

CHAPTER VII : PROJECT MANAGEMENT IN RESEARCH AND DEVELOPMENT ESTABLISHMENT (ENGINEERS)

7. Project Management in Research and Development Establishment (Engineers)

Staff Projects taken up for delivery of products required by Defence Services during the last 15 years achieved minimal success. Out of 19 closed Staff Projects only 3 underwent production, 2 partly achieved the project requirement and remaining 14 could not achieve success in terms of acceptance by the users. Projects were initiated without firm Staff Qualitative Requirement (SQR). Excess time overrun, failure of the laboratory to develop the desired deliverables and mismanagement in post development activities contributed to projects' failure.

7.1 Introduction

The Research & Development Establishment (Engineers) [R&DE (E)] Dighi is a laboratory set up at Pune in 1962 under Defence Research and Development Organisation (DRDO) with the primary role of development of mobility and counter mobility equipments for the Corps of Engineers. Over the years, the establishment has also diversified into development of ground system engineering for missile and other weapon systems. Amongst its major achievements are the Bridge Laying Tank on T-72 chassis, Mechanically Launched Assault Bridge (SARVATRA 15 m), Integrated Field Shelters for operation in NBC environment, Mine Field Marking Equipment, etc.

R&DE (E), like any other DRDO lab, takes up two kinds of projects viz (i) Staff Projects and (ii) Technology Demonstration. Staff Projects are taken up against firm demands placed by the user Services and are based on well-defined requirements projected in the Staff Qualitative Requirement (SQR). Such Projects are expected to result in deliverables within a specified time-frame for eventual induction into service. The second category of projects variously termed as Technology Demonstration /Research & Development (R&D) / Science &Technology(S&T) Projects are taken up for capability building in a given area of research or to solve specific problems arising out of or having a bearing on Staff Projects. These projects are planned to establish futuristic technologies for application in user based Staff Projects. R&D/TD Projects are also taken up to bring critical technologies to the level of maturity that is required for system development and are to that extent precursors to system development projects. Such projects usually involve moderate investment and have moderate success rates.

7.2 Scope of audit

We examined (2011) the projects undertaken by R&DE (E) during the past 15 years covering the period from 1995 to 2010, to make an independent evaluation of the success rate of its R&D endeavour, fully aware of the fact that R&D efforts need not meet with 100 *per cent* success.

We scrutinised 50 projects that included 24 Staff and 26 R&D/TD Projects, out of which 39 projects (19 Staff and 20 R&D/TD Projects) had been already closed after incurring an expenditure of ₹178.66 crore. Balance five Staff Projects and six R&D/TD Projects were still in progress as of February 2011. Out of 39 closed projects, seven Staff and six R&D/TD Projects amounting to ₹10.51 crore and ₹ 34.49 crore, respectively, were sub-projects undertaken on behalf of other DRDO labs.

7.3 Criteria to determine success of projects

Staff Projects can be considered successful if the deliverable in terms of equipments or systems is accepted by the users after satisfactory user trials for induction into Services. As R&D/TD Projects are planned to establish futuristic technologies for application in Staff Projects, such projects can be considered successful on utilization of the developed technology in a Staff Project.

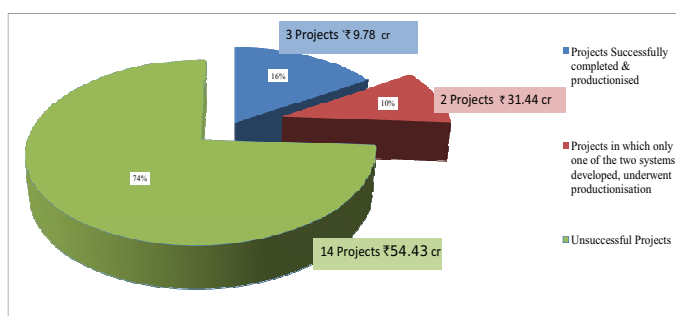
The Ministry stated (May 2012) that once the objectives of R&D/TD Projects are achieved, it should be termed as successful as a strong technological base of critical technologies has been established. The Ministry's reply should be viewed in the context that the main purpose of these projects is to establish successful technologies resulting in deliverables for end use in Staff Projects, or at least, in creation of intellectual property, verifiable with reference to registered patents, and in the absence of that the claim of success would appear to be only theoretical.

7.4 Staff Projects

7.4.1 High failure rate of Staff Projects

We noted that of the 19 closed projects, completed at a cost of ₹ 95.65 crore, only three projects¹² involving an expenditure of ₹ 9.78 crore (16 per cent) had graduated into production, as indicated in the chart below.

Status of Staff Projects: Total number of closed projects = 19



¹² Incidentally of the three successful projects, two projects completed at a cumulative cost of ₹ 3.14 crore, were sub-projects of the Main projects taken up by other DRDO Labs viz. CAIR Bangalore and VRDE Ahmednagar,

Another two projects, viz. Project SARVATRA and Project for Development of Short Span Bridging System, completed at a cost of ₹ 31.44 crore, were only partially successful. Under project SARVATRA, a 15 m and a 20 m bridging system were required to be developed out of which the former went into production. In the project for Development of Short Span Bridging System, 10 m and 5 m bridging systems were required to be developed out of which only the latter was considered for production. The products of the remaining 14 Staff Projects, which constituted 74 per cent of the closed Staff Projects on which a sum of ₹54.43 crore was spent, were not accepted by the users for a variety of reasons.

The Ministry stated that a project successfully realized but not accepted by the user cannot be termed as 'failure' in an R&D scenario as DRDO was not involved in productionisation. The Ministry's reply sidesteps the truism that the ultimate test of success in a Staff Project is productionisation of the developed system and its introduction into Services, even as it may be justifiably arguable in certain cases that part of the responsibility for failure of Staff Project would also lie with the users.

7.4.2 Reasons for low success rate of Staff Projects

Our analysis of closed Staff Projects, where the deliverables were unacceptable to the users, pointed to the following reasons for their failure to meet the demands of the user:

- > Taking up projects before finalisation of SQR (1 project);
- > Excessive time overrun often making the developed technology obsolete (3 projects);
- > Failure of the laboratory to develop the desired deliverables (3 projects);
- > Partial achievement of project requirement (2 projects); and
- > Mismanagement in Post Development Activities (3 projects).

The Ministry stated that the success rates of Staff Projects had been relatively low due to infirm General Staff Qualitative Requirement (GSQR), changing user requirements, lack of industrial base to support the transfer of technology (ToT) and bulk production, time overruns, etc. These issues were examined in audit and our findings are discussed as under:

7.4.3 Taking up projects before finalisation of the GSQR

DRDO undertakes the development of equipments/systems under a Staff Project in accordance with the time frame and functional and operational characteristics projected in SQR formulated by the users. SQR defines in precise terms the deliverables to be achieved. Formulation of an SQR is therefore of prime importance for undertaking a Staff Project. Taking up Staff Projects before finalisation of the SQR by the user carries the risk of the system developed not meeting the users' requirement. A case in point is the user's rejection of the Counter Mine Flail (CMF) on T-72 Tank, developed at a

cost of ₹ 7.94 crore, against the sanction of December 2002. The project had been taken up based on draft GSQR. The flailing requirements of CMF as reflected in the draft GSQR mentioned a vehicle safe lane of 4 metre and flailing depth of 25 cm, whereas as per the final GSQR the required vehicle safe lane and flailing depth was 4.5 metre and 30 cm respectively. Consequently, the equipment developed based on draft GSQR failed to meet the user requirement. A new project was, therefore, sanctioned by DRDO in February 2011 to develop an improved CMF at an additional cost of ₹ 49.85 crore. The project is scheduled for completion by February 2014.

The Ministry, while admitting that taking up projects based on draft SQR might sometimes result in non-acceptance of the systems, contended (May 2012) that waiting for a finalised GSQR to commence development activities would result in unproductive delays since the process of finalizing GSQR is long-drawn and time consuming. This contention is not tenable because if project had been taken up after receiving a firm SQR the risk of delay would have been counterbalanced by higher probability of acceptance of the end result by the user.

7.4.4 Excessive time overrun in Staff Projects

Efficacy of project management is measured by the delivery of project output within the given time frame and cost. However, we observed that time overrun was the norm rather than an exception in Staff Projects undertaken by R&DE (E). Of the 19 closed Staff Projects reviewed in audit, 13 Projects (68 per cent) did not adhere to the original time schedule. The number of extensions granted beyond the probable date of completion (PDC) to each of these 13 Projects ranged between one and four and the time overrun ranged between 7 and 96 months, thus allowing the projects to drag on for years together. However, even repeated PDC extensions could not ensure success of the projects as indicated in the table below:

Table showing unsuccessful projects involving frequent PDC extensions

Sl. No	Project No	Original PDC	Actual time taken	Number of PDC extensions	Status of the projects after closure
1	ADE-176.05	3 years 6 months	11 years 5months	03	Not accepted by users
2	RDE-392	4 years	7 years 2 months	03	Not accepted by users
3	RDE-394	3years	6 years	03	Not accepted by users
4	RDE-365	3years	9 years 2 months	04	Not accepted by users
5	RDE-350	4years	8 years 8 months	03	Not accepted by users

In two of the six Staff Projects closed within the original time frame, project activities continued even after closure of the projects with the approval of the competent financial authority (CFA), which made the fact of closure, a control feature, irrelevant.

The Ministry stated that PDC extensions had been sought due to 'techno-managerial reasons' beyond the control of project team. It further stated that in respect of closed projects, activities such as user trials, etc. continued even after their closure within the PDC since time frames for these activities were not in the control of the project team. The Ministry's contention was not

acceptable since successful development or otherwise of the project could be assessed only on the basis of user trial evaluation and closure of the project without a system having been trial evaluated precluded such assessment. Further, though certain technological problems were inherent in any development project, yet inordinate delays in development carry the risk of the technology under development being overtaken by improved technology in market and users addressing the gaps in capability/requirements by resorting to procurement from other sources.

This is illustrated by the fact that the inability of the lab to develop the system/equipment within the stipulated time frame, resulted in user looking for other alternatives, leading to closure of three Staff Projects notching up a cost of ₹12.88 crore without achieving their objectives as given below:-

Table showing project closed without achieving objectives

Name of the project and objective	Sanctioned cost/Date of sanction	Revised sanction/ completion cost	PDC	Status	Audit comment
Canal Embankment Assault System Equipment	₹ 12.72 crore/ April 1989	₹ 12.20 crore	April 1993	Closed in December 1997	Since the tanks on which the system had been developed became obsolescent, the user decided to opt for Sarvatra bridge, separately under development by the lab.
Development of Hypalon Coated Fabric & Fabrication of Water Tanks.	₹ 0.41 crore/ October 1988	₹ 0.38 crore	September 1991	Closed in December 1997	The Army, right from the start, had been insisting that the acceptance of the water tanks would be subject to clearance of potability and carcinogenicity test to be carried out by DRDO. However, R&DE contended that the test was not mandatory. Since Army was not ready to accept the tanks without subjecting them to these tests and there also being delay in development Army decided to procure the item off the shelf and proposed the foreclosure of the project.
Development of Hydraulic Operated Stanchion System for Arrestor Barrier for SU-30 Aircraft (two sub projects)	₹ 0.27 crore/ 0.06 crore July 2003/ July 2004	₹0.30 crore	September 2004	Closed in September 2004	The project was a sub-project of main project held by ADRDE, Agra for development of Arrestor Barrier for SU-30 Aircraft. ADRDE, Agra followed two parallel approaches for development of Stanchion for the Arrestor Barriers i.e one hydraulically operated stanchion to be developed by R&DE(E) and the other winch operated stanchion to be developed by ADRDE, Agra. Though the prototype of the hydraulic stanchion had been successfully developed by R&DE (E) it was not incorporated in the main project due to delay in development and the main project was completed by the main lab (ADRDE) with Electric Winch design.

Since liberal extensions of Staff Projects directly impact the users, proposals for approval of extensions to PDC should specify its likely impact on the user requirement and user's consent to such extensions should invariably be obtained to determine continuance or otherwise of the projects. The Ministry contended that though there was some delay in developing the Canal Embankment Assault System Equipment (CEASE), yet the system had been successfully developed and technology established. The user, however, felt that they could exploit equipment "SARVATRA" for this role. Hence CEASE did not get inducted. It added that the Army had backed out from placing bulk orders for water tanks. Regarding Stanchion system, it contended that development cost should not be considered as infructuous as based on the

R&D efforts already made the development cost had been saved in another project for Aircraft Arrestor Gear.

In all these cases, the long delays in completion of the projects were the main causes of the disinterest of the users in the products developed by the lab. It is, therefore, essential for DRDO to assess and commit a realistic time schedule, besides sticking to such schedules if only to retain the users' interest in the products.

7.4.5 Failure to develop the expected deliverables

Our empirical experience has shown that user requirement for development of indigenous systems is guided by availability of latest technologies in the world market but not accessible to them for a variety of reasons. However, taking up R&D projects to acquire capability in such technologies, without adequately addressing the complexities, often leads DRDO labs to overstate their existing capabilities. As a consequence, an expectation gap is created whereby, at the one end the lab is unable to develop the system as per the user requirement even during extended time frame; on the other end the users are reluctant to scale down their requirement to realistic levels which finally results in the closure of the projects. In the following three Staff Projects which entailed an expenditure of ₹ 8.34 crore, the desired systems could not be developed even during the extended time frames, due to certain technical problems in design/development of the systems.

Table showing failure to develop desired deliverables

Name of the project and objective	Sanctioned cost/Date of sanction	Revised sanction/ completion cost	PDC	Status	Audit comment
Development of two mobile Hydro- Pneumatic Launcher (HPL) for Mini Remotely Piloted Vehicle (RPV) FALCON	₹ 3.51 crore/ November 1991	₹ 6.13 crore	March 1995	Closed in March 2003	Two prototypes of HPL were to be developed under the project. The first prototype: HPL-I developed was condemned by the user and the second prototype HPL-II did not meet the User's requirements of cross country, road, rail and air mobility and transportability. To meet the User's requirement a new project had to be got sanctioned in January 2002 to develop the third HPL at a cost of ₹4.18 crore, thus resulting in infructuous expenditure of ₹ 6.13 crore on the development of the first two HPLs.
Development of Self Propelled Mine Burrier	₹ 2.75 crore/ January 2003	₹ 2.15 crore	July 2005	Closed in July 2005.	The project developed two separate systems as against a single but twin capability system as per GSQR and was closed without the equipment being trial evaluated by the user. During subsequent evaluation by the user in December 2009, it was observed that the system required some major improvements to make it more rugged and reliable. The system is still undergoing modifications and an expenditure of ₹ 1.50 crore has been incurred on these modifications since the closure of the project as of March 2012.
Light Weight Assault Boat (LWAB)	₹ 0.07 crore/ September 1998	₹ 0.06 crore	February 1999	Closed in June 2000.	The LWAB was developed in Fibre Reinforced Plastic and weighed 72 kg. Consequently though the boat generally met all the GSQR requirements the user did not recommend the boat for introduction in service due to increase in weight from the desired 60 kg.

The Ministry stated that it cannot be said that R&DE(E) did not provide HPL for project FALCON since prototype-I was in use from 1996 to 1998 and prototype II was in use from 1998 to 2002 (for trials). However, mobility performance of the delivered systems was not up to the mark due to the eccentric loading of the launcher rails. It further stated that technological expertise and experience gained during the development led to successful development and delivery of some other system. Thus, expenditure of ₹ 6.13 crore cannot be termed as infructuous. The reply is not tenable since this was not a TD Project, but a Staff Project where deliverables were expected to match the user requirements.

Regarding Self Propelled Mine Barrier, the Ministry agreed that user trials were not planned to be conducted within the project PDC and modifications were being conducted to improve product performance based on users renewed requirements. The Ministry's contention is not agreed to as the system developed was not as per the User's requirement as spelt out in the GSQR and there was no renewed requirement from their end. The Ministry claimed that the Light Weight Assault Boats that had been developed generally met all GSQR parameters except the marginal increase in weight. It did not explain as to why there was an increase of 20 *per cent* in weight and why the lab did not limit the weight to the desired level of 60 kg, which was unacceptable to the Army.

7.4.6 Part achievement of project requirement

When the user envisages development of two systems under a project, to be used in conjunction with each other or with some other system, for enhancing the capability of the systems as a whole, successful development of only one of the two systems results in capability imbalance, thereby defeating the purpose of undertaking the project, as evident from the cases discussed the table below:

Table showing project with partial achievement

Name of the project and objective	Sanctioned cost/Date of sanction	Revised sanction/completion cost	PDC	Status	Audit comment
Development of 'Bridge Assault Mechanically Launched SARVATRA	₹ 17.58 crore/ December 1992	December 1997/ ₹ 22.33 crore	December 1999	Closed in December 2000	The Army's requirement was of a five span bridge comprising 15 m and 20m bridging systems complementary to each other and to be used in conjunction with each other as on to bridge gaps from 15m to 100m within a time frame of 150 minutes. Based on this requirement the project was undertaken by R&DE (E). However only 15m Bridging system was successfully developed and accepted by the User as the 20m Bridging System had limitations while negotiating sand dunes in deserts and was not accepted by the users. As such the bridging system offered to Army was capable of bridging a gap of 75 m only (15m X 5 spans) whereas the requirement of the Army as well as the project was of bridging gaps upto 100m (20m X 5 span).
Development of Short Span Bridging System	₹11.30 crore/ November 2005	May 2009/ ₹ 9.11 crore	November 2007	Closed in May 2009	The project envisaged development of 5m and 10m bridging system to be compatible with the SARVATRA. Only the 5m system was accepted for induction into service. 10m system was still (June 2011) undergoing trials, though the project has been closed in May 2009.

The Ministry stated (May 2012) that two variants of 15 m and 20 m bridging system were developed against the project and both underwent user trials during which 15 m system was recommended for production. It added that solution to the shortcomings of 20 m had been worked out. The Ministry, however, glossed over the fact that the 20 m bridging system had unacceptable limitations forcing the Army to reject the same, though the Army was keen to have both 15 m and 20 m systems as these are complementary to each other. Regarding the ongoing trials of the short span 10 m bridging system, the Ministry stated that user trials were not linked to the project PDC, since the time frames could not be predicted or controlled by the project team. Since user trials are integral to a Staff Project to establish acceptability of the product developed, the claim that it was not necessary to complete user trials within the PDC lacked justification.

7.4.7 Mismanagement of Post Development Activities

Delay in completion of LSP orders even after successful completion of projects

Prototypes accepted for introduction into service by users are expected to be promptly followed by transfer of technology to the production agencies for their bulk production. Where the accepted prototypes are stipulated to undergo further modifications, the post development activities follow the route of Limited Series Production (LSP) before entering into the phase of Series Production (Bulk Production) for delivery to the Services. Mismanagement and/or delay in the LSP by the designer not only nullifies the efforts of the lab in developing the system but also results in non availability of the system to the users.

Two LSP orders issued by the Ministry in March 1999 and January 2002 at a total cost of ₹ 32.66 crore suffered inordinate delays during development/modifications of the system as per the users requirement. Consequently, the LSP units were yet (June 2011) to be accepted by the users thereby delaying their induction into the Services. In one of the cases, delay in completion of the LSP order by the lab resulted in import of the system by the user to meet its immediate requirement as shown in the table below:

Table showing delay in completion of LSP Order

Name of the project and objective	Sanctioned cost/Date of sanction	Revised sanction/ completion cost	Status	Audit comment
Development of Engineer System for Armoured Amphibious Dozer (AAD)	₹0.12 crore/ March 1990	₹0.12 crore	Developed and the system accepted for induction into service in December 1995. MoD issued sanction in January 2002 for LSP of six armoured amphibious dozer at a cost of ₹ 26.94 crore for issue to the Army.	Since proper operation of Rocket Propelled Anchor (RPA) was critical to the operational deployment of the AAD, R&DE (E) was required to improve the metallurgy/reinforce the shank so that it does not bend on falling. The trial evaluation of the dozer with improved RPA developed by the R&DE (E) did not meet the user requirement necessitating further improvements. Even so, the dozer did not pass the confirmatory trials. Cracks were noticed in the RPA during firing. During confirmatory trials held in June 2008,. The Army eventually went in for import of the dozers to meet immediate requirement.
Overhauling of Mast Mobile Aerial – 18.6 m	₹5.72 crore/ March 1999	January; 2000 ₹5.39 crore	System is yet to be taken over by the users	In March 1999 the Ministry accorded sanction for development and supply of two sets of 18.6 m Hydraulic Masts at a cost of ₹ 4.10 crore, subsequently revised to ₹ 5.72 crore. The two systems manufactured at a cost of ₹ 5.39 crore underwent trials between November 2000 and October 2006. However, due to various deficiencies observed during these trials, the Air Force did not accept the masts. In October/November 2006 R&DE (E) asked Air HQ to release the balance fund (5% of total cost held back by Air HQs in accordance with the contract agreement) at the earliest as the system being six years old needed overhauling. However, in January 2009, Air HQ intimated its inability to release the funds for overhaul of the masts as they were not on the IAF inventory but offered to take over the two masts provided that both were made fully serviceable and field trials were conducted to check and clear various observations raised during trials. In January 2009 the lab decided to undertake refurbishment and operationalisation of Mast Mobile Aerial 18.6 m at a cost of ₹ 3.00 crore out of DRDO funds, by December 2011. Even after successful completion of the project in 1990, the masts were yet to be accepted by the user.

The Ministry stated that the lab had successfully completed the sub project for AAD and handed over all specifications and drawings to VRDE Ahmednagar. The Ministry remained silent on the fact that during confirmatory trials held in June 2008, cracks were noticed in the Rocket Propelled Anchor due to which further improvement of the dozers had been recommended.

The Ministry further stated that the lab had successfully developed the 18.6 m Hydraulic Masts but it was not taken over by the user for reasons not known to them. This argument is factually incorrect, since the mast was not taken over by the user because of the various deficiencies observed during trials carried out between November 2000 and October 2006.

7.5 Cost overrun in Staff Projects

Four out of the 19 Staff Projects suffered cost escalation ranging upto 74.80 per cent. Analysis of these projects revealed that in one project the cost escalation was very minimal whereas in the other project, completed at a cost escalation of 27 per cent, the cost was revised due to change in the scope of the project by the users. Initially the project requirement was for development of the 20 m SARVATRA Bridging System as a technology demonstrator but

subsequently Users asked the lab to develop it as a full fledged prototype. The balance two projects were sub-projects undertaken on behalf of other labs and reasons for cost escalation could not be ascertained from R&DE (E).

Our analysis revealed that only one of these four projects, completed at 24 *per cent* cost escalation, was successful and underwent productionisation. The project proposal should indicate a realistic cost estimate for development with proper analysis of the complexities of technologies involved to avoid cost overruns.

7.6 Research & Development and Technology Demonstration Projects

7.6.1 Time and cost overruns in R&D/TD Projects

During the period April 1995 to December 2010, R&DE (E) undertook 26 R&D/TD Projects out of which 20 were closed after booking an expenditure of ₹ 83.01 crore. Six R&D/TD Projects were ongoing at the time of completion of audit. Our scrutiny revealed that as compared to Staff Projects, the percentage of time and cost overrun in R&D and TD Projects was even higher. Out of the 20 closed projects, 16, constituting 80 *per cent* of the total closed projects, showed time overrun ranging between 5 *per cent* and 189 *per cent* and 5, constituting 25 *per cent* of the closed R&D/TD Projects, involved cost overruns. The development process undergoes changes during various stages of design, fabrication or even while conducting in-house technical trials. The development team, on the basis of discussions with various project review committees and institutions many a times opt for better concept/ techniques to develop the system/ technology.

However, the Ministry while justifying time overrun in Staff Projects had cited delay in user trials as the main reason for not adhering to PDC. As no user trials are required for R&D/TD Projects, the reasons for delay in such projects are fully within the ambit of DRDO and have a better chance of being completed within schedule.

7.6.2 Degree of success achieved in R&D/TD Projects

R&D and TD Projects are expected to eventually find application in Staff Projects. Even where this does not happen such projects, if taken up purposefully, have the potential of creating a certain extent of intellectual property that is patentable or otherwise valuable. Our scrutiny revealed that as many as 13 projects, comprising 65 *per cent* of the 20 closed R&D/TD Projects, did not find any application in Staff Projects. Nor were any patents filed nationally or internationally on the basis of work done under these projects. The Ministry did not give any specific details of intellectual value created through such projects. The expenditure on these projects aggregated ₹ 57.25 crore. Apparently, the projects were taken up without considering specifically the possibility of these projects' deliverables eventually getting dovetailed to any of the ongoing or anticipated Staff Projects.

The Ministry's contention that such projects are undertaken to equip itself with future technologies is understandable. However, contrary to that, we noticed

during the course of our examination of these projects, that often the justification given for initiating an R&D/TD Project was the user's requirement. Yet, R&DE (E) had not consulted the users before or during the course of project execution. Consequently the systems developed were either not required by the user *ab initio* or the user evinced no interest in the system, even after its successful development. A few such cases are tabulated below:-

Table showing successful TD/R&D Projects with no end use

Name of the project and objective	Sanctioned cost/ Date of sanction	Revised sanction/c completion cost	PDC	Status	Audit comment
Bridge Laying System Arjun Based Sliding Type	January 1999, ₹ 17.15 crore	₹ 8.42 crore	January 2003	Closed in March 2004	The objective was to develop single span bridge layer sliding type on MBT Arjun Chassis, on static simulator and a 26 m MLC-70 bridge super structure in composite. The user did not evince any interest in the system developed.
Development of incinerators and compactors for waste management in cold region	September 2004, ₹ 1.25 crore	₹ 0.55 crore	March 2008	Closed in July 2008	The sub-project of Defence Research and Development Establishment (DRDE) was completed and the incinerator/compactor developed was put to operation at HQ of Corps in August 2009. However, the system became non-operational within six months. No follow up Staff Project was sanctioned for the eventual utilisation of the technology nor was the defective systems rectified and put to use.
Development of Blast Proof Gates for Blast Pen	December 1991. ₹ 0.98 crore.	₹ 0.51 crore	October 1995	Closed in May 1999	The design of the gate system was successfully evolved. However, it was required to fabricate a gate panel of size 9.67 x 4.05 m and test it before going for fabrication of full scale prototype. Since the cost of full scale prototype fabrication along with supporting structure was estimated to be exorbitantly high, the project was short closed. No Staff Project was taken up indicating lack of user interest.
Technology Base Creation for Structural Health Monitoring	December 1992 ₹ 6.32 crore	₹ 6.28 crore	December 2008	Closed in December 2009	Even after successful completion of the project no Staff Project based on the technology developed for SHM in composite structures was sanctioned. Moreover, the technology developed was still not mature enough for taking up a Staff Project. There was no user requirement for the item.
Development of structural sections and fabrication techniques using advanced composite for military bridges and structures.	October 1987 ₹ 1.97 crore	₹ 1.89 crore	October 1990	Closed in October 1995	The objective was to establish techniques for analysis, design and development of advanced Fibre Re-imposed Polymers composites/hybrid structures for weight saving and improved mobility. However, even after a lapse of 15 years since successful completion of the project, no Staff Project has been taken up for development of composite military bridges and structures indicating lack of user need.

The Ministry claimed that the Arjun Based Sliding Type Bridge Laying System had been successfully executed and added that if and when required the system can be inducted. Paradoxically, it admitted that user did not show any interest. The Ministry's reply was identical in the case of incinerators and compactors for waste management in cold region. The Ministry contended that the expenditure in the case of Blast Proof Gates for Blast Pen was not infructuous as technology and design had been established. In respect of the Technology Base Creation for Structural Health Monitoring, the Ministry's claim was that the technology had been developed and could be offered to the users. Regarding project for development of structural sections and fabrication using advanced composite for military bridges, the ministry added that the technology though had been developed, but due to the decision of the Navy to change the top deck with a composite deck and to get the work done by a foreign shipbuilder, the work had to be short-closed.

The above replies of the Ministry's prove the audit contention that R&D/ TD Projects were taken up without any degree of consultation with the users *ab initio*. A system needs to be put in place to avoid R&D efforts turning unfruitful for want of user's interest.

7.7 Absence of a mechanism to correlate success or failure of projects with personnel deputed

In R&DE (E) there was no mechanism in place to relate the success or failure of projects with personnel deputed on them. Moreover it did not even have a reliable database of the projects undertaken by the lab in the past years. The non-maintenance of such a knowledge base by R&DE (E) precludes expertise based deployment of the personnel on project undertaken by it, which could in turn, result in projects not coming to fruition or being inordinately delayed.

The Ministry contended that success/failure of projects are to be viewed in an R&D scenario. Not all projects can be successful or lead to productionisation for many reasons. Also, in spite of meticulously progressing projects, time and cost overruns are sometimes inevitable due to reasons beyond control of the project team. Further, most of the team members work on many projects simultaneously so as to tap expertise and experience optimally. While we agree with this contention, it is also clear from reply that there was no mechanism in place in R&DE (E) to assess the output of the human resources deployed by it precluded assessment of accountability of personnel towards success or failure of the projects.

7.8 Understatement of project cost due to exclusion of manpower cost

An order issued in February 1977 by the Ministry's specified that the pay and allowances of the staff specially recruited for a project should be taken in to account for computation of cost of a project. However, it did not specify inclusion of the cost of pay and allowances of regular establishment, though a substantial portion of the overall budget allocation is spent on pay & allowances of the regular establishment. R&DE (E) deploys about 771 Scientists and other personnel and the expenditure on their salary amounted to ₹110.56 crore during 2005-06 to 2009-2010.

Expenditure on pay & allowances of regular establishment of R&DE (E) ranged between 21 *per cent* and 40 *per cent* when compared to the overall expenditure of the R&DE (E) as indicated below:

Table: Percentage of Pay & Allowances to total expenditure

Year	Total Expenditure (₹ in crore)	Expenditure on Pay & Allowances (₹ in crore)	Percentage w.r.t total expenditure
2005-06	45.49	12.62	27.74
2006-07	56.59	15.61	27.58
2007-08	70.04	14.99	21.40
2008-09	70.23	24.58	34.99
2009-10	107.61	42.76	39.73
Total	349.96	110.56	31.59

The Ministry replied that no separate manpower was recruited exclusively for project activities and added that but for the implementation of sixth pay commission recommendations the manpower cost would have remained static. There was no increase in manpower since 2001. Project work was carried out by the manpower deployed from existing regular establishment (RE) sanctioned to the lab by the DRDO Headquarters and their pay and allowances are booked under general allocation made to R&DE (E) under pay head.

As the core function of the lab are the research/development projects and the manpower cost of RE forms significant portion of the expenditure of a lab, exclusion of manpower cost of RE results in understating the project cost.

7.9 Conclusion

The Staff Projects taken up by R&DE (E) for delivery of products required by the Defence Forces witnessed very low rates of success in induction of systems into the Services. Many of these failed mainly because of taking up projects before firming up the user requirement, being rendered irrelevant due to excessive delay in development of systems, failure to develop the desired deliverables, and mismanagement in the post development activities.

The main reason for the technologies developed under R&D/TD Projects not leading to exploitation of these technologies in Staff Projects was lack of proper assessment of the user requirement *ab initio*. Time and cost overruns were significantly high in almost all the projects, which is an indication of underestimation of cost and time or overestimation of capabilities.

Non-maintenance of any data regarding the Scientists and Technical Officers deployed on various projects by the lab and their output in terms of success or failure of the projects may, in the long run, result in failure to tap the expertise built up in the earlier projects or repeating the same mistake of deploying the same Scientists/Technical Officers who could not contribute much in the field of activities in which they were deployed earlier. Not booking pay and allowances of the manpower deployed on project activities, even though significant, has resulted in understating the project cost.

Recommendations:

- a) ***All Staff Projects need to be sanctioned /undertaken by DRDO on the basis of approved SQRs received from the users. The Ministry should ensure that items which meet essential SQR parameters are accepted into service to enable further improvement;***
- b) ***Frequent revision of the user requirement should be avoided, particularly when a project is in advanced stage of completion;***
- c) ***The project proposal should indicate a realistic time frame for development without overstating the capabilities available or understating the complexities of technologies involved. The duration required for user trials should also be factored into the PDC;***

- d) Sanctions for approval of extension of PDC should specify its likely impact on user requirement in respect of Staff Project and user's consent to extension should be obtained to determine continuance of the projects;*
- e) Staff Projects, which envisage development of more than one system in accordance with the user's requirement, should be closed only after carrying out the user evaluation of all the systems developed under the projects;*
- f) The closure report should correctly reflect the user's assessment of the systems developed;*
- g) As delay in completion of LSP orders results in delayed production affecting the user requirement, the development activity of LSP order should not lag far behind the time frame specified in project proposal;*
- h) High value R&D and TD Projects need to be undertaken after due consultation with the users to appropriately assess user requirement, so that technologies developed under these projects by the DRDO lead to their useful assimilation in Staff Projects; and*
- i) A suitable method of apportioning manpower cost needs to be devised for computation of the actual cost of a project.*