CHAPTER – 3

HUMAN RESOURCES PLANNING IN EME

3.1 Process of Human Resource Planning (HRP)

The HRP or Manpower Planning is the process by which a management determines how an organisation should move from its current manpower position to the desired manpower position. Through proper planning, a management strives to have the right number and the right kind of people at the right places, at right times, to do things which results in both the organisation and individual receiving the maximum benefits. It takes into account the upgrading of skills in existing human resources. It thus aims at projecting future manpower requirements. Coleman\(^ {66} \) (1970) has defined HRP as the process of determining manpower requirements and the means for meeting those requirements in order to carry out the integrated plan of the organisation. Stainer\(^ {67} \) (1971) defined it as the strategy for the acquisition, utilisation, improvement and preservation of enterprise human resources. It thus relates to establishing job specifications or the qualitative requirements of jobs determining the number of personnel required and developing the sources of manpower. In Indian Army, we have Defence Service Regulations (DSR), which explicitly explains the qualification regulations for the different trades and grades of soldiers. There are eighteen different arms and services and 133 different trades to do various types of jobs. Out of this, some trades are common to all arms and services. In the Corps of EME itself, there are sixty trades and in each trade, four grades (viz. Grade IV, III, II and I). For each grade, there are different level of knowledge and skills that a craftsman has to know. According to Wickstrom\(^ {68} \) (1971), HRP consists of a series of activities from forecasting to actual selection, training, development, utilisation, career progression, motivation and compensation to ensure that future manpower requirements are properly utilised. This planning however is not rigid or static, but is amenable to


modification, review and adjustments in accordance with the needs of an organisation or the changing circumstances. The HRP is a double edged weapon. If used properly, it leads to maximum utilisation of human resources, reduces excessive labour turnover and high absenteeism, improves productivity and aids in achieving the objectives of an organisation. If wrongly used, it leads to disruption in the flow of work, lower production, less job satisfaction, high cost of production and constant headaches for the management personnel. Manpower analysts determine the number of people required, authorised, and available to operate, maintain, support, and provide training. The term manpower management includes the activities of screening, selecting, evaluating, training, controlling and employing them in their specific role.

Manpower induction planning can be defined as a strategy for acquisition, training, utilization, improvement and retention of human resources and its effective management. This requires meticulous planning, i.e. induction planning, training and development planning, career planning and placement planning. The basic principle of sound manpower induction planning is that a suitable replacement should be available immediately on an individual being wasted out. It also has to be ensured that trained manpower is available for contemplated new raising, without affecting operational effectiveness of the existing units. However, owing to various reasons e.g, adhoc suppressions, new raisings without additional sanctions, ban on invocation of foot notes and limit on first line reinforcements, the yearly intake of recruits has shown serious fluctuations resulting in either grossly exceeding or under utilisation of the available training facilities. This has caused imbalances in holding of manpower as a result of which certain Arms/Services are deficient of manpower while others are holding surplus.

The basic principle of manpower induction planning is that every individual being wasted out should be immediately replaced by a trained soldier. Over a period of time, this principle could not be followed due to constraints like:-

(a) Adhoc suppression of manpower / trades.
(b) New raisings required to be made from within the existing resources.
(c) Changes made in induction policy.
(d) New thrust towards `save and raise'.
Apart from the above constraints, inadequate database and lack of proper forecasting model has lead to uneven flow of manpower from year after year. This has resulted in the following anomalies:-

(a) Large variation in holding of manpower in units, with deficiencies in some Arms / Service and surplus in others.
(b) The violation of manpower ceiling laid down by the Government.
(c) Grass overloading or under utilization of designed training capacities of the training centres.

The impact of resource crunch has also forced the army to evolve the concept of `Save and Raise'. Under this the following measures have been taken:-

(a) Reduction of troops.
(b) New raisings from within existing resources.
(c) Reduced invocation of footnotes and the first line reinforcement.
(d) Reduction in Non-fighting Formation (NFF) establishment.

Manpower requirements for Army and in particular for the Corps of EME are based on the range of operations during peace time, low intensity conflict, and war time. It should consider continuous, sustained operations and required surge capability. The program manager must evaluate the manpower required and/or available to support a new system and consider manpower constraints when framing recruitment rules to ensure that the human resource demands of the system do not exceed the projected supply. The assessment must determine whether the new system will require a higher, lower, or equal number of personnel than the predecessor system, and whether the distribution of ranks/grade will change. Critical manpower constraints must be identified to ensure that manpower requirements remain within the sanctioned strength. Based on a functional analysis, an assessment should be conducted to determine which functions should be automated, eliminated, consolidated, or simplified to keep the manpower numbers within constraints. Manpower requirements should be based on task analysis that are conducted during the functional allocation process and consider all factors including fatigue; cognitive, physical, sensory overload; environmental conditions and reduced visibility. Additionally manpower must be considered in conjunction with personnel capabilities, training and other human factors.
The process of HRP is one of the most crucial, complex and compact managerial functions, which involves the following main issues:-

(a) Deciding goals or objectives
(b) Estimating future organisational structure & manpower requirements
(c) Auditing human resources
(d) Planning job requirements and job descriptions
(e) Developing a strategic human resource plan.

The following main factors seriously affect the effective human resource planning:-

(a) **Inheritance.** Persons from good background generally work professionally. The quality and rate of physical as well as mental development is dissimilar in different individuals due to genetic differences.

(b) **Climate.** Climatic location has a definite effect on the efficiency of the workers.

c) **Health of Worker.** Worker’s physical condition plays a very important part in performing the work. Good health means the sound mind, in the sound body.

(d) **General & Technical Education.** Education provides a definite impact on the working ability and efficiency of the worker.

(e) **Personal Qualities.** Persons with dissimilar personal qualities have definite differences in their behaviour and methods of working. The personal qualities influence the quality of work.

(f) **Wages.** Proper wages guarantee several benefits to the employees such as providing better standard of living, meeting their basic physiological needs adequately resulting to cheerfulness, discipline etc at the work place by keeping them satisfied. This provides impetus to organisational productivity and profitability.
(g) **Hours of Work.** Long and tiring hours of work/exercise have overall bad effect on the competence of the workers. Their productivity goes down, enthusiasm dies and monotony sets in.

Though HRP is beneficial to the organisation, employees and trade unions; some problems do crop up in the process of HRP. Important among them are:-

(a) **Resistance by Employers & Employees.** Many employers resist HRP as they think that it increases the cost of manpower as trade unions demand for employees based on the plan, more facilities and benefits including training and development. Further, employees feel that HRP is not necessary as candidates are/will be available as and when required due to unemployment or other reasons. Employers’ version may be true about unskilled and clerical staff but it is not true in the case of all other categories as there is shortage for certain categories of human resources. Trade unions and employees also resist HRP as they view that it increases the workload of employees and prepares programs for securing the human resources mostly from outside. The other reason for their resistance is that HRP aims at controlling the employees through productivity maximization.

(b) **Uncertainties.** Uncertainties can also affect the human resources practices due to absenteeism, seasonal employment, labour turnover etc. Further the uncertainties in industrial scene like technological change, marketing conditions also cause uncertainties in human resource management. The uncertainties make the HRP less reliable.

(c) **Inadequacies of Information System.** Information system regarding human resources may not be perfect in all industries. Some industries are not giving requisite importance to HR/personnel department and less importance is attached to HRP. Further the reliable data and information about the economy, other industries, labour market, trends in human resources, etc. are not sought in a proper manner by these organisations.
A brief survey of pertinent issues which need to be considered in working out the manpower requirements for the armed forces may serve to bring into focus the challenges facing them. These are enumerated below:-

(a) **Light vs Heavy Forces.** An important consideration is to see the force composition in the light of the contemporary strategic landscape. The fundamental juxtaposition is between forces that are light to ensure flexibility, mobility, easy projection to distant areas, characterised by speed and surprise; and the heavy forces with better staying power and capability of longer engagements.

(b) **Teeth-to-tail Ratio.** The age-old controversy of ‘how much of the teeth (combat capabilities) versus how much of tail (support capabilities)’ still goes on. Generally speaking, a high ratio presents an image of hard-hitting, mobile force with the freedom of action and relatively low targeting vulnerability; but with low sustainability. In contrast, a low ratio, though it spells greater sustainability, may appear sluggish and inflexible. In reality, the ratio should largely depend on the doctrine and technology.

(c) **Active vs Reserve Forces.** A large standing force may be perceived as stronger in an immediate sense, and its active component as better trained, equipped, maintained and more responsive; but its vulnerability and maintenance puts a heavy demand on the exchequer. On the other hand, the reserves are perceived as second-rate fighting forces, ill trained, undisciplined and generally less effective. A mobilisation doctrine for periodic activation could be of some help, as in the case of Swiss and Israeli armed forces.

(d) **Regular vs Support Cadre.** The pyramidal structure, with the wide base, necessitates support cadre career officers at the functional level. Suitable manpower policies, therefore, have to be evolved to cater for their recruitment, training, utilisation, retention and compensation, and the desired ratio should be worked out and maintained so that the cadre management is effectively done.
(e) **Voluntarism vs Conscription.** Though at present, ours is a voluntary force giving an image of a body of well-motivated individuals dedicated to the national purpose even at the cost of their lives, the possibility of the future requirement demands forcing us to examine alternatives like conscription or compulsory liability schemes for every able-bodied educated youth should not be overlooked.

(f) **Women Entry.** In recent years, all the services have opened their doors to the fairer sex to join in selected branches for specific periods of engagement. The present day manpower planners have to keep in view the current polices pertaining to their recruitment, utilisation, career development, retention and envisaged changes, and their effects in the long term perspective.

The philosophy of the force-structure design dictates that it satisfies the national strategy for mobilising and fighting a war. Manpower requirements to man and sustain the force-structure are determined by:-

(a) Projection of type of missions the forces would be asked to perform in a given future time-frame.
(b) Constraints that would be placed on such actions, including budgetary limitations.
(c) Recruitment, retention and reserve capability of each arm/service/branch and existing surpluses and deficiencies.
(d) Routine wastages and their replenishments.

HR planning ensures optimum utilisation of available human resources. The major advantages of manpower planning are enumerated below:-

(a) It is useful both for the organisation and the nation.
(b) It generates facilities to educate people in the organisation.
(c) It brings about fast economic developments.
(d) It boosts the geographical mobility of labour.
(e) It provides smooth working even after expansion of the organisation.
(f) It offers opportunity for workers for promotions, as an incentive.
(g) It creates atmosphere of motivation in the organisation.
(h) Training becomes effective.
(j) It helps in career development of the employees in the organisation.

3.2 **Organisation and Unit Level Strategies**

For a judicious HRP, it is imperative for the management to decide the macro level (organization level) strategies and dovetail it into unit (micro) level strategies so that the ultimate organisational goals are achieved and there is complete synchronisation between the two. Unit level HRP strategies are identified and evolved in consonance with the overall business strategy. A simple HRP system, dovetailing corporate strategies into unit level strategies is depicted at Figure – 3.1.

**Figure – 3.1 : HR Planning System**

Human resource planning has acquired a strategic connotation. Thus, there are new attempts to use HR strategies for attaining competitive success and facilitating business strategy. Increasingly, planned HR interventions are being used in the processes of man management. In the new business scenario, one
finds a lot of turbulence and even chaos. Mass-production, mass-marketing and long range planning are no more the bottom lines for expanding business empires. Instead, leanness in business operations and incrementalism in business strategy are tending to be the ways of industrial life. Customisation is becoming more important than before. Market rationality is deciding relocation of industry from high-cost north to the labour-surplus south of the globe. This is being done to fight competition by lowering costs. Information Technology (IT) is playing a critical role in the whole business process. IT is also being increasingly applied to all aspects of production. Developments in IT are creating a wired world. The emergent e-business is likely to throw into turmoil established relationships between various actors in business including buyers, sellers, suppliers and competitors. To the traditional factors of production – land, labour and capital - IT is also added now as an important factor. This has led to the proliferation of computer-aided design (CAD) and computer-aided manufacturing (CAM).

Since enterprises are finding it difficult to develop sustainable competitive advantage, organisational mortality is on rise. Business strategies are so adjusted as to facilitate innovation in the face of perpetual uncertainty. Certain broad things needing strategic attention in business management have emerged. These themes include business process re-engineering (BPR), benchmarking, knowledge management, right sizing, collaboration, outsourcing, kaizen, teamwork, vision mission and core values, empowerment, flexibility, proactive management, learning and virtual organisation, customer delight, corporate social and environmental responsibility etc. The earlier focus on learning skills is yielding on focus of identification and development of competencies. As Mills⁶⁹ (1991) argued, the new organisation structure can only be developed when all organisational members possess the required competencies, understand team vision, trust each other and are supplied with the requisite information and tools for cooperating and collaborating with each other. It has become important for all organisations to find a way to smoothly navigate this transition.

Some of the major macro level strategies initiated by the Army (in particular by the Corps of EME) in the recent years are discussed below:-

---

(a) **Army Technology Centre (ATC).** Seeing the rapid growth of technology adopted in the Army equipments and weapon system, a need was felt to establish an Army Technology Centre to smoothly absorb and transfer the technology to the users and maintaining agencies. Accordingly an all arms ATC was established at Headquarters Technical Group in Oct 2004. This is working perfectly well with all technical data hosted on Equipment Help Line on Army Intranet. The Technology Centres (TCs) have been established at Corps HQ level and Interactive Forums are regularly organised by the Equipment Managers for the users at Corps level. In addition, there are Technology Innovation Development Centre, Technology Transition Management Group and Core Group of Experts, which meet periodically to discuss and decide the road map for the Army to meet the future technological challenges effectively and proactively.

(b) **Indigenisation.** Till 2004, indigenisation of spares was primarily the responsibility of Directorate General of Quality Assurance (DGQA). Thereafter, as per the recommendations of a Group of Ministers Committee, this job was entrusted to the Corps of EME for those defence equipments for which no transfer of technology for its production has been made. This was an onerous task which has been successfully undertaken by the EME under a Directorate of Indigenisation.

(c) **Modernisation of Army Base Workshops.** Anticipating the vintage of the EME Field and Army/ Advance workshops, their modernisation job was undertaken at a massive scale including procurement of state of the art plants, equipments and specialist equipments.

(d) **User Repair Concept (URC).** With a plan to downsize the EME, a concept of first line repair by the users has been started. Under this, the EME training establishments will train the users to take the job of Unit Repair Organisations (UROs) and Field repair Workshops (FRWs) in short time. Accordingly, 10 Infantry Division and 14 Infantry Division personnel were trained by EME training establishments (MCEME, EME School, 1 and 3 EME Centres) to take over the first line repair job. The basic trades involved are Vehicle Mechanic, Armoured Fighting Vehicle Mechanic,
Electrician, Telecom Mechanic, Armourer, Metal Smith, Welder etc. This was implemented selectively by the users

(e) **Project EMERALD.** The project EMERALD stands for EME Reliability and Availability Logistics Delivery. This is an ERP exercise to integrate EME Directorate, EME Commands including Field Army, Training Establishments, HQ Technical Group and its MAGs, and HQ Base Workshop Group along with its Army Base Workshops for achieving optimal synergy and results. RFP for this Project is under issue.

(f) **Technical Entry Scheme (TES).** The TES was initiated to tap young men after their 10 + 2 examination in the Army including EME to overcome the shortage of officers in the army.

(g) **Women Entry Scheme (WES).** The WES was started in the services group of Army to provide entry to the women as officers to meet the officers’ deficiency and provide an equal opportunity to the woman folk in non-combat role. As on date, there are 124 women officers in the Corps of EME. They are either technical graduates or having post-graduate degrees in specialised disciplines like computer science and others. Their service tenure is for 14 years during which they are detailed on courses too. In year 2008, Defence minister\(^7\) approved permanent commission to women officers of AEC, JAG Accounts and AMC branches of Indian Army.

(h) **Enhancement of Intake Threshold.** In order to meet the higher requirements of future jobs, the intake threshold of five trades in EME was enhanced from ten to ten plus two standards with Physics, Chemistry and Mathematics. The five trades are Vehicle Mechanic (MV), Electrician (MV), Fitter (Fd), Fitter (AFV/ AD) and Armourer. Because of this, their general categorisation has been changed from Soldier (GD) to Soldier (Technical). This has affected nearly 30% of EME personnel.

On the other hand, some of the unit level strategies adopted by EME units are discussed below:-

---
(a) **Achieving Annual Targets/Loads.** In consonance to Army HQ directives, each EME unit is given some annual repair/overhaul/manufacture targets/loads. Therefore, every unit orients their resources (including human) towards achieving these allotted targets.

(b) **Quality Repair.** Achieving quality of repairs to give maximum satisfaction to the users is another strategy of all EME units.

(c) **Fast Turnaround Time.** Once an equipment or vehicle is received, it is the effort of each EME unit is to repair it as quickly as possible and hand it over back to the users for its exploitation.

(d) **Customer Orientation.** Since EME is a service organisation, its other priority is to orient itself to meet the needs of the users units to the maximum extent.

(e) **Support to Field Army.** One of the core strategy of EME units located in peace is to render all support to the units located in field so that they can do their jobs more efficiently. This is achieved by repairing their equipments, Major unit assemblies (MUAs) and rotables on priority and carrying out in-situ repairs.

(f) **Aid to Civil Authorities.** Aid to the civil authorities in the time of calamities, like flood, earthquake and other disasters is the social and national responsibility of all EME units.

### 3.3 Demand and Supply Forecasting

Firstly both futuristic demands forecasting as well as supply forecasting requirement has to be judiciously made. These forecasts will necessarily have the following considerations:

(a) Anticipated number of retirements, pre-mature retirements and other wastages due to sickness (low medical category), deserters etc.

---


(b) Anticipated number of new vacancies arising due to expansion, diversification, increased roles with varied skills and high intake threshold.

(c) Increase in the technological threshold, induction of high-tech equipment, modernization and computerisation.

(d) Global emerging markets and heightened competition.

(e) Organisation vision, mission and long-term strategies.

(f) Likely threat perception in the world and in the neighbourhood.

Models do not forecast but people do. But quantitative models using mathematical techniques and computer processing can be a big help to people trying to forecast future requirements. Several types of models useful in forecasting human resources needs will be examined now, and the opportunities and constraints in applying the models will be discussed. The models may be descriptive - representing what is, or normative - representing what should be. Descriptive models help to make sense out of mass of seemingly complex and often contradictory empirical data on staffing and personnel flows or movements. Data on past and current staffing patterns are manipulated by mathematical techniques. The result is typically a simplified and abstract view of the levels and flows of personnel throughout the organisational system. Forecast of future personnel flows, and surpluses and shortages of personnel against future needs, may be developed through models. However, future is determined by applying past patterns in projections or by making certain assumptions about future flows and desired staffing objectives. Thus, normative models of 'proper' future staffing are less reliable as a basis for management decision making.

Various mathematical techniques have been applied in exploiting various aspects of human resource flows and needs through models. Techniques such as regression analysis, Markov analysis, and linear programming permit manipulation of important historical data for variables considered to be significant by the planners. Additionally, assumptions or parameters underlying system behaviour may be modified in models. Simulation techniques make it possible to evaluate the importance of many factors that influence the organisation's human resource needs and availability. Modeling enables managers to explore aspects of systems that cannot be observed directly, such as the pattern of movement of employees.
among different sets of jobs in an organisation over time and reactions of internal manpower supply to change in management policies and employment decisions. Various authors reviewed different techniques used in model building and suggested their classification into types. However, four types of models may be broadly identified, representing a classification of techniques by their sophistication. Each type of model has successively greater scope, technical complexity and added functions. These types are shown in Table 3-1.

<table>
<thead>
<tr>
<th>Types of Model and Characteristics</th>
<th>Techniques</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Simple Forecasting Models</strong></td>
<td>Judgmental forecasts, Rules of thumb, Staffing standards, Radio-trend analysis, Time series, Delphi technique</td>
<td>Rudimentary forecasts of available supply and demand under stable conditions, Long-range forecasting</td>
</tr>
<tr>
<td><strong>Organisational Change Models</strong></td>
<td>Succession analysis, Markov/Stochastic process, renewal models, Regression analysis</td>
<td>Replacement analysis and blockages, Probability based flow forecasts, Correlations to project Changes</td>
</tr>
<tr>
<td><strong>Optimisation Models</strong></td>
<td>Linear programming, Non-linear programming, Dynamic Programming, Goal Programming, Assignment models</td>
<td>Future needs defined by constraints, Future needs identified to achieve defined objectives, Matching individuals with anticipated vacancies</td>
</tr>
<tr>
<td><strong>Integrated Simulation Models</strong></td>
<td>Corporate models: Combined techniques</td>
<td>Total entity simulation linked with corporate Planning</td>
</tr>
</tbody>
</table>

**Table –3.1 : Basic Types of Models and Applications**
(a) **Change Models.** Whereas simple forecasting models provide judgmental estimates of needs and availability of talent in a given planning period, a change model provides a forecast covering two or more successive planning periods. Typically, a model is designed to show how an organisation will look under certain assumptions about the future. These assumptions may be based on past experience, such as probabilities of transactions among organisational levels and units based on past movements, or they may be proposed by the model designer. Some of the assumptions or policies can be changed, and variables providing a somewhat different perspective of prospective changes can be added or dropped. Where assumptions and variables are modified, the models are called ‘simulations’.

(b) **Succession Models.** There are only five possible shifts in a personnel system: in, up, over, out, and changes in individual capabilities, or behaviour and potential. Tracing these flows makes it possible to plan effective actions that will result in improved human resource management. In many organisations, succession plans are drawn for key positions and levels. These plans, often in the form of ‘replacement charts’, present various data pertaining to prospective personnel changes, organisational structure and job relationships, age and promotability of positioned incumbents, identified backup candidates or successors (with age and appraised readiness or timing for promotion). Through a manual process of projecting retirements, transfers, and promotions using these charts, a planner may analyse the movement of personnel and the related organisational changes. Charts may be drawn for future points in time, say three years and five years. Assumptions regarding attrition and retirements may be based on subjective judgments about likely individual behaviour or may be applied on a class basis in terms of projected loss rates. The results of such a manually operated modeling may include:-

(i) Projection of total attrition, or the number of additional persons needed to be added to the pool.
(ii) Projection of blocked progression lines due to immobile incumbents.
(iii) Identification of ‘problem’ positions lacking available backup candidates.
(iv) Identification of surpluses of talent in particular categories, calling for redirection of career plans.

(c) **Probabilistic Models.** While succession analysis examines individual data for forecast changes in staffing supply and demand, a probabilistic model examines data on employees as groups. Movement of employees among different classifications (or states) in a model may be forecast based on past movement. Classifications typically involve organisational units and levels, but they could also represent locations, salary classes, functional responsibilities, job categories, length of service, educational levels, or even specific jobs. Looking at the probabilities of employees moving from one classification to another or out of the organization altogether, a matrix or table of transitional probabilities would be generated. This gives the dynamics of flow in the system from one point to another; the basis for a probabilistic or ‘stochastic’ model. The stochastic process tells whether employees will remain in a given state or move to each of the other possible states at some future time. Data are typically gathered for one or few years, averaged to determine probabilities. In most stochastic models it is assumed that these transition probabilities are stable among consecutive periods. Stability depends on the definition of the states and length of time interval involved. Adjusting the probabilities, based on managerial judgment of how movement will change, would imply moving from a stochastic model towards more flexible simulation. Here, the projections are based on assumptions instead of past system behaviour. Markov chains are often used as the mathematical models in such cases. Another type of stochastic model is the renewal model. Here, flows of personnel are viewed as triggered by vacancies. These vacancies when filled from lower levels of the organisation, pull personnel through the system. For example, when promotions are affected only to fill jobs that become vacant and recruitment is constant, the movement of people
responds directly to vacancies created. There would, of course, be a chain effect as a person moves to fill a vacancy, creating a vacancy at the lower level. Renewal models have not been as widely applied as Markov-type models, but they are potentially useful. For example, Harrison White\textsuperscript{72} developed a series of such models for analysing mobility and measuring vacancy chains. His application of the models to a 50 year history of clergy in three national churches demonstrated that individual careers are not dependent on the careers of others in an organisation. Markov models and renewal models are versatile forecasting techniques mostly used for manpower availability forecasting.

(d) **Regression Models.** A correlation is a relationship among variables. The technique for measuring the degree of correlation is the regression analysis. The technique is widely used in human resource forecasting where it is believed that future staffing requirements are correlated with some measurable indicators of output, revenue, etc. When we can quantify the relationship between staffing and other factors, we have a sound basis for accurate forecasting. Regression models are most applicable where staffing needs vary directly with other measurable factors such as production, sales, and unit costs. Simple relationships are often difficult to isolate. Complex, multivariate relationships may be handled by multiple regression analysis, although the technique has not been widely applied in human resource planning.

(e) **Optimisation Models.** Some models do more than manipulate data to forecast future staffing patterns. Some forecast, not what is likely to happen, but rather what is necessary to happen if certain objectives are to be achieved. The optimal (or ‘best’) future staffing patterns might mean minimised costs, minimised turnover among employees, targeted proportions of women and minorities in certain groups, achievement of a specified talent mix, or other objectives. The tools described above are often incorporated in optimisation models, but techniques such as linear programming are also used.

(i) **Linear Programming (LP).** This technique provides a specific solution which is optimal according to measurable criteria. It is useful for considering staffing needs at a particular point in time and within given constraints. Deviations from the plan can be examined through the model in terms of their impact on the actual end results. Essentially, a LP model determines the level of staffing required to meet organisational objectives when a number of specified constraints are defined. Linear programming is a mathematical technique for determining the optimal solution under a set of given constraints, represented by mathematical expressions. It is applicable when expressions proportional to the measure of the activities and all relationships are in the form of linear inequalities. However, relationships are not always linear, and hence non-linear programming may be applied. Another variation of the technique is dynamic programming, which is similar, but involves a series of optimisation decisions or solutions, one at every stage, for a multistage problem. At any one stage, several decisions may appear to be of equal merit; only when the effect of all stages on the overall goal is determined, the optimal solution reached.

(ii) **Goal Programming.** A refinement of the linear programming model is the goal programming model. This approach uses Markov analysis and linear programming in combination. It is applicable where several constraints affect staffing (for example, budgetary and promotional policies) and where the problem extends over several time periods. Goal programming models permit more comprehensive analysis of the behaviour of human resource systems. Additionally, they permit the development of goals that are realistic and attainable. The modeling tests alternative goals by examining the discrepancies between forecast results and identified targets, and thereby suggests optimal goals that are attainable. For this reason, goal programming represents a powerful advancement in modeling technology for human resource planning as well as for planning equal employment opportunities and affirmative action. Included in such a system can
be such factors as external availability of talent, personnel movement, and budgetary and other policy constraints.

(f) **Assignment Models.** Most models examine personnel movement and staffing needs in terms of aggregates. Markov analysis, for example, requires approximately fifty persons in each category for useful results. A personnel management model however, processes individual data assigning individuals to job vacancies simultaneously. The purpose is to optimise the overall utilisation of talent and to forecast, with the greatest possible degree of precision, the shortfalls and surpluses of anticipated talent. Essentially the model assigns each person, one at a time, to a suitable job (based on preferences, time, seniority, or other selected criteria). It simulates the entire organisational changes for a period. Dynamic models of this type, covering multiple periods, are feasible as are models that bridge multiple organisational units (Larson\textsuperscript{73} 1973).

(g) **Integrated Simulation Models.** Computer based simulation models are useful when parameters of future changes are not known (for example, transition rates, correlations) and when managers wish to test alternative views of future conditions. When multiple problems are addressed by a simulation model (for example, recruitment, assignment, cost analysis) and when multiple employee groups or classifications are considered, a model may be said to be integrated.

In order to forecast the manpower availability in the Corps of EME, the following principal factors are considered:-

(a) **Stocks and Flows.** The members of an organisation can be classified into categories based on some commonality of attributes. For example, Captains, Majors and Colonels are some of the categories in the army. Organisation can be considered as a dynamic system of stocks and flows. The numbers in different categories called as stocks. The numbers moving from one category to another in a given time interval are called flows. Flows out of categories could be due to wastages or promotions.

Flows into categories could be due to promotions/ demotions/inductions. Consider a system of initial stocks 189, 93, and 20 in categories I, II, and III respectively. To consider the behaviour of the system for one year, let the corresponding wastages during the year be 20, 4, and 3, and the inductions be 15, 6, and nil. The promotions during the year be 19 from category I to II, and five from II to III. This information is depicted at Table- 3.2.

<table>
<thead>
<tr>
<th>Category</th>
<th>Initial Stock</th>
<th>Wastage</th>
<th>Induction</th>
<th>Promotion from lower Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>20</td>
<td>3</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>II</td>
<td>93</td>
<td>4</td>
<td>6</td>
<td>19</td>
</tr>
<tr>
<td>I</td>
<td>189</td>
<td>20</td>
<td>15</td>
<td>-</td>
</tr>
</tbody>
</table>

**Table – 3.2 : Stocks & Flows in 3 Category Manpower System**

To work out stocks at the end of the year; subtract flows due to wastages and promotions from the initial stock; for category I it works out to 189-19-20 is 150. This number (150 for category I) is the part of the initial stock which remains in the same category. We can then add induction (15 for category I) during the year to arrive at the final stock (165 in category I). These can be represented schematically by in a flow chart as at Fig 3.2.
(b) **Matrix of Transition Probabilities.** Table - 3.3 displays in a matrix format, the transitions among various categories (i.e. promotions and retentions) and transitions into and out of the manpower system (i.e. inductions and wastages) in absolute numbers. It is more convenient, for further computations, to express these transitions in terms of proportions or probabilities. This is done simply by expressing the elements of the matrix as a proportion of the initial stock in each category.

<table>
<thead>
<tr>
<th>Category</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>Wastage</th>
<th>Total (Initial stock)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>150</td>
<td>19</td>
<td>-</td>
<td>20</td>
<td>189</td>
</tr>
<tr>
<td>II</td>
<td>-</td>
<td>84</td>
<td>5</td>
<td>4</td>
<td>93</td>
</tr>
<tr>
<td>III</td>
<td>-</td>
<td>-</td>
<td>17</td>
<td>3</td>
<td>20</td>
</tr>
</tbody>
</table>

**Table- 3.3 : Transition Matrix**

<table>
<thead>
<tr>
<th>Category</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>Wastage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0.79</td>
<td>0.10</td>
<td>-</td>
<td>0.11</td>
</tr>
<tr>
<td>II</td>
<td>-</td>
<td>0.90</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>III</td>
<td>-</td>
<td>-</td>
<td>0.85</td>
<td>0.05</td>
</tr>
</tbody>
</table>

**Table- 3.4 : Transition Proportions/Probabilities**

Refer Tables – 3.3 and 3.4. Thus the first element (i.e. 1st row and 2nd column) becomes 150/189 i.e 0.79, the second element (i.e. 1st row and 2nd column) becomes 19/189 (0.10) and like-wise. The matrix thus obtained could be multiplied with the initial stock to give us the final stock before induction. Then the induction figures could be added. This process is known as the **Markov process**\(^74\) and is depicted in Table - 3.5. Fundamentally, it uses the method of multiplication of matrices - initial state to the respective probabilities. The calculations for the first year are at the Table- 3.5.

---

final stock after induction becomes the start point for the next operation i.e. the final stock after the first year becomes the initial stock at the beginning of the second year, and the transition matrix when multiplied with this, gives the final stock for the 2nd year, before induction. Thereafter, the induction

\[
\begin{bmatrix}
189 & 93 & 20 \\
0.79 & 0.10 & 0 \\
0 & 0.90 & 0.05 \\
0 & 0 & 0.85 \\
\end{bmatrix}
\]

<table>
<thead>
<tr>
<th>Elements</th>
<th>Matrix Multiplication</th>
<th>Result</th>
<th>Induction</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S_1 \times P_1)</td>
<td>189 \times 0.79 + 93 \times 0 + 20 \times 0</td>
<td>150</td>
<td>15</td>
<td>165</td>
</tr>
<tr>
<td>(S_2 \times P_2)</td>
<td>189 \times 0.10 + 93 \times 0.9 + 20 \times 0</td>
<td>103</td>
<td>6</td>
<td>109</td>
</tr>
<tr>
<td>(S_3 \times P_3)</td>
<td>189 \times 0 + 93 \times 0.05 + 20 \times 0.85</td>
<td>22</td>
<td>0</td>
<td>22</td>
</tr>
</tbody>
</table>

Table- 3.5 : Markov Process

figures are added to give us the final stock at the end of the 2nd year ie at the beginning of the 3rd year. For year to year prediction of the stock, if there is no change in the transition matrix (a stable state), such iterative matrix multiplications, known as Markov chaining, yield the desired result. It should be noted that the wastage proportions are not included in the matrix. In a matrix of transition probabilities (MTP), the row totals should each work out to 1. However, in the manpower planning matrix, the wastage is deliberately not included and it corresponds to 1 - row total. For example, the wastage for first row in MTP at Table 3.5 is \[ 1 - (0.79 + 0.10) \] ie 0.11.

(c) The Markov process is amenable to computerisation, and user-friendly software packages are available. By entering the initial stock in each hierarchy, the promotion flows, the annual recruitments, and predicted wastage flows, the stocks can be forecast year after year. With a given set of stock and flow parameters, the steady state and the year in which it will be achieved can also be predicted. If any change in flow parameters is anticipated, the same can be programmed to make the process dynamic.
(d) **Push-Pull Flows.** Vertical flows giving rise to promotions can be classified according to whether the impetus for an upward move lies at its starting point or its destination. In the latter situations, an individual moves into a higher rank because it is necessary to fill a vacancy arising at that level. The promotions effected from the lower rank are governed by the number of vacancies arising in the higher rank due to wastages in that rank and promotions from that level to the next higher category. This is known as pull flow; since the vacancies pull individuals from lower to higher grade. Other manpower strategies which could be adopted to fill the vacancies in higher rank could be by lateral transfers or recruitment from outside. In our context, however, flows can be easily modeled as the Markov model and since the promotions are purely vacancy based, the higher ranks are not allowed to grow in cadre strength. If the requirement flow at the lowest level is also regulated by vacancies only, then the model is known as renewal model. In practice, however, pull flows are the most usual types of flow other than at the entry points into the system. The promotion model following push-pull flows in the Corps of EME is at Figure – 3.3.

---

**Figure- 3.3 : Promotion Model being followed in Corps of EME**
To handle the increasing variety and complexity of managerial forecasting problems, many forecasting techniques have been developed in recent years as discussed in the previous chapters. Each has its special use, and care must be taken to select the correct technique for a particular application. The planner as well as the forecaster has a role to play in technique selection; and the better he understands the range of forecasting possibilities, the more likely it is that organisation’s forecasting efforts will bear fruit. The selection of a method depends on many factors – the context of the forecast, the relevance and availability of historical data, the degree of accuracy desirable, the time period to be forecast, the cost /benefit (or value) of the forecast to the organisation, and the time available for making the analysis. Techniques vary in their costs, as well as in scope and accuracy. The planner must fix the level of inaccuracy he can tolerate - in other words, decide how his decision will vary depending on the range of accuracy of the forecast. This allows the forecaster to trade off cost against the value of accuracy in choosing a technique. Figure – 3.4 shows how cost and accuracy increase with sophistication and charts this against the corresponding cost of forecasting errors, given some general assumptions.

![Figure - 3.4 : Costs Vs Accuracy](image)

The most sophisticated technique that can be economically justified is one that falls in the region where the sum of the two costs is minimal. Once the planner has defined the purpose of the forecast, the forecaster can advise him on its useful frequency. From a strategic point of view, they should discuss feasibility of
changing decision once it is found that the forecast was inaccurate. If it can be changed, they should then discuss the usefulness of installing a system to track the accuracy of the forecast and the kind of tracking system that is appropriate.

3.4 Estimating Net Human Resource Requirement

The net human resource requirement will be the difference between the net demand and the net supply. Since these are the anticipated figures which are subject to a number of uncertainties/unknowns, hence some gaps are likely to exist. Nonetheless these will give a more close approximation to the actual ones. Hence estimation must be done. However, it should not be rigid but rather be flexible, which will be subject to continuous correction/updating.

Strategic workforce planning is not limited to hiring and retaining talent, but anticipating future manpower needs of an organisation. In a dynamic business scenario, manpower planning is critical to organisational growth and stability. It is integral to recruiting, retaining, retraining and redeployment of talent. Linked to business needs of the organisation, the process is much more complicated than it seems, primarily because it also involves developing skills and competencies of existing employees to meet organisation demands which can change with time. Having a contingency plan in place in case of any eventuality (talent shortage) is also critical to the process. Future manpower planning is directly linked to the strategic business plans of an organisation. The estimation on manpower and budgets are governed by customers' demands or growth potential. Business needs are achieved from effective management of materials, machines, money and manpower. Manpower needs, if planned properly, in terms of profit required, numbers, time and place, will give the company mileage over competitors in terms of consistency in output. Effective human resources planning give optimal productivity in terms of timelines and quality of deliverables. It will not only improve people competency, but will also ensure that people grow with the company. This helps arrest the attrition rate. An organisation set on the growth path needs competent people to achieve its objectives. Finding the right human resources is not an easy task. Since for sales, product management, research and development, production etc there is a requirement of educated and skilled manpower, which will not be readily available in the future.
Human resource planning should not be considered in isolation and should be an integral part of the total management system, as shown in Figure 3.5. Specifically, enterprise plans becomes the basis for organization plans, which are concerned with the structure and activities necessary to achieve enterprise objectives. The present and forecasted organization structure determines the number and qualifications of soldiers required. Then the demand for soldier is compared with manpower currently available through the management inventory. Based on this analysis, internal and external sources of manpower are utilised in the processes of recruitment, selection, and promotion of soldiers. Other essential aspects of human resource planning - shown in the model - are appraisal and training and development of soldiers.

![Figure - 3.5: Total Management System](image)

Manpower planning also affects leading and controlling as seen in the model. For instance, well-trained soldiers exert leadership by creating an environment in which people, working together in groups, can achieve enterprise objectives and at the same time accomplish personal goals. Similarly, the selection of qualified soldiers also affects controlling by, for example, preventing undesirable

---

75 College of Defence Management, pamphlets Human Resource Development Volume- I & II.
deviations from becoming major problems. Human resource planning, naturally, is situational; it is carried out within the organisation, which, in turn, is linked to the external environment. Therefore, internal factors of the army - such as personnel policies, organisational climate, and the reward system - must be taken into account. Clearly, without adequate rewards, it is impossible to attract and keep quality soldiers. Similarly, the external environment cannot be ignored; high technology demands well-trained, well-educated, and highly skilled soldiers. In fact, technology often demands a multi professional work force with soldiers trained in several professions such as engineering, physics, and mathematics. Another external factor may be a small supply of soldiers coupled with great demand for soldiers in the labour market, which may prevent an army from growing at a desired rate. It is evident that staffing is a complex process, but this does not mean that it cannot be systematic. On the contrary, effective staffing demands a systems approach.

The aspects of National Policies, geo-political development of the neighboring countries, world situation, internal / external strife etc form the key drivers for the same. In planning, opportunities are identified, and objectives are set. Alternative courses of action should be developed, evaluated, and selected. Since the enterprise operates in an uncertain environment, contingency plans are also developed. It is important, however, that planning should not be done in isolation. Rather it must become an input for the staffing function. After all, the plans will have to be implemented by people, hence these are related to the human resources. The projected development/modernisation form the key components. Provisions are to be made for vertical and horizontal integration of authority and information relationships. The model suggested provides a conceptual framework for a logical process, but the authorities know that in practice these steps have to be integrated. For example, in setting enterprise objectives, one has to take into consideration the availability of manpower. Indeed, it is often the lack of qualified recruits that prevents an army from growing and expanding at a desirable pace. Similarly, recruitment selection, placement, and promotion may influence a change in the army plans and structure. The structure must be organic and flexible - not mechanistic and rigid. To indicate the dynamic aspects of effective human resource planning, feedback loops have been included in the model. The suggested human resource model provides a framework for
integrating key aspects of all managerial functions: planning, organising, staffing, leading, and controlling.

It is well known that the understaffing results to the business losses, customers and profits. On the other side, overstaffing is wasteful and expensive. Moreover it is costly to eliminate because of modern legislation in respect of redundancy payments, consultation, minimum periods of notice etc. Thus, overstaffing reduces the competitive efficiency of the business. Planning staff levels requires that an assessment of present and future needs of the organization be compared with present growth and future predicted resources. Appropriate steps then be planned to bring demand and supply into balance. Thus the first step is to take a 'satellite picture' of the existing workforce profile (numbers, skills, ages, flexibility, gender, experience, forecast capabilities, character, potential, etc. of existing employees) and then to adjust this for immediate, mid-term and the future by amendments for normal turnover, planned staff movements, retirements etc, in line with the plan for the corresponding time frames. This result will be affected by various situations and hence has to be modified. This, clearly, requires a great deal of information accretion, classification and statistical analysis as a subsidiary aspect of personnel management. What future demands will be, is only influenced in part by the forecast of the personnel manager, whose main task may well be to scrutinize and modify the crude predictions of other managers. Hence future staffing needs will be derived from expansion forecasts, technological changes on task needs, changes in employment practices and Government policies etc.

What should emerge from this 'sky gazing' is a 'thought out' and logical staffing demand schedule for varying dates in the future which can then be compared with the crude schedules. The comparisons will then indicate what steps must be taken to achieve a balance. The inputs will need constant varying to reflect 'actual' as against predicted experience on the supply side and changes in production actually achieved as against forecast on the demand side.