and September 2007 after a lapse of three years. CSIR stated in July 2012 that Ion Chromatography System was delayed in the process because tenders were invited thrice as the scientific equipments were generally not available on the shelf. As regards Gas Chromatographs (GCS) System the delay was also stated to be due to re inviting of tenders. The fact remained that the equipment could not be used for the intended purpose in the project.
				30.	Gas Chromatographs (GCS) System	0.41	NPL	January 2007	September 2007	February 2008	
10.	Industrial waste minimisation and cleanup	13.93	September 2007	31.	X-ray defraction unit	0.25	NEERI	September 2006	July 2007	July 2007	The equipment could not be used in the project due to delay in issue of supply order.
11	Quality enhancement of coal for its efficient utilisation	7.31	September 2007	32.	Digital contact angle and surface tension analyzer	0.11	CIMFR	March 2007	June 2007	January 2008	Issuance of purchase order at the fag end of project resulted in delay in installation. As a result, the equipment could not be used for the intended purpose in the project.
12	Design analysis and health assessment of	16.34	March 2007	33.	Upgradation of RS Console software	0.13	SERC	October 2006	June 2007	July 2007	SERC stated that all the equipment purchased were intended to strengthen all round R&D

Sl. No	Title of the Project	Actual expenditure (₹ in crore)	Date of completion of the project	Sl. No. of items	Name of the equipment	Cost (₹ in crore)	Procured by	Date of issue of supply order	Date of receipt	Date of commissioning	Remarks
	special structures including bridges			34.	Tower Crane	1.65	SERC	November 2006	February 2007	April 2007	capabilities and that all the equipment procured had the potential for usage in all ongoing projects. This indicated that equipment were procured for up-gradation of infrastructure and not for network project. The reply of SERC is not tenable since CSIR had stipulated that the laboratories should procure only those equipments that were absolutely required for carrying out research under the network project. CSIR did not offer any comments on the issue.
				35.	Upgradation of Servo controller with software	0.33	SERC	Not available	March 2007	After July 2007	
13	Impact of anthro-pogenic perturbations on oceano-graphic atmospheric process	14.01	March 2008	36.	Spectrometer	0.18	NPL	March 2005	July 2005	December 2009	The equipment was commissioned after completion of the project in March 2008. This resulted in non-completion of the work under the project. CSIR stated in July 2012 that the spectrometer was being used for generation of long-term records which was major purpose of launching the network project. The fact however remained that the equipment could not be used for the intended purpose for which it was procured under the project.
14	New and improved road technologies	24.30	January 2010	37.	APTF	13.37	CRRI	February 2007	January 2010	April 2010	CSIR stated (July 2012) that there was delay in deployment of terms for pre shipment factory acceptance test and training, re-

Sl. No	Title of the Project	Actual expenditure (₹ in crore)	Date of completion of the project	Sl. No. of items	Name of the equipment	Cost (₹ in crore)	Procured by	Date of issue of supply order	Date of receipt	Date of commissioning	Remarks
											tendering in selection of transporter and creation of infrastructural facilities. The fact remained that the equipment could not be used for the intended purpose in the project.
15	Development of key technologies for photonics and opto-electronics	31.95	March 2007	38.	FBG/LPG	1.80	CSIO	NA	NA	Not commissioned upto October 2007	CSIR stated (July 2012) that the machines were to be procured from two different countries with integration of two systems at the place of one of the companies. During the process one of the companies was merged with new company and completion of various formalities took precious time. The fact however remained that the equipment could not be used for the intended purpose for which it was procured under the project.
TOTAL						**48.73**					

Appendix VII (Refer Para 2.6.1)

Status of meetings of Monitoring Committee and Task Force

Sl. No	Title of the Project	Nodal Lab	Month of sanction by CSIR	Month of issue order for constitution of MC by CSIR	Month of completion of the project	No. of meetings of MC to be conducted	No. of meetings of MC actually conducted	Percentage of shortfall of meetings of MC	No. of meetings of TF to be conducted	No. of meetings of TF actually conducted	Percentage of shortfall of meetings of TF
1	Developing new building construction materials	CBRI	August 2003	October 2004	March 2007	5	Not available	-	10	Not available	-
2	Developing cells & tissue engineering	CCMB	July 2003	October 2004	March 2007	5	5	0	10	1	90
3	Animal models and animal substitute technologies	CDRI	October 2003	October 2004	March 2007	5	2	60	10	1	90
4	Developing capabilities & facilities for micro-electromechanical systems (MEMS) and sensors	CEERI	January 2004	January 2005	March 2007	4	4	0	10	5	50
5	Quality enhancement of coal for its efficient utilisation	CIMFR	May 2004	October 2004	September2007	6	5	17	12	Not available	-
6	Positioning Indian nutraceuticals and neutrigenomics on global platform	CFTRI	August 2003	October 2004	March 2007	5	3	40	10	Not available	-
7	Development of key technologies for photonics and opto-electronics	CGCRI	August 2003	October 2004	March 2007	5	2	60	10	5	50
8	Development of medicinal plant chemotypes for enhanced marker and value added compounds	CIMAP	July 2003	October 2004	March 2007	5	2	60	10	2	80
9	Environment friendly leather processing technology	CLRI	January 2004	October 2004	March 2007	5	4	20	10	8	20
10	Capacity building for coastal placer mineral mining	CIMFR	April 2003	October 2004	March 2008	7	5	29	14	5	64

Sl. No	Title of the Project	Nodal Lab	Month of sanction by CSIR	Month of issue order for constitution of MC by CSIR	Month of completion of the project	No. of meetings of MC to be conducted	No. of meetings of MC actually conducted	Percentage of shortfall of meetings of MC	No. of meetings of TF to be conducted	No. of meetings of TF actually conducted	Percentage of shortfall of meetings of TF
11	Developing capabilities in advanced manufacturing technology	CMERI	January 2004	October 2004	March 2007	5	4	20	10	5	50
12	Electronics for societal purposes	CSIO	July 2003	October 2004	September2007	6	Not available	-	12	Not available	-
13	Discovery, development and commercialisation of new bioactives and traditional preparation	CSIR-Hqs.	April 2004	May 2005	March 2008	5	2	60	14	16	0
14	New and improved road technologies	CRRI	August 2003	October 2004	January 2010	9	6	33	18	9	50
15	Drug target development using in-silico biology	IGIB	January 2004	October 2004	March 2011	13	4	69	26	14	46
16	Asthmatic and allergic disorders mitigation mission	IICB	July 2003	October 2004	March 2007	5	3	40	10	Not available	-
17	Newer scientific herbal preparations for global positioning	IIIM	August 2003	October 2004	September 2010	12	3	75	24	7	71
18	Developing new generation fuels & lubricants	IIP	Not available	October 2004	March 2007	5	3	40	10	6	40
19	Biomineral processing for extraction of metal values from ores and concentrates	IMMT	March 2004	April 2005	March 2007	4	4	0	10	Not available	-
20	Exploration and exploitation of microbial wealth of India for novel compounds and biotransformation process	IMTECH	January 2004	November 2004	March 2007	10	2	80	22	Not available	-
21	Developing and sustaining high science & technology for national aerospace programmes	NAL	February 2005	October 2004	March 2010	10	Not available	-	22	Not available	-

Sl. No	Title of the Project	Nodal Lab	Month of sanction by CSIR	Month of issue order for constitution of MC by CSIR	Month of completion of the project	No. of meetings of MC to be conducted	No. of meetings of MC actually conducted	Percentage of shortfall of meetings of MC	No. of meetings of TF to be conducted	No. of meetings of TF actually conducted	Percentage of shortfall of meetings of TF
22	Impact of anthropogenic perturbations oceanographic atmospheric processes in and around India in the context of global change	NIO	February 2004	April 2005	March 2008	6	3	50	14	3	79
23	Development of catalysis & catalysts	NCL	August 2003	October 2004	September2007	6	3	50	12	Not available	-
24	Industrial waste minimisation and clean up	NEERI	April 2004	October 2004	September2007	6	6	0	12	Not available	-
25	Technology for engineering critical assessment	NML	March 2004	October 2004	March 2007	5	4	20	10	Not available	-
26	Upgradation of SI base units, national standards of measurements and apex calibration facilities	NPL	March 2004	October 2004	March 2008 (Upto December 2007)	7	1	86	14	3	79
27	Design analysis and health assessment of special structures including bridges	SERC	March 2003	October 2004	March 2007	5	5	-	10	5	50
TOTAL						**171**	**85**		**356**	**95**	

Appendix VIII (Refer Para 3.1)

Project wise position of number of technologies developed and commercialised

Sl. No	Project code	Nodal Lab	Number of techno-logies developed	Number of techno-logies transferred as of July 2012	Number of technologies commercialised as of July 2012	Revenue generated from sale of technology (₹ in lakh)
1	Developing new building construction materials	CBRI	33	19	19	1
2	Developing cells & tissue engineering*	CCMB	2	0	0	0
3	Animal models and animal substitute technologies	CDRI	41	0	0	0
4	Developing capabilities & facilities for micro-electromechanical systems (MEMS) and sensors	CEERI	16	0	2	0
5	Quality enhancement of coal for its efficient utilisation	CIMFR	0	0	0	0
6	Positioning Indian nutraceuticals and neutrigenomics on global platform	CFTRI	7	2	2	16
7	Development of key technologies for photonics and opto-electronics	CGCRI	26	1	1	3
8	Development of medicinal plant chemotypes for enhanced marker and value added compounds	CIMAP	7	1	1	21
9	Environment friendly leather processing technology	CLRI	13	4	2	227.50
10	Capacity building for coastal placer mineral mining	CIMFR	9	1	1	31
11	Developing capabilities in advanced manufacturing technology	CMERI	6	1	1	2
12	Electronics for societal purposes	CSIO	11	1	0	0.45
13	Discovery, development and commercialisation of new bioactives and traditional preparation	CSIR-Hq	2	1	0	0
14	New and improved road technologies	CRRI	21	1	1	2
15	Drug target development using in-silico biology**	IGIB	62	0	0	0
16	Asthmatic and allergic disorders mitigation mission	IICB	23	0	0	0

Sl. No	Project code	Nodal Lab	Number of techno-logies developed	Number of techno-logies transferred as of July 2012	Number of technologies commercialised as of July 2012	Revenue generated from sale of technology (₹ in lakh)
17	Newer scientific herbal preparations for global positioning	IIIM	5	0	0	0
18	Developing new generation fuels & lubricants	IIP	21	1	1	8
19	Biomineral processing for extraction of metal values from ores and concentrates	IMMT	1	1	0	0
20	Exploration and exploitation of microbial wealth of India for novel compounds and biotransformation process	IMTECH	0	0	0	0
21	Developing and sustaining high science & technology for national aerospace programmes***	NAL	9	3	3	0
22	Impact of anthropogenic perturbations oceanographic atmospheric processes in and around India in the context of global change	NIO	0	0	0	0
23	Development of catalysis & catalysts	NCL	5	1	1	14
24	Industrial waste minimisation and clean up	NEERI	41	3	3	51
25	Technology for engineering critical assessment	NML	8	6	0	1.7
26	Upgradation of SI base units, national standards of measurements and apex calibration facilities	NPL	6	4	0	4.56
27	Design analysis and health assessment of special structures including bridges	SERC	24	0	0	0
Total			**399**	**51**	**38**	**383.21**

* CSIR initially (July 2012) stated that revenue of ₹10.48 crore was earned, which was contradictory as no technology was developed. CSIR later (September 2012) accepted that the amount was not generated from this network project.

** CSIR stated (July 2012) that four software were transferred. Audit observed that these were actually developed from a project titled 'Development of versatile, portable software for Bioinformatics' under another scheme of CSIR.

*** CSIR stated (July 2012) that NAL generated revenue of ₹60.74 crore. Audit however observed that this amount was not realised from network project.

APPENDICES

Glossary of names of laboratories of CSIR

Abbreviation	Name of the Laboratory
CSIR-HQ	Council of Scientific and Industrial Research Headquarters, New Delhi
AMPRI	Advanced Materials and Processes Research Institute, Bhopal
CBRI	Central Building Research Institute, Roorkee
CCMB	Centre for Cellular and Molecular Biology, Hyderabad
CDRI	Central Drug Research Institute, Lucknow
CECRI	Central Electrochemical Research Institute, Karaikudi
CEERI	Central Electronics and Engineering Research Institute, Pilani
CFTRI	Central Food Technological Research Institute, Mysore
CGCRI	Central Glass and Ceramic Research Institute, Kolkata
CIMAP	Central Institute of Medicinal and Allied Plants, Lucknow
CIMFR	Central Institute of Mining and Fuel Research, Dhanbad
CLRI	Central Leather Research Institute, Chennai
CMERI	Central Mechanical Engineering Research Institute, Durgapur
CMMACS	Centre for Mathematical Modeling and Computer Simulation, Bengaluru
CRRI	Central Road Research Institute, New Delhi
CSIO	Central Scientific Instruments Organisation, Chandigarh
CSMCRI	Central Salt and Marine Chemicals Research Institute, Bhavnagar
IGIB	Institute of Genomics and Integrative Biology, New Delhi
IHBT	Institute of Himalayan Bioresource Technology, Palampur
IICB	Indian Institute of Chemical Biology, Kolkata
IICT	Indian Institute of Chemical Technology, Hyderabad
IIIM	Indian Institute of Integrative Medicine, Jammu
IIP	Indian Institute of Petroleum, Dehradun
IITR	Indian Institute of Toxicology Research, Lucknow
IMTECH	Institute of Microbial Technology, Chandigarh
IMMT	Institute of Minerals & Materials Technology, Bhubaneswar
NAL	National Aerospace Laboratories, Bengaluru
NBRI	National Botanical Research Institute, Lucknow
NCL	National Chemical Laboratory, Pune
NEERI	National Environmental Engineering Research Institute, Nagpur

Abbreviation	Name of the Laboratory
NGRI	National Geophysical Research Institute, Hyderabad
NIIST	National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram
NIO	National Institute of Oceanography, Goa
NISCAIR	National Institute of Science Communication and Information Resources, New Delhi
NML	National Metallurgical Laboratory, Jamshedpur
NEIST	North-East Institute of Science and Technology, Jorhat
NPL	National Physical Laboratory , New Delhi
SERC	Structural Engineering Research Centre, Chennai