

TOWARDS CAPACITY DEVELOPMENT FOR A RESEARCH AND DEVELOPMENT ORGANIZATION IN BANGLADESH AIR FORCE

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Introduction

Since the ancient time science and technology have fascinated mankind. Behind these endeavors were the years of hard work, dedication & more importantly scientific research. Research in particular has always been the foundation stone of almost each and every invention. All nations consider military strength to be one of her key elements of national power. Current nature of war is marked by rapid and significant changes in concept, doctrine and technologies. A nation needs to keep pace with the changes and advancement to attain her defence capability. Bangladesh should no way exception to that. She needs to harness the advancement and up-gradation of technologies. Bangladesh (BD) is surrounded by India and Myanmar from three sides. As per defence capability, India is far advanced than Bangladesh and Myanmar is rapidly advancing in defence capability. More so, the present geo political situation of Myanmar and Rohingya crisis has put the Bangladesh-Myanmar relation in a dilemma. Thus to remain at par and keep balance of power, Bangladesh needs to modernized her defence forces. As a developing country falling into 'Thucydides Trap' will not be a wise option, rather to have its own Research and Development (R&D) organization for the modernization of defence will be suitable option.

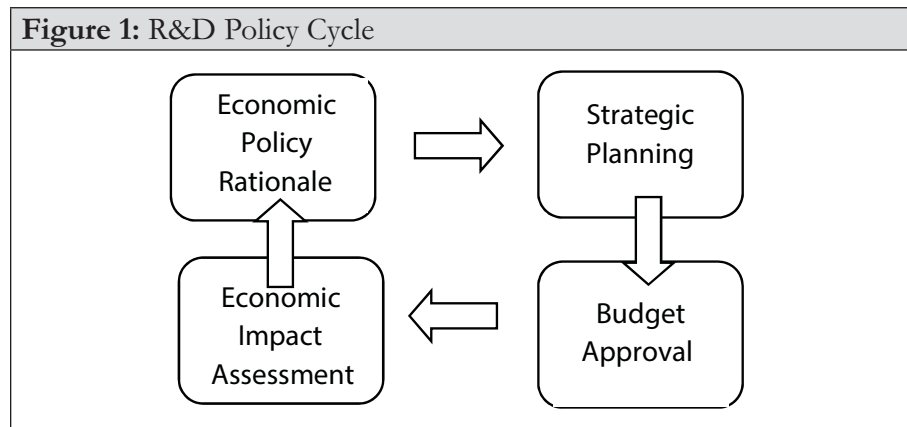
Bangladesh Air Force (BAF) being a key element of Bangladesh defence needs to keep pace with the changing scenario. The air technologies, weapons and equipment are very expensive and complex in nature. Indigenous R&D can be the key factor for modernizing BAF. Presently, R&D sector is less focused in BAF due various constraints. The R&D initiatives are not well organized and insignificant.

On the other hand, Bangladesh Army has Army Training and Doctrine Command (ARTDOC) to carry out organized R&D which is contributing to the service and to our economy. So, for the better contribution to the up-gradation and modernization, BAF needs a R&D organization.

Key Concept and Reviewing of Existing R&D Practices in BAF

Key Concept

R&D Policy. R&D policy of a country focuses on amount and type of investment, regulation, direct and indirect financial assistance, provision of information and so on. Once government approves a particular category of R&D support, it must be implemented through strategic planning. Basing on the planning, necessary budget allocation is done and economic impact assessment studies are regularly conducted to determine the effectiveness of various projects within these programmes. Finally the results should be fed back to the managers and to the economic policy process for appropriate adjustments. The above mentioned R&D policy cycle is shown in the bellow figure:



Existing R&D Practices. The R&D practice signifies the current procedure or process followed for obtaining R&D objective in BAF.

Practices include organizational set-up, staff employment for R&D and the process & procedures of R&D. It also means the budget allocation and manpower posting for R&D. These are mostly tangible and concrete elements of R&D.

Glorious History of R&D of BAF

‘Kilo Flight’ was formed during the Liberation War 1971 which had a glorious history to undertake R&D work. History says Indian authorities and IAF donated one DC-3 Dakota, one Twin Otter plane and one Alouette III helicopter for the newborn BAF. BAF technical personnel modified those aircraft and helicopter for strafing, rocketing & bombing. The above mentioned R&D effort had an overreaching implication. As an outcome of the R&D effort with tiny assets, BAF skilled and braved pilots undertook strategic operation to create strategic effect and made a unique example in the history of air power.

After the Liberation War, BAF could not hold the rhythm of R&D activities. BAF kept herself busy with re-organization and re-establishment program. Despite the fact, in different cases the necessity was felt to undertake R&D project. Few of the remarkable steps are described below:

- Repair of engine to make MiG-29 aircraft fly worthy to uphold BAF/ National image.
- Making C-130 aircraft ser No 0754 fly worthy which remained grounded for 11 Years.
- Making 03 Mi-171sh helicopters serviceable in Mali which were severely damaged due to hostile mortar attack.
- Conversion of Precision Guided Munitions from General Purpose Bomb.
- Overhaul plants of Basic Trainer, Helicopter and F-7 series aircraft.

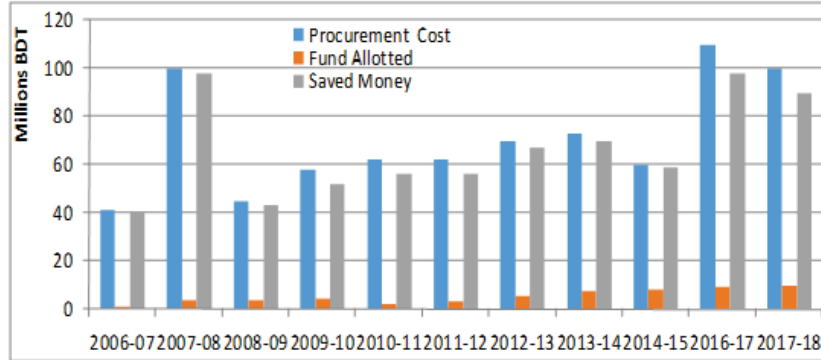
- Over the time, BAF emerged as a professional force. To develop further, R&D policy was formulated and circulated by Air HQ in 2007 for followings:
 - To strive for self-reliant BAF.
 - To utilize indigenous technology.
 - Enhance operational readiness.
 - Increase operational and maintenance capability.
 - To ensure cost effective maintenance and safe foreign currency.
 - To establish technological integration & dual-use technology.
 - To keep pace with advancement of technology.
 - To gain long term war sustenance.

Due to above move, the scope and range of BAF R&D activities were increased than before. But, the progression rate was hindered due to various limitations. It may be mentioned that 'Evolutionary Research' offers the source for break through innovations. But to make it practicable, it needs huge financial involvement and sophisticated technology. BAF R&D plan should intend at 'Application Research'. R&D standing committee is formed at Air HQ to act as approving authority for all R&D projects. Committee is chaired by ACAS (O&T), presently ACAS (P). Besides, there is a R&D execution committee headed by Officer Commanding, Flying Wing or Operational Wing of a base as President. Other members will be as selected by Air Officer Commanding or Base Commander of that respective base.

R&D Activities

Cost Benefit Analysis. In FY 2006-17, total fund allotted for the purpose of R&D was only BDT 5,20,00,000.00 (Tk five crore and twenty lac only). The investment was so little but achievement in terms of cost benefit analysis was enormous. Against total procurement cost of BDT 78,10,00,000.00 (Tk seventy eight crore and 10 lac only) foreign currency which was saved is equivalent to 72,90,00,000.00 (Tk seventy two crore ninety lac only). The graph of above statistical analysis is shown below:

Figure 2: Cost Benefit Analysis 2006-07 – 2017-18



Source: Developed by author

Scope of R&D Activities. Initially, R&D activities were limited to modification of ground support equipment, trolleys and general engineering in nature. In addition Non Directional Beacon (NDB), Remote Control System for aircraft arresting barrier, Personal Computer Based Voice Recording System, Noise Jammer (EW), Auto Junction Line Tester etc were the examples of R&D activities. But such project could not meet the user expectation in terms of performance despite cost effectiveness. Bangabandhu Aeronautical Complex (BAC), 214 MRO (F-7 series fighter ac overhauling plant), 216 MRO (Mi-series helicopter overhauling plant) and 207 MRO (electronics component repair and overhauling plant) are capable to overhaul basic trainer PT-6 ac, Bell-212, 206 & Mi series helicopter and F-7 series fighter aircraft, but no remarkable progress has been observed in the field of R&D.

Reverse Engineering (RE). RE encompasses any activity that is done to determine how a product works and to learn the ideas and technology that were used in developing that product. Prospect of goal oriented R&D projects involving tailoring or modification of existing technology is enormous. BAF is yet to take significant move on RE.

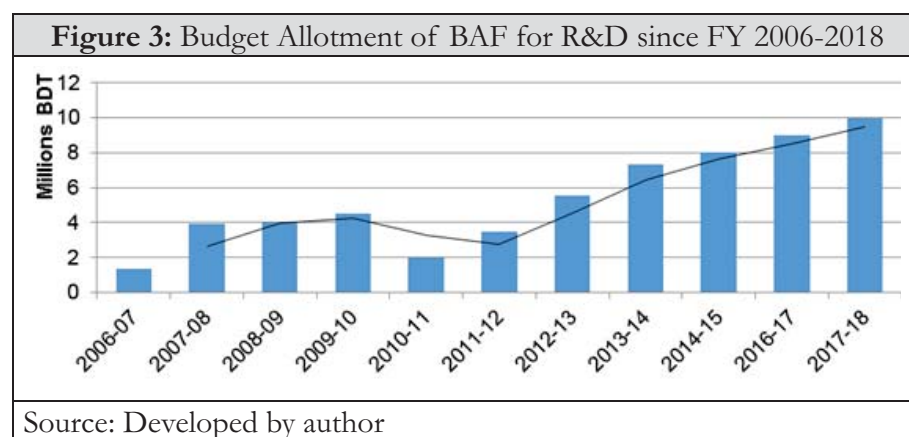
Auspicious Move. Undertaking R&D project on UAV was a long cherished dream for BAF. After long 10 years of work, it has come

to a shape. The said UAV is now equipped with sophisticated and complex electronics like GPS guided autopilot, live video transmission equipment, ground control station and various other features. In addition to R&D project on UAV, undertaking R&D project to convert general purpose bomb to PGM in collaboration with Chinese specialist is another remarkable steps to enhance the capability of BAF.

Issues and Challenges of the Existing R&D Practices

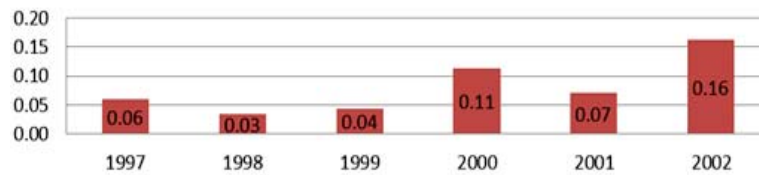
Towards the capacity development of R&D in BAF, it is imperative to examine the issues and challenges of the present practices for further mitigation. Issues and challenges in the existing R&D practices of BAF which requires due attentions are as follows:

- **Budget Constraint.** Budget allocation for R&D activities for BAF is seriously lacking. In 2006-07, approximately BDT 15 lac was allotted for R&D. The highest budget was in FY 2017-18 and that was BDT 1 crore. This budget allocation is meagre for an air force to carry out R&D. The budget allotment trend is shown below:



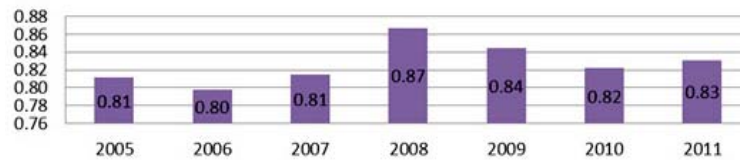
For better understanding statistics of Defence R&D budget allocations in terms of % of GDP of Myanmar, India and Pakistan are shown below:

Figure 4: Defence R&D Budget of Myanmar (% of GDP)



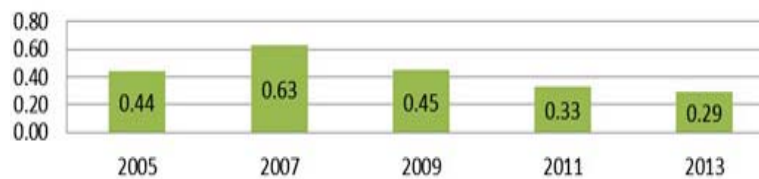
Source: Developed by author

Figure 5: Defence R&D Budget of India (% of GDP)



Source: Develop by author

Figure 6: Defence R&D Budget of Pakistan (% of GDP)



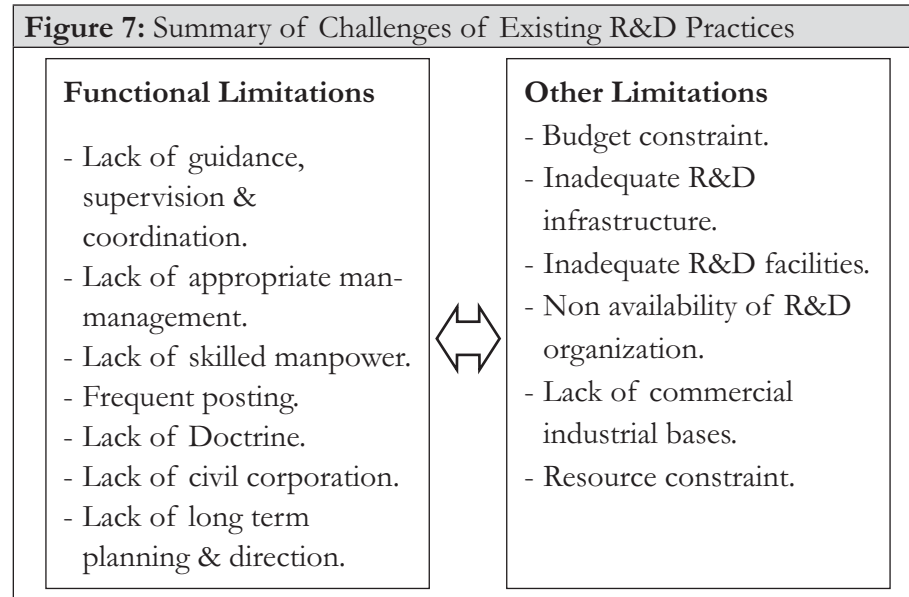
Source: Developed by author

- **Inadequate R&D Infrastructure and Facilities.** To carry out R&D with hardware and software of air power, demands adequate infrastructure and facilities, like heavy industrial base, aircraft manufacturing plant, missile and weapon manufacturing plant, numerous number of research laboratory facilities including metallurgical laboratory.
- **Non-availability of Established R&D Organisation.** There is no established R&D directorate at Air HQ level in BAF for planning, executing, monitoring and development of R&D activities.

BAF needs to go far way in regards to development and innovation of platforms and modern technology.

- **Lack of Appropriate Man-Management to Ensure Sustained R&D Activities.** Frequent posting and deployment of officer and technical personnel to different place who were involved with the project is one of the biggest barriers to continue R&D work.
- **Lack of Expertise.** To undertake R&D, dedicated researcher is needed with high degree of specialization & higher education and significant number of scientists. But, such expertise is definitely missing for the case of BAF.
- **Lack of Doctrine to Rationalize R&D.** Any modern air force must constantly strive to up-date its defense doctrine in relation to time, technological advancement and capability of adversary. A nation possesses old day's doctrine, is likely to be at the mercy of a progressive adversary during war. But, BAF is yet to create such doctrine to boost R&D.
- **Lack of Commercial Industrial Base.** Now-a-days Armed Forces of the world are fulfilling most of its technological needs from commercial industrial bases rather than depending exclusively on defense industries. The Armed Forces of the countries like USA, Sweden, France, Germany and UK have joined hands with their own commercial industrial bases. But, such facilities and circumstances are yet to prevail for country like Bangladesh in general and for BAF in particular.

The summary of the challenges of existing R&D practice are given below:



Case Studies

R&D at ARTDOC

ARTDOC formulates and disseminates concepts and doctrines of warfare in the fields of strategy, operational art, tactics, logistic, training and human resource development (HRD). The major limitations that the organization is facing are the limitation on the budget and less focus on R&D by the leaderships. However these can be mitigated by allotment of additional budget and mind set towards the R&D. Aspects which facilitates R&D are discussed below:

- Army Headquarters conduct various evaluation and research project related to training and manpower development through ARTDOC.
- Headquarters ARTDOC also conduct various research work on own initiative.
- The prevailing culture of the organization is very R&D friendly.

- The Headquarters are sufficiently staffed with qualified officers to undertake various research works.

R&D in India

India's quest for self-reliance through R&D got significantly boosted during 1990s. Hindustan Aeronautical Limited (HAL) could manufacture Tejas Light Combat Aircraft by undertaking R&D projects. Overall significant progress have been achieved on missile defence, software development, electronics component but success along with cost effectiveness and getting market to export in respect of aircraft industry is yet to be achieved and still remain doubtful.

Defence Research and Development Organization (DRDO). DRDO was established in 1958 which is the core of R&D in Indian Armed Forces. At present, DRDO is a compound of 52 laboratories and is running by more than 7,000 scientists and about 23,000 other scientific, technical and supporting personnel. DRDO also provides ample spinoff benefits to the society at large.

Software Development Institute (SDI). The Indian Air Force took step by establishing a dedicated SDI to integrate new weapons and systems into the Fight aircraft. SDI has saved foreign exchange to the tune of Rs 500 cores within five years. In addition SDI is also undertaking development of Mission Planning System, Air Defence Simulator, Electronic Warfare (EW) systems etc.

R&D in Pakistan

Pakistan also established her R&D long time back. Pakistan R&D is functioning in collaboration of civil and military part as given below:

- **Pakistan Council for Scientific and Industrial Research (PCSIR).** The PCSIR is a government-owned research organization responsible to conduct R&D work on problems that are being faced by the industrial sector in order to take up some measures for the application and utilization of research results.

- **Defence Science & Technology Organization (DESTO).** The DESTO pursues R&D on development of weapons systems over a variety of disciplines, including aerodynamics, propulsion & propellants, and avionics.
- **Pakistan Aeronautical Center (PAC), Kamra.** PAC offers specific types and general engineering services. General Engineering Services include calibrations, heat & surface treatments, non-destructive inspections, high and low end parts manufacturing, composite & rubber parts manufacturing. It has the potential of overhauling most of her combat aircraft and their engines. It can also rebuild/renovate/repair damaged ones and manufacture selected parts and other key user's items. Recently aviation city has been established at PAC which would house various hi-tech and state of the art academic, research and development institutes.

R&D in Myanmar

Very limited information about R&D activities of Myanmar Air Force is available in different internet source. From the budgetary analysis in R&D, it may be presumed that Myanmar is taking effort in much higher scale in R&D than the defence sector of Bangladesh. Myanmar Air Force has the capability to overhaul and assemble PT-6 trainer aircraft, assemble STOL CH-701 light aircraft. In Myanmar, the aviation technology was based on the experience of maintenance and overhaul of aircrafts & helicopters from Myanmar Air Force since 1941 and Myanmar Airways since 1948. They have put significant effort for design and construction of the gliders, powered glider and hovercraft. Myanmar Aerospace Engineering University was established in February 2002. Few programme are discussed below:

- **Space Technology Research Activities.** Satellite Communications Engineering Research Laboratory was established with the objectives to carry out research works on the fields of space based technologies. Rocket Technology, UAV and Satellite Communications, Design and Construction Research group are working in such laboratory.

- **Clandestine Chemical Weapon Programme.** The possibility of Myanmar having a clandestine chemical weapon program was reiterated by US Central Intelligence Agency (CIA) in 1988 and 1992.

Key Findings from Case Studies

From the above study of R&D activities of home and neighboring countries it is realized that BAF has to go long way to boost R&D activities to overcome challenges of R&D activities, infrastructure, grow expertise and budget allocation. By increasing the capability of 'General engineering Service', BAF R&D organization at BAC can get the same output like PAC Kamra. In EW Department especially, imported program are susceptible to being compromised during a crisis as the adversary can have access to their vital statistics from the manufacturing states. Indigenously designed and very well safeguarded software program are the only solution. On the other hand, BAF should put a long term plan for trainer aircraft manufacturing plant and design & development of weapon system like missile, rocket and bomb to suit requirement to reduce dependency on other countries. Besides, as a long term plan it is required to give emphasis on Space Research and Integrated Guided Missile Development Program.

Rationale of a R&D Organization for BAF

Bangladesh has become a developing country from least developed country. It is the high time to develop an R&D organization if BAF intend to attain self-sufficiency in terms of military equipment and platforms. BAF should devise long and short terms plan where R&D will create a huge impact.

Short Term Plan

Civil-Military Joint Venture. Integration of resources will help to maximize the R&D capability and use of Dual-use Technologies.

PAD. BAF can use phased out aircrafts as dummy targets. Decoys of SAM launchers, artillery guns, AD radars, may be produced locally and

be placed at the outskirts of airfield areas. Besides, different innovative tactical deception methods may be developed through R&D within the local resources for deception.

Reconnaissance. R&D may be carried out on fighter aircraft to develop indigenous aerial reconnaissance capability.

UAV and Drone. Successful R&D projects on UAV and Drone will play an instrumental role.

EW. BAF currently has limited EW capability. Therefore, special focus needs to be given to enhance EW capability through proper R&D.

Weapon System. Conventional weapon through R&D should be modified to smart weapon for effective use. In this regard remarkable progress through R&D project has already been done. BAF is to make effort to develop interoperability of using similar type of munitions in different fighter aircraft.

Indigenous Engineering. Indigenous engineering will allow to have flexibility in own capacity building and self-reliance. Reverse engineering could be first of its kind. Self-reliance in the field of maintenance would not only save lots of foreign currency but is likely to open the prospect of earning by carrying out complete overhauling of aircrafts/helicopters of sister services and friendly countries forces.

BAF Training System. In advance level it is felt that, Combat Commanders Course is to be developed and introduced. Some R&D projects on evaluating entire BAF training system and subsequent career progression profile are to be under taken for developing better HRD in future.

Skilled Human Resources for R&D. BUET, BIT, DU have qualified professors and laboratories. These universities can carry out some kind of R&D work which may be funded by BAF. There are highly qualified NRBs who are residing in different countries. Besides, every year a good number of expert personnel also get retired from defence services and other institutions. Their expertise can be utilized on contract basis. Steps may be taken to enhance cooperation and collaborations between civil and military research faculties.

Long Term Plan

Development through Innovation. BAF may endeavor for technology transfer and joint collaboration with friendly countries.

Manufacturing of Trainer Aircraft. The primary trainer aircraft manufacturing project may be undertaken at BAC in collaboration with foreign/partner companies.

R&D on Missile Technology. Many of the developing countries have made remarkable progress on indigenously built missile technology. There is ample scope for development of missile technology in the form of air to air missile, SAM and cruise missile. In future BD needs to consider carrying out R&D on Space Research and Integrated Guided Missile Development Program.

Software Development Institute (SDI). The integration of a new weapon system is a complex process primarily involving software work. While the weapons themselves are expensive, their integration to a platform is even more expensive. Considering these factors, BAF should take steps to establish a dedicated SDI.

Electronics Limited. BAF can carry out R&D on EW, IFF, RWR, Radar Technology and avionics equipment by establishing Electronics Limited.

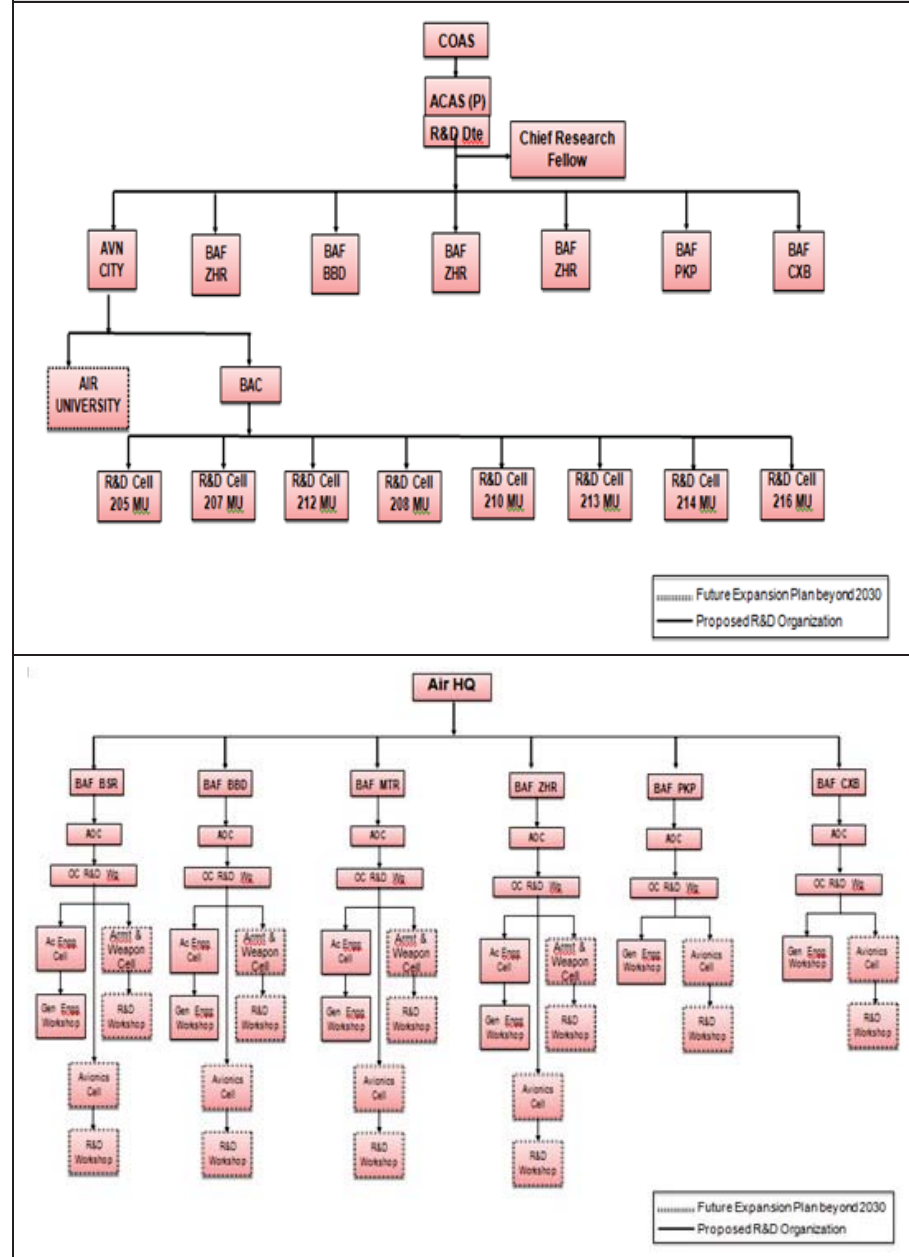
Recommended Framework Towards R&D Organization for BAF

Recommended Framework

The proposed structure may be implemented in two phases. Phase 1 is suggested under short term plan and Phase 2 is suggested under long term plan. The frame work is also designed to facilitate maximum utilization of already established organizations like BAC, MIST, and different MROs and with additional proposal of Air University. Proposed organogram has been initially influenced by the R&D structure of Pakistan. However, in future with the establishment of R&D organization of other sister services, the Indian model DRDO can be established and also may opt

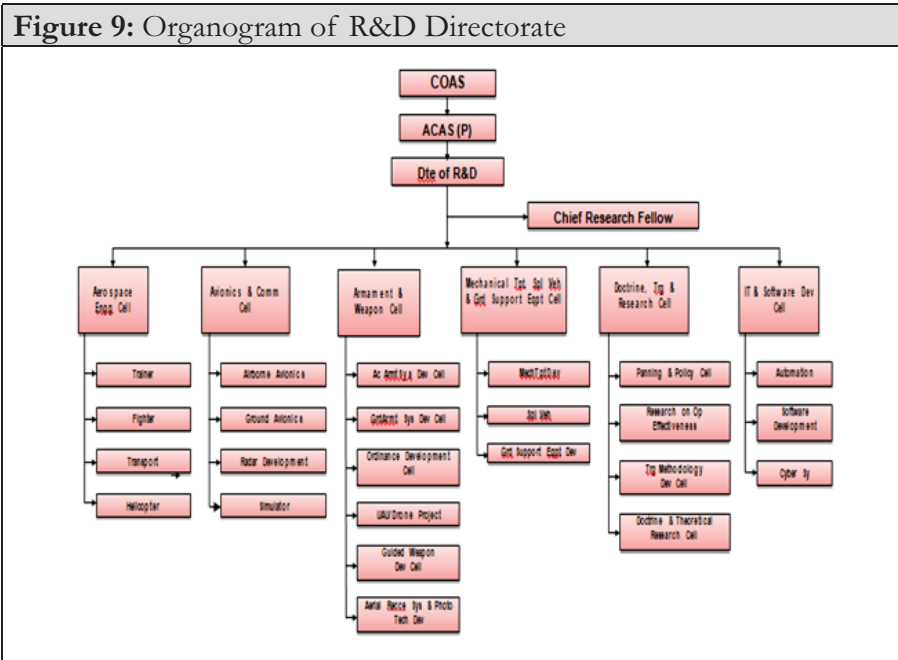
for Space Research and Integrated Guided Missile Development Program. The Functional Organogram of BAF R&D organization is given below:

Figure 8: Functional Organogram of BAF R&D organization



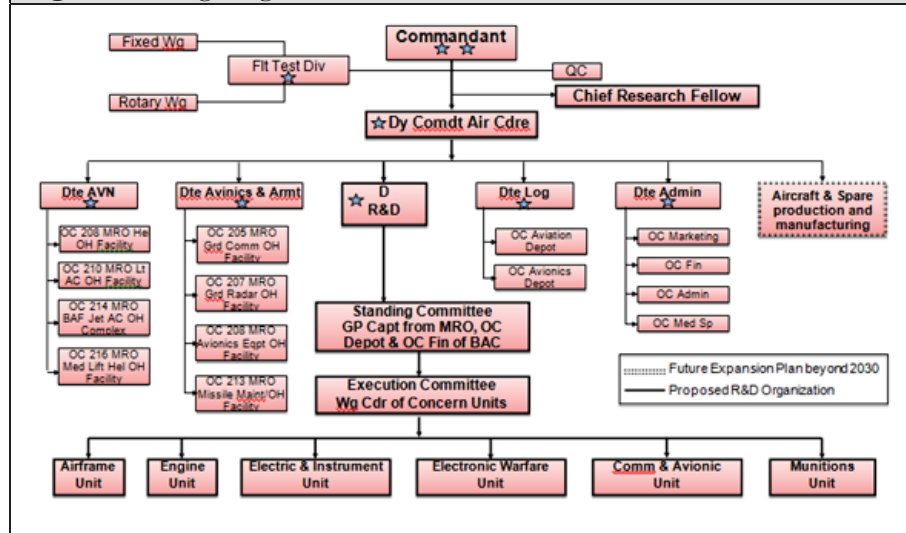
Focal Aspects of R&D Organization

R&D Directorate at Air HQ. A separate directorate needed to be established at Air HQ under ACAS (P). The function of this directorate will be planning, execution, monitoring and development of R&D activities in BAF. The directorate should be headed by Director R&D. The directorate will be staffed by Chief Research Fellow (CRF) and Deputy Directors of different specializations such as Aerospace Cell, Avionics and Communications, Armament and Weapon System, Mechanical Transport and Ground Support Equipment, Doctrine, Training & Research and IT & Software development cells. The organogram of R&D Directorate is given below:



R&D at BAC. A directorate has already been proposed under BAC and is on the process of establishment. All the MROs are structured directly under BAC and therefore, BAC will coordinate and control all R&D efforts in all the MROs. The proposed Organogram of BAC is given in Figure 10:

Figure 10: Organogram of BAC



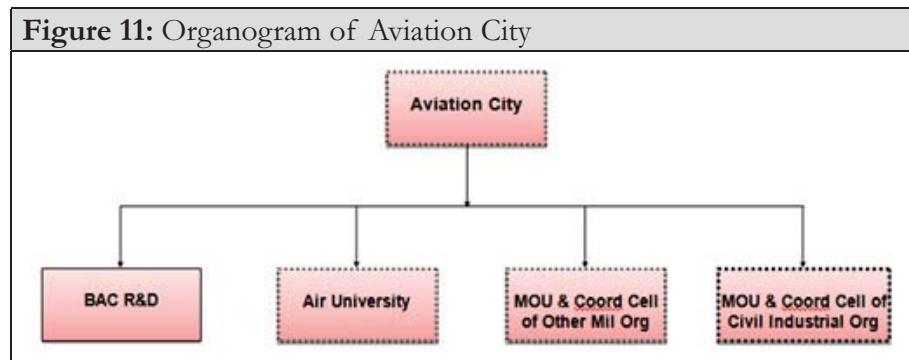
Civil-Military Cooperation. Under MOD or BUP, some joint projects may be developed in collaborations with other public and private organization or university and industry. The proposed Air University will also be involved vastly in the theoretical research sector once established.

Aerospace/Avionics/Armament/IT Cell. These cells will be initially responsible to control and coordinate the design and testing of various equipment/component. Once successful, the equipment/components may be manufactured industrially. Apart from manufacturing of different spares of engineering range, effort should be given to develop and design for viability and application of different armament range weapon, avionics component including development of electronics circuit, programming, simulator design, up-gradation of UAV and drone projects.

Doctrine, Training and Research Cell This cell will be designed to look after and carry out research on planning and policy, operational effectiveness of different squadrons and BAF as a whole. Other tasks entrusted on this cell may be to coordinate research and evaluate the training methodology and also on the doctrine and theoretical research in collaboration with researchers from NDC, DSCSC, etc.

R&D Wings at Base/Unit Level. R&D Wing may be established in every bases and units, which will be responsible for all R&D tasks assigned to the base. Functional capacity and capability of the General Engineering Workshops may be enhanced as well as separate workshops for avionics and munitions may be established under proposed R&D wing of the respective bases.

Aviation City. Like PAC, Kamra establishment of an Aviation City has been proposed which will be the hub of all research works undertaken in the field of aviation or related to it throughout the country. The proposed organogram of Aviation City is given below:



Conclusion

BAF has a glorious history of R&D which had an overreaching implication during our liberation war 1971. After the liberation war, BAF could not hold the rhythm of R&D activities. Under economic back drop, BAF kept herself busy with re-organization and re-establishment program. To strife for self-reliant BAF R&D policy was circulated in 2007 and R&D activities got the momentum in BAF. Under contemporary strategic environment, development of self-reliant air force and utilization of indigenous resource has become prime option for BAF. By undertaking R&D projects huge amount of foreign currency was saved. But, except few cases weight of effort was not significant. R&D activities were limited to general engineering in nature. Though by now BAC, 214 MRO (U), 216

MRO (U) and 207 MRO (U) were established but, only few projects were concerned with development and innovative in nature. Besides, there is also limited progress in Reverse Engineering.

Despite above fact, undertaking R&D projects on UAV and conversion of dump bomb to PGM has opened a new hope. But, such hopes are being hampered due to various limitations and challenges like budget constraint, lack of expertise and facilities, doctrine and organization. To encourage R&D activities, BAF has nominated Directorate of Plans, but there is no established R&D directorate at Air HQs. From the study of R&D activities of neighboring countries, it is realized that BAF has to go long way to boost R&D activities to overcome challenges of R&D activities, infrastructure, grow expertise and budget allocation. By increasing the capability of 'General engineering Service', BAF R&D organization at BAC can get the same output like PAC Kamra. Like Pakistan, R&D organization of BAF in coordination with other civil and military industrial base could pursue R&D on weapon, aerodynamics, propulsion, and avionics as well as dual use technology.

It's a dream for BAF to have the capability of manufacturing primary trainer aircraft. Besides, as a long term plan design & development of weapon system like missile, rocket and bomb to suit the requirement to reduce dependency should also be considered. For further progress in future it is required to give emphasis on Space Research & Integrated Guided Missile Development Program. For the capacity development in R&D of BAF, a framework of a R&D organization has been recommended under two phases, i.e. short term and long term. The proposed structure is designed to facilitate maximum utilization of already established organizations and MROs with additional proposal of Air University and Aviation City. A dedicated R&D Directorate will coordinate all the R&D activities of BAF. The proposed framework has been initially influenced by the R&D structure of Pakistan. However, in future with the establishment of R&D organization of other sister services, the Indian model of DRDO can be established.

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