Effectiveness of Quality Assurance in Army Procurements

Mahendra Prasad*

A closed loop feedback system for ensuring the quality of the Army equipment exists. Notwithstanding this, a number of Army equipment show a high failure rate at crucial times and are, therefore, a matter of great concern. These failed equipment have resulted in a number of avoidable casualties as well as restricted operational planning by tactical commanders in the field due to the non-availability of equipment for deployment, which results from their low reliability or high rates of failure. This article examines how this system has been exploited in terms of analysing the feedback from the field Army and using the outcomes of these analyses for incorporating improvements in General Staff Qualitative Requirements (GSQRs), Acceptance Test Procedures (ATPs), Quality Assurance Plans (QAPs), etc., all to ensure that a better quality product is procured. Based on the analysis, it also provides certain recommendations to improve the existing system.

Quality is invisible when 'Good' and impossible to ignore when 'Bad'.

Introduction

The Indian Army has to operate in diverse climatic conditions, in some of the most difficult and inhospitable terrain. From Thar to Siachen, the variation in temperature is more than 100 degrees. Thus the soldier and

* The author is currently a Research Fellow with the Institute of Defence Studies and Analyses, New Delhi.

ISSN 0976-1004 print

Journal of Defence Studies, Vol. 7, No. 3, July–September 2013, pp. 43–56

the equipment both have to be rugged enough to bear this variation in terrain and climate. Additionally, the tactical manoeuvres in a battle are also restrained by the equipment capability, reliability and availability. For instance, the Indian Army's ability to locate M5 Stuart Light Tanks[1] at Zoji La on 1 November 1948 in Operation Bison acted like a force multiplier and gave it a winning edge over the enemy after an earlier unsuccessful attack launched by 77 Parachute Brigade. This would have been impossible if the tanks we possessed at that time had not had the capability, ruggedness and reliability to endure the extreme cold climate and rugged terrain at that particular location. In contrast are the high failure rates of INSAS (Indian Small Arms System) at Kargil: the rifle encountered some reliability problems in the very cold climate in which the conflict took place—due to the cold weather, the rifle would jam occasionally and the polymer magazines would crack[2]—which led to numerous setbacks.

It is thus imperative that the equipment in the hands of soldiers is of superb quality and has a high reliability, in addition to being rugged. The quality assurance (QA) of the equipment must focus on ensuring these aspects. It is essential that the effectiveness of QA inspections done at the time of procurement of equipment is continuously monitored, feedback obtained from the customer (in this case the field Army), and gaps in quality, and the loose ends that led to these gaps, be identified and tightened. It, thus, ought to be a closed loop feedback system. Subsequently, a database needs to be generated which can act as a Quality Assurance Information System (QAIS) for ensuring quality of future procurements. Whether these activities constitute QA philosophy and how these can be institutionalised through a Standard Operating Procedure (SOP) will be examined in this article.

Effectiveness of QA

Effective QA of equipment will ensure that the equipment perform their intended function under given operating conditions repeatedly, with the optimum maintenance, and when operated in accordance with the manufacturer's instructions for the operator. Effective QA, in turn, ensures that there are no or negligible complaints against the product, that has been quality assured. An ineffective QA, on the other hand, is evident from the numerous complaints of product failure, especially during its warranty period and for reasons attributable to the *design, material and*

production process once the product is taken into service. In other words, a product that is effectively quality assured is silent in its service while the one that is not properly quality assured is rather noisy. Thus, the measure of effectiveness of QA of a product is the statistic of its failure, especially during the warranty period, due to its quality or the lack thereof.

The products also fail due to reasons other than design, material and production processes. These are the *maintenance lapses* and *not operating them in accordance with the instructions*. A holistic approach to QA would call for ensuring that a product should fail to perform its intended function if it is not operated in accordance with the provided instructions or not optimally maintained.[3] For instance, if the engine oil of an automobile is not changed at the mileage specified by the manufacturer, it should not start; or if the operator of an earth-moving plant takes any short-cut in its operation, the plant should shut off automatically. This would, however, require the incorporation of a number of additional features and fail-safe mechanisms in the product, thereby raising its cost exponentially. It is purely for economical reasons that such features are not advisable unless they are life threatening, for example, in aircrafts. These aspects are best addressed by a more professional training of operators and maintenance personnel as also by resorting to corrective maintenance wherever required being more economical.

Responsibility of Ensuring Quality at the Time of Induction

The global practice is to carry out a detailed technical and environmental evaluation of the prototype in addition to the field and maintainability trials by the buyer. This is followed by inspection of random samples picked up from each lot of the product offered by the vendor in accordance with an ATP based on a QAP. An identical practice is followed by the Directorate General Quality Assurance (DGQA). The policy specifying the responsibility of ensuring product quality is very clear wherein the responsibility rests on both the vendor as well as the customer. The vendors are responsible for carrying out all the checks and inspection of their products in such a manner that only those items or lots of items are offered to the DGQA for inspection which are considered by them to conform to the product requirements and features given in the contract. The QA authority of the buyer (the DGQA in the current case), prior to acceptance of the product, is responsible for inspection of the offered

products. During this inspection, it ensures that the quality aspects, in agreement within the framework of product requirements and features given in the contract document, have been complied with. Products, which successfully clear both these requirements are accepted, issued to the end-users and are called in-service equipment.

Quantum of Inspection

It is highly desirable that 100 per cent inspection of all the equipment being procured is carried out for entire range and depth in the most stringent manner so that the instances of failure are brought to a negligible level. This, however, is not advisable due to its prohibitive costs. In-spite of the dual responsibility of ensuring quality of the product (both by the buyer as well as the supplier), it has been observed that howsoever intensive an inspection the buyer may carry out, it does not guarantee a 100 per cent protection against receipt of an inferior quality product. This is generally applicable to all items but particularly true for highly complex products, the acceptability of which can conclusively be evaluated only by performing destructive testing, which is neither permissible nor feasible. The quantum of inspection by the buyer, therefore, remains a function of the ability and willingness of the manufacturer to prevent production of defective product and of the evidence with which the manufacturer supports that ability.[4]

In-Service Procedure

Initiation of Defect Reports (DRs)

Once the product is accepted and taken into service, it is supposed to be maintained and operated as per the manufacturer's instructions given in the maintenance and user manuals. Whenever a new defect develops in the product, which is not due to operator's fault or a maintenance lapse but is attributable to failure of a component or assembly, a DR is raised on that piece of equipment by the officer commanding the unit holding the equipment, or the workshop on whose maintenance load the equipment falls. Detailed instructions for initiating DRs are in place and contained in relevant order.[5] The major aspects highlighted in the DRs are: registration details of the equipment; procurement details like supply order/contract number and date; the date the equipment was taken into service; terrain and climatic conditions where the defect occurred; whether

the equipment was under warranty at the time of occurrence of the defect; nomenclature and part number of the defective component/assembly and its photograph and illustrative sketch; number of equipment on which identical defect occurred simultaneously (in case more than one identical equipment are affected); and probable cause(s), among others.[6]

Defect Investigation (DI)

The officer commanding the dependent workshop lists the perceived reasons for occurrence of defect in terms of shortcomings in design, failure of material, etc. The equipment is retained in the 'as is where is' condition without effecting any repairs.[7] This DR finds its way to the Authority Holding Sealed Particulars (AHSP) through the staff channel, that is, through the EME battalion, Corps EME, Command EME, etc., with comments from every level up the channel. A copy of the DR is sent to Headquarters Technical Group (HQTG) to maintain a database and progress the defect investigation through concerned Maintainability Advisory Group (MAG) that is responsible to take up the matter with the concerned AHSP for expeditious action, in cases of delay in investigation. The AHSP, in turn, and with the assistance of the vendor who supplied that equipment, carries out detailed investigation of the defect *in-situ* and, if required, in a laboratory. (In most of the cases where a laboratory investigation is required, only the affected component or assembly and not the complete equipment is sent to the laboratory.)

Post DI Action

Having ascertained the root cause of the defect, the corrective action for that defect on the piece of equipment, on which it was reported, and the preventive action to prevent occurrence of identical defect on rest of the population of that equipment are worked out in consultation with the manufacturer. These actions are promulgated to the environment by the concerned AHSP through their technical directorates and HQTG. If the equipment is under warranty, the AHSP instructs the vendor to rectify the defect in-situ, free of cost. If any modification is required to prevent recurrence of the defect, manufacturer is also instructed to provide modification kits and either carry out or facilitate such modification for entire population of equipment supplied by it. However, if the equipment is not in the warranty period, the concerned workshop is instructed to resort to remedial measures to repair/replace the defective component/assembly as per normal procedure in vogue.

Instructions exist to report follow-up cases of defects in the form of 'Follow-up Reports' to maintain an up-to-date statistics of each incidence of failure due to the reasons attributable to quality of the product.[8]

There is a closed loop system in which the concerned AHSP gets a feedback in the form of a DR about the QA it carried out on a particular piece of equipment. In case the inspection carried out during the QA was adequate, no defects due to QA aspects would arise and there would be no a feedback, thereby indicating a good quality product. However, inadequate or improper inspection during the QA process of a product would flood the concerned AHSP with a large number of DRs, thus reaffirming the quote given at the beginning of this paper.

Analysis

Though the time lines for defect reporting and investigation are clearly laid down, they are seldom followed. Investigation and closure of many defects takes more than six months, and in quite a few cases more than a year. Keeping defective equipment for such long duration without preservation causes further deterioration; it also deprives the user of the services of that equipment. The user units feel the maximum pinch if only one number of that type of equipment is authorized to them. In such cases, if the authorized equipment becomes defective, the unit is deprived of the services of this equipment till the time it is repaired. However, if instead of repairing this defective equipment, a defect report is initiated then the equipment cannot be repaired before the investigation to ascertain the causes and operating conditions that led to the occurrence of the defect, is concluded. This investigation may take a long time and till then the defective equipment is not available to the user unit to which it belongs. For instance, if only one generating set is authorised to a minor unit deployed in an operational area, and it remains unavailable to them for want of a defect investigation for a year, the unit is condemned to live without electricity for that duration, unless it borrows one from some other unit.

Many times the officers commanding workshops are under tremendous pressure to improve equipment availability, which discourages them from reporting certain defects; instead, they carry out repairs of the defective equipment and put them back into service. Thus many defects go unreported, leading to a distortion in the feedback on QA through defect reporting.

In case of equipment not under warranty period, there is a tendency to avoid defect reporting. This is due to the fact that even if later on it is conclusively established that the defect occurred due to manufacturing aspect(s), such as improper design, material or production process, its cost of repair shall have to be borne by the customer. If that were the case, why should the customer put itself at inconvenience by carrying dead inventory in form of defective equipment? (It must be noted here that many reputed Indian vendors like Tata Motors, Maruti Udyog Ltd., Ashok Leyland, etc., sometimes provide replacements even after the warranty ends as a goodwill gesture.)

In order to encourage manufacturers to improve the quality of their products, the DGQA is authorised to permit self-certification of certain manufacturing aspects, such as QA of raw material and/ or production processes. For this, the manufacturer has to consistently demonstrate its ability in those aspects for which it seeks self-certification. This is also periodically reviewed and if, at any stage, a vendor is found lacking in any aspect of self-certification, its authorisation is withdrawn. This is, however, not true in case of Defence Public Sector Undertakings (DPSUs) and Ordnance Factories (OFs). The Department of Defence Production (DDP) has permitted them to carry out the self-certification for raw material and production processes, and the DGQA carries out inspection of the finished product only. This has led to numerous defective equipment entering the service, for example, Radio set STARS-V, supplied by Bharat Electronics Ltd (BEL) and BMP-II, supplied by Ordnance Factory Project, Medak, with defective materials used in manufacture of their hulls.

The scope of defect reporting is three-fold: (1) to pinpoint the exact cause of defect, (2) to ascertain remedial measures, and (3) to instruct the supplier to provide free replacements if the equipment is under warranty and rectify the defect in future supplies.[9] However, the complete exercise provides very useful information in terms of causes of defects, which led to failure of in-service equipment. These include the following:

(a) Defects caused as a result of improper operation of the equipment.
(b) Defects occurring as a result of inadequacies in maintenance practices.
(c) Defects attributable to QA aspects, that is, those due to improper design, inferior material and inadequate production process(es), and workmanship, or a combination of any of these.

Of the above, the first two relate to the user and the maintaining

agencies, respectively, and are utilised for improving training of the operators/crew and the maintenance personnel, as also to identify and plan refresher courses for them. The third, however, remains inadequately exploited. In addition to invoking the warranty clause and seeking product modification for future supplies, it can also be utilised to carry out a statistical assessment of the effectiveness of QA, and for its introspective analysis to create a dynamic QAIS for future applications. This is not being done presently in a formal manner as is evident from the Pro-forma[10] for Annual inspection Report of AHSP and SQAEs/QAEs. It is observed that in this Pro-forma only the DRs status is reported. In addition to this, the inspecting officer checks if any important case study on the reported defects was undertaken by the unit being inspected. Whether these case studies have been centrally preserved as a database for quality improvement or whether the lessons learnt from them are being utilised for inclusion in GSQRs/QAPs/ATPs, is currently not known.[11] As an organization, the DGQA has grown and evolved sufficiently over a period of time; hence, in addition to aspects such as modernization of laboratories, automation of internal administrative matters, etc., it must also focus on utilising the field failure data, received in the form of DRs, for further improving QA practices in a dynamic manner.

Recommendations

Actions by DGQA

The DGQA vision statement reads:

Trust of the Trusted

> *Trust and confidence of the nation stems from the trust in the people, who are guarding the borders. In the battlefield trust emanates from the confidence in the performance of the equipment at the given time. Such confidence in the defence equipment is generated through quality assurance by DGQA organisation.*[12]

The vision statement says it all. The first and the foremost responsibility of the DGQA is to ensure that equipment in the hands of troops guarding the country's borders is of such quality and reliability that their trust on the equipment is never broken. Thus quality and reliability of equipment has to be of the highest order. For this, the quality of QA needs to be impeccable. In order to ensure this impeccable QA, the DGQA must consistently aim to improve its prime service of QA

of weapons and equipment procurements. It is thus imperative that the DGQA must constantly strive to improve the quality or effectiveness of the QA it does on the equipment procured, by bringing about changes in their QA tools on the basis of dual input, that is, feedback from the field Army in the form of DRs as well as Expert Judgement.[13] So far as feedback received in the form of DRs is concerned, it can be utilised for improving effectiveness of QA using the under-mentioned model.

Model for Establishing Voids in QA Using DR Data

The following model enumerates the sequence in which the investigation of DR data can be made, in order to pin-point the stage(s) of QA process undertaken during the procurement where additional checks and balances could be incorporated to prevent such occurrences in future procurements.

(a) In an ideal case scenario, none of the equipment used by the field Army should fail; yet, for the reasons enumerated in the section on'Quantum of Inspection' earlier, it is neither feasible nor possible. The AsHSP may, however, work out a figure (or a range) of expected number of defects that are likely to arise due to manufacturing defects, on the basis of inspection data and taking into account the total population cleared for acceptance after inspection, total number of lots, lot sizes, and the sample sizes chosen for assuring a certain percentage of success, with a certain confidence level, with respect to each equipment inspected.

(b) Only those equipment for which the number of DRs—with defects attributable to manufacturing causes (called the attributable-defects)—cross the upper limit of this range warrant further investigation into the QA carried out at the time of their acceptance.

(c) Segregate these attributable defects on the basis of assembly/sub-assembly/component. Check whether the defects of a particular assembly/sub-assembly/component come from the same lot. If yes, then review the procedure of picking up the samples, that is, whether the samples were drawn randomly; did they truly represent the strata; were these equipment earlier offered in some other lot and rejected and later on reworked by the manufacturer and offered again in some different lots; who inspected those pieces of equipment, and so on. This information can be ascertained from

the Inspection Note, IN number, etc. A questionnaire listing out all the aspects of sampling can then be prepared for examination.

(d) In case nothing wrong is found in the sampling, check whether the ATP had directions to inspect the affected item of the equipment separately; was any test certificate from any accredited lab accepted for that item; were any failures reported on that item during field/technical/environmental evaluation; and/or did the supplier not mention inspection of this item in the draft ATP, etc. Another questionnaire for this aspect can be prepared and exercised. A more comprehensive check of the quality control and manufacturing/assembling processes may be made at manufacture's premises.

(e) If no fault is found in ATP, the QAP and GSQR can be similarly probed.

(f) The analysis regarding occurrence of a particular defect in specific terrain and climatic condition can also be similarly carried out in order to improve upon the environmental evaluation of the equipment.

(g) Check whether the defect occurred due to any aspect for which self-certification rights were granted to the manufacturer.

The above model is only indicative and not exhaustive. It has scope for further improvement and needs to be refined before it can be implemented.[14] It would be a laborious process in the beginning as all the required data would seldom be available at one place and would have to be brought together. A lot of *data mining* shall also be required. A possible solution is to maintain databases at AsHSP or technical directorates in a suitable form and regularly update them. A number of suitable Quality Improvement (QI) Tools like *Fishbone analysis, Histograms, Scatter Diagrams*, etc., can be incorporated in the model wherever they fit, in order to reduce effort.

Nonetheless, a modest systematic beginning can be made and the model can be improved with the expert opinion of the DGQA staff. To begin with, the officers and staff of DGQA undergoing various courses at the Defence Institute of Quality assurance (DIQA) can be given projects on individual cases as part of their course curriculum. The DR database available at AsHSP can be made available to them to ensure that their efforts to undertake an analysis of this kind is not wasted as accumulated literature at a training establishment, but has some real time applicability

for the organization. The initial database may be created from these project reports and centrally maintained by the Directorate of Policy Planning and Training (DPP and T) at headquarters DGQA or decentralised to AsHSP, whichever is found to be more effective in its application and convenient. Subsequently, in order to reduce time required for analysis, software consisting of various modules can be prepared, which may be used as an information system to obtain important inputs for improving the complete QA exercise, beginning with commenting on quality aspects in GSQR, technical and environmental evaluation, preparation of QAPs, ATPs, and the final inspection for acceptance of a finished product. Once this system firms up, it shall offer an excellent feedback to all QA activities related to procurement, that is, it would become a QAIS in the true sense.

Auditing Quality of QA[15]

A complete inspection of the activities of the AsHSP is carried out internally during the annual inspection by officers heading the technical directorate, as per the procedure in vogue. Though the audit of the quantity of QA and its financial effect, facilities such as laboratories and their up-gradation, etc., are carried out annually, there is a need to check the quality of QA as well and take corrective concerted action if it is found wanting in any aspect. The pro-forma for annual inspections may therefore be amended accordingly. An external audit by an independent agency comprising of experts from the Army, industry and academia is also recommended for a second opinion and a worthwhile assessment. Its frequency may be decided by the DGQA itself and may vary based on the pace of procurement activities.

Actions by Army Units, Workshops, DPSUs, OFs and DDP

For the above exercise to be successful it is necessary that the users (field Army) report the defects meticulously. The problem of units, which have only one of a type of equipment available to them, will have to be addressed by centrally controlling such equipment at higher levels, such as at the brigade and division levels. Temporary inter-unit transfer of equipment will mitigate such problems as hither-to-fore. The importance of defect reporting has to be understood and applied with all sincerity in the larger interest of the organization. The agencies responsible for reporting defects, namely, the units holding equipment, Electronics and Mechanical Engineering workshops, and MAGs may be sensitized on this very important aspect.

The self-certification privilege granted to the Indian Industry, especially DPSUs and OFs, should be taken by these organizations in right earnest. They must strive to prove themselves worthy of such privilege in each supply of stores to the Army. While the DGQA is empowered to cancel this authorization for private industry if the latter fails to ensure quality in the self-certification aspect, the DPSUs and OFs have immunity. Any shortfall in the aspects for which a self-certification authority is granted to them should be viewed seriously by the Department of Defence Production (DDP) and, if improvement is not demonstrated satisfactorily, in order to address such shortfall, the DDP may consider withdrawal of this privilege from the defaulting DPSU(s)/OF(s) on the specific recommendation of the MAGs and/or the user. This would ensure a *level playing field*[16] in the aspect of quality control for both the private and government-funded industry, thereby bringing in improved quality products at competitive rates.

Since there is a human tendency to cut short the procedures, 100 per cent correctness in maintenance and operational aspects of equipment, as recommended by the manufacturer in user and maintenance manuals, is difficult to achieve. Though the user and maintaining agencies must continuously strive to improve the training of their operators and technicians, the DGQA can help them by ensuring that, wherever feasible and economical, manufacturers incorporate necessary design features in the equipment to ensure that it would not operate if not operated or maintained in accordance with the instructions. Such advice can be given to users and the maintaining agency for incorporation in the GSQRs.

Conclusion

In order to ensure that the Indian Army performs its operational tasks efficiently and effectively, it is necessary that only high-quality and reliable equipment and weapon systems be provided to it. The QA organization responsible for ensuring quality and reliability of these equipment and weapon systems, therefore, needs to be empowered by the DDP; at the same time, the organization also needs to empower itself internally by continuously improving its ability and upgrading its skills. The creation of a QAIS based on the suggested model, wherein feedback from users is analysed to identify the root cause of the problems and its application to relevant activity of the QA, coupled with expert judgement in the form of internal and external audit of the quality of the QA, would prevent

stagnation of these activities and result in a dynamically improving and evolving effectiveness of the organization, which is highly desirable at the moment.

Notes

1. Sinha, S.K., *Operation Rescue: Military Operations in Jammu & Kashmir 1947–49*, New Delhi: Vision Books, 1977, p. 174; and Ranbir Singh, *Memorable War Stories*, New Delhi: Ocean Books, pp. 9–13.
2. See 'INSAS Not Performing To Optimum Level: Army', *The Times of India*, 13 August 2001, available at http://en.wikipedia.org/wiki/INSAS and http://articles.timesofindia.indiatimes.com/2001-08-13/india/27224295_1_assault-rifles-drdo-scientists-small-arms-system, both accessed on 16 Nov 2012, accessed on 13 June 2013. The army had complained that the country's indigenous state-of-the-art 5.56 mm Indian Small Arms S(INSAS) was not performing to the optimum level, with major defects like cold arrest, breakage and cracking of components reported in active areas like Siachen, Kargil and other high-altitude zones. Major defects in assault rifles as well as light machine guns like change lever system, breakage of carrying handle, screw locking butt, crack of retainer and breakage of barrel bulge were reported from forward areas.
3. This emerged during a telephonic discussion with S. Radha, Additional Director, Defence Institute of Quality Assurance (DIQA), Bangalore, on 15 November 2012.
4. Riordan, John J., 'Protecting the Consumer Against Inferior Quality', *Department of Defence Cost Reduction Journal*, Issue 3 (Fall, 1966), p. 41.
5. For more details, read the relevant Army Order 8/93 on DR.
6. Ibid., p.37–38.
7. Ibid., p. 43.
8. Ibid., p. 42.
9. Ibid., p. 36.
10. 'Standing Operating Procedure for Annual Administrative Inspection", 30 January 2012, Chapter II, Section 13, pp. 333-72, in *Standing Orders (Administration)*, Vol. I, for Defence Quality Assurance Organisation issued by DGQA.
11. This aspect emerged during an informal discussion with a senior serving officer on 15 November 2012, who wishes to remain anonymous.
12. See http://www.dgqadefence.gov.in/index.php, accessed on 21 November 2012.
13. Klas, M, 'Predicting Defect Content and Quality assurance Effectiveness by Combining Expert Judgement and Defect Data—A Case Study", *Software*

Reliability Engineering, 2008, accessed through digital Library IEEE Xplore on 16 November 2012.

14. An in-house study team, which has access to all the database and information that cannot be put in public domain being classified in nature, needs to carry out a study to refine this model to an implementable form.
15. Expert Judgement can concurrently be used for Audit of effectiveness of QA and will entail incorporation of relevant inspection aspects in the annual inspection performa, to be checked during the annual inspection of AsHSP and SQAEs/QAEs by Additional Director Generals heading the technical directorates.
16. For more details on aspects needing 'level playing field' for private industry, refer to Amit Cowshish, 'Defence Procurement Procedure: The Unfinished Agenda', *Journal of Defence Studies*, Vol. 6, No. 3, July 2012, pp. 8-9.