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OPERATIONS IN OFFICIAL PASSPORT OFFICE

The Indians are on move. The number of Indians travelling abroad is increasing and the trend is likely to accelerate as income level increases and trade expands. The number of passports issued by passport offices has reached 15 lakhs (table 1). Explosive growth in early 70's was result of the Gulf boom for work, now a large number travel abroad for tourism, trade collaborations, shopping, education, training and official purposes.

Passports for Indian citizens are issued by the Ministry of Foreign Affairs (MFA). Work load for issuing passports will increase in future not only for new passports but also a large proportion of the existing passport holders will require renewal. The government has taken various measures to meet the increasing demand like creating new passport offices, increasing capacity of the existing passport offices and policy changes like waving police enquiry in special cases, increasing the validity of passports from 5 years to 10 years, simplifying procedures. However, these measures have not been able to kept pace with the rising demand.

Low and rigid capacity associated with increasing demand has increased delays. Delays worries both, the public and the ministry officials. One can see increasing number of complaints for the delays in consumers' column of most newspapers. The delays lead to loss of business & trade opportunities, technical collaborations, manpower export, foreign exchange and other benefits.

With increase in the value of time and in the dynamic world, passports will be demanded in shorter periods. Thus pressure will increase not only to issue more passports but also to issue the same faster. Unless more steps are taken, costs to clients and society will continue to increase. Presently twenty two passport offices are operating in the country.

Major job of the passport office is to issue new passports and renewal of expired ones. Renewal is required when the passport expires or the passport becomes full with entries from repeated travel. Internal activities of the passport offices vary from printing of passports and application forms, making passport, keeping records, despatching passports, to liaison with police department for police verification etc.

Like any other government department, the passport office also faces resource crunch. The office incurred cost from its own pocket for each passport it issued.

Recently, in the third week of July 1993, the passport fee has been increased 5 times from Rs 60 to recover costs.

Passport application forms are available at a charge of Rs 20. The client fills the form, attaches photographs and documents, gets attestation and deposits it with the passport office along with the passport fee (now Rs 300). The office makes passport after receiving a positive police verification. A passport is issued after 3 months if police verification report is received in time. Personal passport remains valid for 10 years after which it can be renewed.

Official Passports

The government and public sector officials visiting abroad for official purposes (meetings, conferences, training) cannot travel on their personal passports. They are required to obtain an official passport. Press and other officials accompanying the politicians on official visit are also issued official passports. Senior officers of the government, diplomats and ministers are given diplomatic passports by this office. Official passports are issued by official passport office which is different from the personal passport office.

In this note we shall illustrate the operations undertaken for making official passports. The observations are drawn from one of the official passport offices in a major city. You are required to scientifically analyse the operations and suggest concrete measures for improving the performance of the system.

The official passport office has two wings, one for the official and the other for diplomatic passports. Both wings are housed in a big hall. The office is headed by a section officer and controlled by a senior Indian Foreign Service (IFS) officer of the rank of Director. This office issues official passports for the government officials and diplomatic passports to Indian diplomats and other VIPs including ministers going aboard for official purpose. Unlike personal passports, the official passports are issued for a short duration of 1 to 2 years. The client has to surrender his personal passport, if he has one, before taking an official passport. Official passport has to be returned to the office by the client on his return. The section officer gives a monthly report to the Director indicating number of passports issued during the month. The office on a five day week basis.

Pre-transaction stage

For obtaining an official passport the person first has to obtain a four page standard application form. The applicant fills the form giving details of his name, age, sex, educational qualifications, marks of identification, names of countries

to travel, purpose of travel, two specimen of signatures (on the application form), details of personal passport if held, and attach two passport sized photographs with the application form. The application form and the photographs have to be attested by the head of the institution where he works. Two letters are required to be attached along with the application form, one from the head of the institution and other from the ministry to which his institution is associated, indicating that the applicant has to attend conference/training and they have no objections for his travel abroad. Police verification is not required for the issue of official passport.

Transaction stage

The client or his agent presents the filled application form along with the two letters to the sectional head of the office. The sectional head inspects the form and letters for completeness and authenticity. If the documents are in order the applicant is asked to collect his passport after a week. When the documents are incomplete, the discrepancy is brought to the notice of the applicant and he is asked to do the necessary.

Application forms found complete are marked for issue of official passport by the sectional head. The application forms are sent to a dispatch clerk, sitting in the same room, who records the form number, date and marks on it an identification number for internal use. Everyone in the office uses ink pens. The dispatch clerk sorts the applications on the basis of official or diplomatic passports when the batch size is around 5 or after 15 minutes whichever is earlier. The sorted application forms are sent to the clerks of respective wings who sit in the same room.

The applications for official passports are accepted by the clerk A of the official passport wing. Clerk A records the name, age, department, form number, identification number and the countries to be visited in a register. He then passes the application to another clerk B sitting on his left.

Clerk B keeps a inventory of fresh passports in a locked almirah. He takes out fresh passports in small batches. For each withdrawal he records number of the passports taken out and the date in a register which is also kept in the almirah. On receiving application forms from clerk A, he starts preparing the official passport.

Clerk B enters the required details on the passport- name, sex, profession, domicile (India), height, colour of eyes and hair, name of father/husband, permanent address, particulars of the person to be intimated in event of death (his name, address, relationship, telephone number), place of birth, date of birth, visible distinguishing marks, countries to be visited in that order in three pages of the passport. The details are copied from the four page application form.

Next operation done by the clerk is to paste a photograph of the applicant on the passport. Generally the size of the photograph is larger than the space available for pasting it. The clerk takes out a steel scissor, similar to one used by tailors, and cuts it to the required size. Often it takes two to three trails to get the required size. After this, fluid gum is pasted on back side of the photograph and is allowed to dry a little. Then the photograph is pasted on the passport. The other photograph of the applicant is then pasted on the application form without changing the size. The clerk then cuts one of the two signature samples of the applicant from the application form and pastes it on to the passport below the photograph. The process of cutting and pasting the signature specimen is same as that for photograph. Then a rubber stamp of the MFA is put such that it marks both the photograph and the specimen of signature pasted below it. Other rubber stamps put on the passport by clerk B at this stage are date of issue, citizen of India, passport office stamp, expiring date, stamp of the section officer. The clerk then notes identification number, passport number, name of the applicant and other minor details on a register.

The passport along with the application form is then passed on to clerk C on the left of clerk B for preparing visa forms. This clerk types the details of the applicant on a printed form on his manual typewriter. For each country to be visited, a separate form is typed afresh. The clerk makes 2 copies of the visa form using a carbon paper. This clerk passes the application form, passport and the visa forms back to clerk B.

Clerk B makes a file for each passport. In the file the application form and one copy of visa forms are kept. This file is kept for future use if necessary. The clerk writes the name of the applicant's name, application number, dispatch number and the passport number on the cover of the file. The file is then stocked for record purposes on a table.

The passport and one copy of visa are then given to the sectional head for signature. He puts signature on the visa once and passport twice- one on the photograph and other above the stamp put by clerk B. After this a peon pastes a transparent *poly* sheet on that page of passport on which photograph and signature specimen are pasted. This is required to reduce the chances of forging. Then peon takes the visa form and passport to a fixed machine to put another stamp on visa and passport. This is a special stamp without ink.

The passport and the visa forms are given to a another clerk of the diplomatic passport wing. When the applicant comes he signs the letter and takes his passport and visa forms from this clerk. If the applicant owns a personal passport he surrenders the same to the clerk. The clerk puts a rubber stamp on the official passport and writes the number of the personal passport, date of its issue and the office from which this passport is issued.

The office has a standard of issuing passport within 7 days. However, due to urgency and delays in the departments of the applicants, passports are often required at a short notice. It is not unusual to see people demanding passports same day to attend conference/meeting next day in the destination country. The urgency takes these people to the Director of the office who depending upon the case often asks the sectional head to issue the passport on priority. Often high priority is given for making official passports to politicians, and other senior governments.

It not uncommon to see the clerks and the sectional officer clarifying technical points on the issue of passport. The sectional head has a direct telephone line. Often clients ask for details about the status of the passport from their places. The officer enquires the same from the clerk who keeps the passports which have been prepared. A number of other enquiries are also made by the clients on the phone.

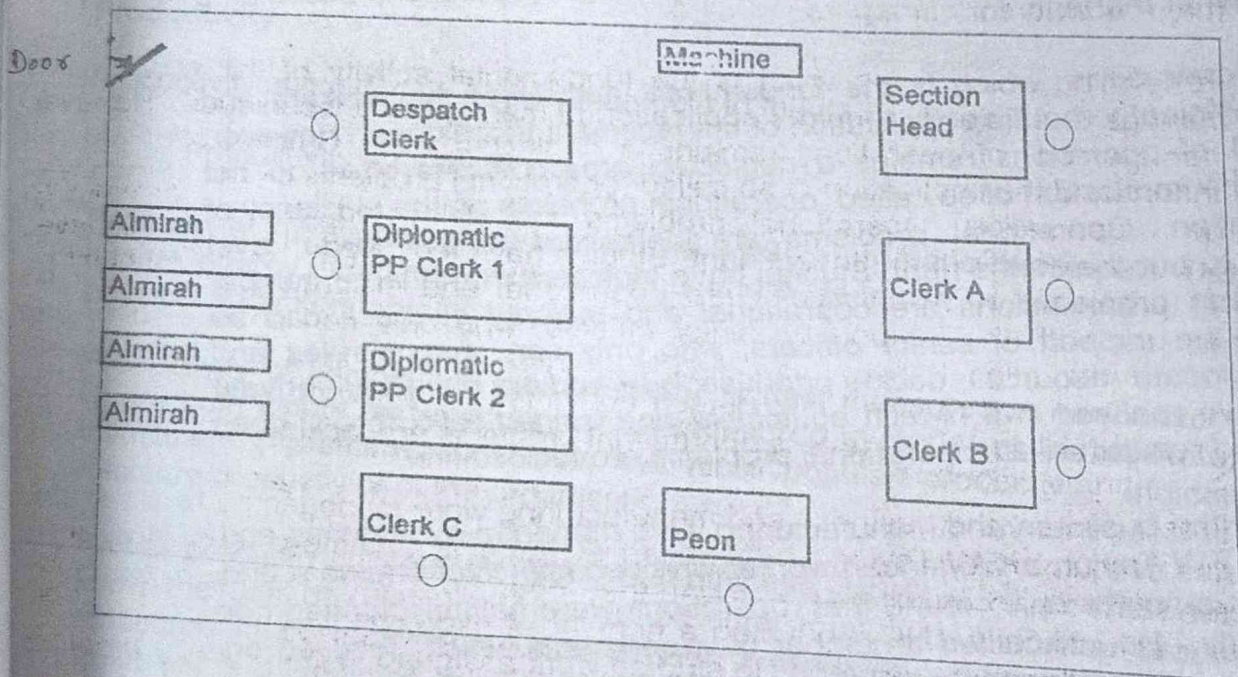
Post-transaction stage

As stated earlier, after returning from abroad the official passport is to be returned to the official passport office. If personal passport was taken into custody for issue of official passport, then a letter from the head of the institution of the client should be submitted along with the official passport to get back the personal passport. The letter from the institution should state that the person has returned from abroad/could not go aboard and hence personal passport be returned. The personal passport is given after 15 days from receiving the request. It can be obtained personally or by post.

TABLE 1 : Total Passports Issued by Different Passport Offices in 1991.

	Office	Issued	Percent	Cumulative
1	Guwahati	6070	0.39	0.39
2	Bhubneshwar	6420	0.42	0.81
3	Nagpur	7447	0.48	1.30
4	Goa	10311	0.67	1.97
5	Patna	18853	1.23	3.19
6	Bhopal	19634	1.28	4.47
7	Bareilly	43432	2.82	7.29
8	Calcutta	55921	3.63	10.92
9	Jaipur	62274	4.05	14.97
10	Lucknow	62917	4.09	19.06
11	Bangalore	68742	4.47	23.53
12	Madras	76609	4.98	28.50
13	Chandigarh	77303	5.02	33.53
14	Delhi	90065	5.85	39.38
15	Jalandhar	91879	5.97	45.35
16	Ahmedabad	98693	6.41	51.77
17	Hyderabad	115256	7.49	59.26
18	Trichy	120176	7.81	67.07
19	Kozhikode	122793	7.98	75.05
20	Cochin	141832	9.22	84.26
21	Bombay	242156	15.74	100.00
22	Srinagar		0.00	100.00
	Total	1538783	100	

Source: Annual Report 1991. Ministry of Foreign Affairs.



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OPERATIONS MANAGEMENT IN OFFICES

Organisations perform a number of operations to produce outputs (service, products). For example, major operations involved in transport service are forecasting demand for capacity planning, acquiring resources- buses, computers, employees, funds; deciding routes, printing tickets and time tables, scheduling buses and employees, training, undertaking repair and maintenance, construction of depots, disbursing salary etc. Output is the combined effect of these operations. When number of operations required to produce output are large, coordination and monitoring of operations becomes a major activity for managers.

Performing operations, which is the fundamental activity of the workers and managers, efficiently requires application of management techniques. However, management of operations remains a neglected area. Officers often do not understand the implication of so called operational problems on the efficiency of the organisation. Operational problems are delegated to the lower level of functionaries to put the things right. Studies have indicated that a large number of problems in organisations are operational and majority of these can be tackled with the support of senior officers, who only can change rules and procedures, allocate resources, decide priorities, hire workers etc. Even private companies have realised that hi-tech equipment and trained work force does not give desired results unless operational problems are tackled first.

Till last century the business and manufacturing were managed by hunches and rules of thumb. FW Taylor, an American worker who became chief engineer and later started his consultancy, found that operations were neither planned nor done scientifically. He conducted a number of experiments which focused on the of work done by workers. He studied work assigned to workers by breaking their task into number of sub tasks, invented best way to doing the job, promoted Adam Smith's idea of specialisation and standardisation, assigned job to the person with adequate skills, trained workers, designed new tools, standardised tools, introduced breaks, measured work, linked incentives to outputs etc. His results showed that large productivity improvements were possible when jobs are analysed and done scientifically. Taylor advocated that the responsibility of the management is to plan, coordinate, monitor and staffing operations. His ideas were widely applied after publication of his most influential work, *Principles of Scientific Management* in 1911. Taylor is also known as father of scientific management.

Efficient management of operations requires forecasting, planning, coordination, acquiring resources, implementation. Operations management techniques have been applied in all areas- military (Operation Desert storm), manufacturing, construction, mining, posts, banks, traffic control, offices, government and even in design of kitchens and telephone instruments. Operations management can be used in all functional areas- logistics, purchase, stores, queues, training, marketing, production. New management science techniques like systems, just-in-time, total quality management, value analysis, re-engineering have further enriched operations management. Study of operations can improve productivity often without/little investment. Specific advantages from improvement in operations could be reduction in load, increase in capacity, lower delays, fewer resources (labour, capital, energy), lean organisations, reduction in costs, increase in sales, higher profits. In this note we shall restrict to improving productivity of the work performed in offices.

Productivity

Productivity is defined as a ratio of outputs to inputs

$$\text{Productivity} = \text{Output/Input}$$

Productivity measures efficiency of the system to transform inputs (labour, capital, energy, time) into outputs. Inputs and outputs can be expressed in time, physical and monetary units.

Productivity of competitive private sector is best measured in economic terms where both inputs and outputs can be measured in monetary terms. Return on investment (=profit/investment) is the most popular productivity indicator to measure productivity of the organisation.

Partial productivity measure (total output/single input) is more appropriate to know the use of particular input to produce total output. Partial productivity measured in pure physical units (litres/km, wheat/ha, transactions/employee, fruit/tree) is a indicator of efficiency of technology and management practices used in transformation.

In government, cost of inputs involved in producing outputs can be easily computed but it is difficult to measure the value of its outputs (education, programmes for poverty eradication, pollution control, rural development) to the society. In such cases productivity is computed from number of outputs produced for unit rupee, unit labour, unit time etc. Productivity of offices where little technology is used and repetitive work is performed, can be measured by labour productivity ratio (judgments/judge, ration cards/employee, transactions/employee) and time productivity ratio

(raids/month, judgments/year, patients/day). [Data Envelopment Analysis is a linear programming based technique to identify low productivity units (bank branches, dispensaries, post offices, schools) which have multiple inputs and outputs, and where value of outputs is difficult to measure].

Productivity can be increased by changing inputs and/or outputs so that their ratio increases. In view of increasing load, resource crunch and rigidity in firing labour, producing more output from same inputs and by increasing the output considerably with small increase in inputs are more appropriate in government. The specific methods of improving productivity are motivation, operations management and investment in new technology.

Work Study

Work study is an important technique of operations management which involves micro analysis of operations. Work study is also called time and motion study. Work study analyses the way a work is done (motion study) and its measurement (time study). Motion study requires study of sequence of flow of work in the office (plant), arrangement of points where work is done (layout), body motions of the worker, design of the workplace, location of tools on the work place, design of tools and equipment, scheduling etc. Work study can reduce delays and work content of the job by eliminating unnecessary motions, using better tools, reducing movement and storage etc. Time study measures time required to perform a task by worker. Time study is used for manpower planning, monitoring performance, designing incentives.

In addition to Taylor, other early notable contributors to the work study were Frank Gilbreth and Lilian Gilbreth (husband and wife). They found that motion study can increase the productivity considerably. Their well known experiment increased the output of a bricklayer from 150 bricks an hour to 350 bricks (more than 200% increase in output) by designing an adjustable scaffold, chaining the mortar mixture to eliminate the need for tapping, arrangement of bricks of the scaffold etc.

Work Study in Government Offices

Government offices are often accused of slow processing of files/papers, slow decision making, work of influential done on priority, increasing corruption at lower level. Physical condition of government offices is miserable as compared to ones in corporate sector. Government offices are crowded with employees and visitors, disorganised, dirty, poor lighting and ventilation, stinking toilets, broken furniture, lack of furniture, non working equipment, low use of information technology. In addition, offices have lengthy and time consuming procedures, employees are transferred frequently, jobs are given without training, those

trained are given other jobs, lack of trust. Work study of office operations can streamline operations and improve productivity with little investment.

Activities involved in doing a task can be classified into four basic operations. These basic operations are productive operations, transport, storage and inspection. Operations can also be classified as productive and unproductive. Storage, inspection and transport are unproductive operations since they do not add value to the job. Like productive operations, the unproductive operations too consume resources and time, and add to delays and costs.

Studies have indicated that total number of productive operations form a low proportion of total operations required to do a job. In addition, productive operations consume only a small part of total time (time to complete a job = productive operations time + storage/waiting time + inspection time + movement time) and resources (manpower, machines and tools for productive operations; manpower and measuring instruments for inspection; trolleys and peons for movement; and racks, tables, store rooms, security guards for storage).

First step in work study is to prepare an outline note which describes the procedure to be followed, procedure actually followed, operations done on the job, their sequence, location of points where a job is done (layout diagram), tools and equipment used, environment of the office. Outline note does not give details involved to perform operations. Large improvements are possible from outline note even without detailed motion and time study. A careful study of the operations in the system can suggest changes in the procedures being followed, sequence of operations, combining operations, simplifying operations.

Procedure: Actual studies indicate that a large part (85%) of the improvement is possible by change in design of products (procedures) alone. Procedures do not change with the changing conditions. A study of procedures can show that a number of procedures being followed have lived their life and are no longer relevant. Often *local* procedures are introduced which were relevant at a time. Banks ask for introduction from third party to open an account. This procedure is followed with rigidity even though it is not mandatory. A department had to come back to annual system when its head office refused to accept its computerised reports. Similarly, procedures often disallow use of photocopies of originals, credit cards/cheques are still not accepted for payment of bills by many organisations. Some organisation still pay of salary for four class employees/daily wagers in cash. Changes in procedures can improve productivity. Since procedures are designed and modified by management their involvement is crucial for improvement in productivity. Few years back ministry of foreign affairs decided to issue personal passports if police inquiry is not received within three months.

Layout Diagram: Layout diagram gives location of each employee and equipment (Xerox machine, computer, racks) in the office. Layout will indicate whether all employees of the office sit in the same office or not, whether they sit according to the need of the work or according to their own convenience, excess furniture in the office etc. Layout affects delays and movement of the job in the office. A flow diagram of the job movement in the office (super imposed on layout) will indicate need for better layout. New layout should reduce and streamline movement by changing the location of employees, equipment and storage systems in the office. New layout can often reduce space requirement, a resource which is often scarce in government office. When a public sector officer went on deputation to a government department, he called engineers from his earlier organisation to suggest better layout for the clerks' office. With new layout movement of files and clerks was streamlined, excess furniture was removed, location of clerks in the office was according to the flow of work. The office, which was demanding more space for long, was now having excess space.

Sequence: Study of sequence in which operations are done, can help to combine similar operations which are done at different places. Flow of work superimposed on layout chart can suggest changes for better sequencing.

Tools & Equipment: Tools and equipment improve productivity by reducing time, effort, fatigue. The tools and equipment available in the market have increased in variety and sophistication. Tools often used in the offices are staplers, sharpeners, pins, clips, tags, stamps, gum paste, scissors, punching machine etc. The equipment in the offices could be typewriter, calculator, computer, Xerox machine, telephones etc. New equipment enhance productivity. Carbon copies saves typing time, word processing allows easy editing, mail merge eliminates need for typing identical communication, telephones makes information gathering quicker etc. Computations in one financial department is still done manually by a large number of clerks. These employees were not averse to calculators but the department has not cared to provide them one.

Environment: Environment in which the work is done affects productivity. Noise, temperature, humidity, cleanliness, lighting, interaction with outside world (public, frequent phone calls) are some of the environmental factors. Buildings of the district offices are often more than hundred years old, when neither electricity nor fans were available. Providing better environment is important not only to increase productivity but also to make workers feel happy.

Analysis of Basic Operations: Outline note can now be analysed for improving operations that are performed by workers and tool/equipment. We explain need for performing these operations and strategies to improve them.

Productive operations

Operations which add value to the job are called productive operations. A number of activities may be performed by the worker to complete a task. To process a file activities performed by a clerk may include reading letters, taking notes, typing, stacking and searching paper/files, putting flags, writing, putting office stamp, stapling, computing etc. Speed with which a task is done by the worker depends upon work involved (including procedure and sequence) in the job, his knowledge and skills, tools provided to him, design of workplace. A detailed study of activities performed for a task can lead to simplification, elimination or combining of activities by change in procedures, sequence of operations, scheduling, providing (sometimes designing) better tools and machines (calculators, computers, staplers).

Simplifying, Eliminating, Combining Activities: Close examination of not so well designed jobs can easily lead to simplification, elimination or combining of activities. Sealing letters with cellophane tape instead of lac (introduced more than 100 years ago by British but still continued by Indians), converting multiple office stamps into one, using carbon paper/Xerox machine to make duplicate copies, using stapler instead of pins and clips, using pre gummed letters, using standard forms (for applications, internal communication, issue of material, monitoring reports), using calculators for computation using coloured paper/files for easy identification can simplify eliminate or combine activities.

Skill and Knowledge: All tasks, including so called unskilled jobs, require skills. Best way of the doing a activity should be developed by the management and the worker should be trained to do it. Employees who are not trained may spend a lot of time on non productive activities like-checking rules and procedures and other activities which are not productive.

Workplace Design: Design of workplace affects the time to accomplish the job. Defence and aircraft manufacturers spend a lot of effort to design the cockpit. Improvement in workplace involves design of chair and tables to reduce fatigue, location of tools within the reach, improvement in the tools, method of handling the job.

Tools and Equipment: As discussed earlier, tools and equipment affect the productivity of operations. Often special purpose tools may need to be designed to improve productivity (jigs and fixtures).

Scheduling: Scheduling is the job of supervisors and managers. Scheduling can help in meeting deadlines, efficient use of resources, coordinating activities. CPM/PERT is a technique for scheduling activities of projects.

Inspection:

Inspection: A job is inspected to detect shortcomings in productive operations and quality deterioration that may occur in transport and storage. Inspection is not considered a productive operation and hence has a separate identity in four basic operations. Inspection is a non productive operation which consumes time and resources but does not add value. Expensive mechanics and doctors spend most time in fault detection (inspection).

Specific purpose for which inspections are undertaken could be ensuring adherence to procedures, quality and quantity of materials received/despached (stores), mistakes and errors in operation (production supervisor, financial computation), fault detection (doctor), controlling corruption. Lack of trust and risk averse nature of the office also increase inspection load.

Number of inspections performed often equals to number of productive operations. Manufacturing has at least three inspections- inspection of quality (and quantity) of the goods received, quality check after transformation and final inspection of assembly. Multiple inspections are common in finance departments. Finance/treasury inspections are made for signature matching, computations, numbers recorded in registers, inspection of cheques etc.

Inspection is a major activity in governments. Government accounts are inspected by different authorities to ensure proper utilisation of funds and adherence to rules and procedures. A large work force in governments does inspection related jobs (inspectors of health, customs, excise, quarantine, train ticket). Inspection and monitoring consume a substantial time of government officers. [Principle-Agent theory is an emerging area in economics which suggests better contracts between conflicting individuals to discourage shirking, inspection cost and corruption].

Time & Resources for inspection: Time consumed for inspection depends upon number of inspections, time for inspection, and time spent in storage and transport involved in moving the job to the inspection place. The resources

required for inspection are manpower, equipment, instruments etc. Storage and transport are additional resources which needed to move and store jobs for inspection.

Strategies to reduce inspection

Study of procedures and concepts of Quality Management which can reduce and also eliminate need for inspection.

✓ **Early detection:** Just-in-time concept calls for immediate inspection to avoid further value addition. Early detection of errors and poor quality reduces load, delays and costs.

✓ **Job to Right person:** Errors and mistakes can be reduced, and hence inspection, when jobs are performed by trained and knowledgeable persons (who know rules and procedures). Employee who repeatedly make mistakes should be given training for performing the job.

✓ **Mistake Proof Methods:** Introduction of mistake proof methods like building appropriate checks (in computer programmes for data entry), using computers and calculators (computations), photocopying (rather than making copy by typewriter), forms of different colours (in banks) can eliminate need for inspection. An office eliminated need for inspecting reports for errors and spelling mistakes when it computerised its operations for data processing and production of cheques.

✓ **Reduce Inspections:** Number of inspections can be reduced if a job is inspected after few operations rather than after each operation.

✓ **Building trust:** A large part of the inspection could be due to lack of trust between the parties. As stated earlier, Japanese companies have reduced number of inspection by building trust worthy relations between buyers and sellers.

✓ **Decentralisation:** Inspections in large organisations inspection are not done by front line employees (who accepts applications, cheques). If front line employees are delegated the power to inspect the incoming load, the early inspection will reduce further value addition, reduce delays and work load on the system.

✓ **Increase penalty:** When purpose of inspection is to check corruption, increase in penalty can reduce mistakes.

✓ **Method of inspection:** When volume to inspect is high, inspection by random sampling can reduce inspection time.

Finding the cause of poor quality: Quality management calls for better quality so that inspection can be eliminated. There is always a cause for poor quality. Efforts should be made to identify and control the causes of poor quality (incomplete form, wrong data entered, file lost, worn-out tool, vibrations from nearby machine). In the districts the appeals against the decision of Tehsildars are heard by the sub division magistrate. The appeals against the SDM is heard by collector and commissioner/revenue board hears the appeals against the judgment of collector. By improving the quality of judgment (more time spent) the number of appeals can come down and hence the load.

Storage (Waiting):

A job often waits at various desks and racks before it is moved, inspected or productive operations is done. Literature classifies waiting as intentional (storage) and unintentional (delays). Intentional waiting occur when inspector or productive operator is busy or rules require papers to be stored for a specific duration. Unintentional waiting could be for variety a of reasons- peon not available to move the job, the machine is out of order (computer, Xerox, typewriter), employee is on leave, non availability of resources required to do the job (paper), signal not received.

Storage is also an unproductive operation. It does not add value but consumes physical resources (racks, shelves, desk space, bins, almirahs, store rooms, computer floppies, computer memory etc.). Storage increases delays to complete the job.

Points where waiting is large (files are always pending) indicates existence of bottlenecks. These points require critical examination. The bottlenecks may arise from busy worker (unequal workload), non availability of resources (absenteeism, stockouts), breakdown of resources (machines, tools) or waiting for signals (poor communication, high bureaucracy). Bottlenecks from unequal load means the earlier operation is faster.

Strategies to reduce storage related time and resources:

Ensure Resource Availability: Resource availability can be improved by streamlining purchases to avoid stockouts (paper, printer ribbon), encouraging leaves during lean periods (LTC leave), better maintenance (low machine breakdowns) etc.

Quick Transport: Storage time can be reduced by encouraging movement of papers/files as soon as these are processed (movement in small batches). It will reduce storage time but may require more transport resource.

Modern Storage Systems: Clerks spend a large amount of time for locating files, filing and retrieval of papers, records, files. Modern filing and storage systems can reduce time associated with storage and retrieval, and may also reduce storage space requirement. Consistent numbering and use of proper racks reduces time to stack and locate books in libraries.

Save Space: Government has established norms for the duration for storage of different types of records/papers. Often these norms are not followed and hence a large space is devoted to storage. Storage space requirement can also be reduced by better filing systems and use of modern storage systems. Storing information in computers (floppies, tapes) can substantially reduce storage space requirement.

Improve Communication: Processed files also wait when signals are awaited for further processing. Better communication facilities and delegation of authority can reduce these delays.

Just-in-time Concepts: Just-in-time and inventory management concepts reduce storage time and resources by removing causes that encourage storage. These concepts can also be used to improve transport, inspection and productive operations.

Transport:

Movement of job takes place between storage, inspection and productive operations. Movement of jobs is affected by distance between the points and number of operations done on the job. Transport is also an unproductive operation which adds to delays and consumes resources (peons, trolleys).

Strategies to reduce transport related delays and resources:

Location: When number of offices in the organisation are many, change in their location can reduce movement, transport time, and resources. A location chart of the offices is a useful technique to determine new locations. When offices are shifted to new buildings location of offices must be considered to improve productivity.

Layout: Diagram shows location of all equipment and people working in the office. Analysis of flow diagram can lead to better relocation, reduce distance and time. Can also help in combining certain operation. Target should be smooth flow of work and minimum distance traveled by the work.

Combining Operations: If a worker can do more jobs at same point the transport can be reduced.

Movement in Batches: Transport can be reduced considerably by moving files/papers in larger batches. Transport can also be reduced by fixing time for movement. The latter strategy is used by post office.

Information technology: Telephones, computer networking, e-mail can eliminate transport where movement of papers/files is involved.

Strategy for implementation of operations management techniques.

As senior officers you may not have time and skill to identify and implement all changes yourself. Thus you will need help from others. We suggest following options for taking operations management study:

Operations Manager: For large offices a skilled person can be given job of operations manager. The operations manager should identify areas for improvement with the help of supervisors and employees, and coordinate implementation of productivity improvement programme. For example if an office plans to introduce standard forms, the operations manager can collect all forms in use, identify new forms which can be introduced, delete or combine forms which can reduce the writing work (leave application), prepare standardised formats, take the responsibility of its timely printing and supply, keep a master copy, monitor impact of new format on customers and employees, make further changes, explore computerisation possibility etc.

Involve Employees: Operations management study cannot identify all ills in the system. Every day changes create new problems. Thus continuous improvements (*Kaizen* in Japanese) become essential to get best results. The employees, who actually do the job and whose cooperation is essential for implementation of productivity improvement programme, should be involved in getting suggestions and identify problems that are likely to come in implementation. A suggestion scheme for the employees can be introduced. The employees who suggest new methods *must* be given commendation certificates or other rewards. Suggestion scheme should be introduced only when management feels that it is determined and capable of introducing all useful suggestions.

management. If the organisation has resources it can hire an experienced consultancy company. National Productivity Council, which is supported by the Government of India and has regional offices all over the country, can be contacted for operations management study.

Involve Private Sector: Operations management studies in large companies are done by industrial/mechanical engineers and MBAs. You may contact nearby private companies to conduct operations management study for your office. Private companies in the west are have begun to share their expertise with the government to streamline operations and improve productivity. It helps the private sector since they are dependent upon the government offices for quick decisions.

Involve Students: Most MBA and engineering students take field projects during their summer training. You may contact your nearest management and engineering schools and ask the boys to undertake operations management study in your organisation. This option is likely to be cheaper, the students may also use latest techniques taught to them and finish the project in a fixed duration.

Hire Skilled Workers: In government little training, if any, is given to the lower level employees. The departments should hire skilled workers and provide them training in improving operations. The employees should be transferred only when they have acquired skills to do the new job.

Time frame: For the offices of collectorate/SDM it should not take more than 1 to 2 months to complete the study. The implementation of suggestions coming from the study will depend upon the availability of resources, complexity of the system and the authority of the head. The suggestions can be implemented in small steps with a fixed time frame. During implementation the role of the head should be to forge coordination and remove bottlenecks that emerge.

A useful tips for implementation of productivity programme

Productivity day: You can fix one day in a month (quarter, year) when employees can meet to discuss measures to improve productivity. On this day new suggestions can be identified, suggestions can be selected for implementation after brain storming, appraisal of ongoing productivity can be done, certificates and cash rewards can be given, coordination problems can be sorted out and films on productivity and quality can be shown.

Since study of operations is an neglected area, you will find that following can be introduced in most offices even without a formal study.

Better Environment: Employees can do more and better job when better work environment is provided. Steps should be taken to reduce crowding, keep office clean (aim at providing cleanliness better than hospitals), toilets should be usable by everybody, maintenance department should be involved to reduce idle time from breakdowns (tube lights, fans, typewriter).

Give furniture: Furnishing of offices remains a neglected area. New office buildings are created but little attention is given to furniture. Furniture in offices is generally inadequate, bulky (occupies too much space) and sometimes broken. Though obvious, minimum furniture should be given to all employees. Storage systems (racks, shelves) should be given high priority to reduce search time, reduce space.

Reduce Public-Employee Interaction: Interaction between the public and office employees is high due to lack of control. Steps should be taken to reduce and even avoid public interaction with all employees. Only supervisors should be allowed to interact with the public. It will reduce distractions to the employees. Single window systems is another solution.

Start Single Window: Organisations which have many offices can start single window system for inquiry, for collection of applications, distributing forms, collection of money. It will reduce the public-employee interaction to a large extent. If this centre can provide service efficiently the public will also benefit since they will now not have to run around after many offices and officials.

Standardise Forms: Standardisation of forms reduces writing work and processing time. Standard forms are also easy to handle and store. Standardisation of forms will save time, labour, space, and its consistency can make computerisation easier. If standard form already exist, these may need redesigning if they were designed long back.

Give Telephones: Officials and clerks move from office to office, within office to discuss, clarify, to inform, to discuss, to complain, to monitor etc. Availability of employees in the office will improve if intercom connection is also available to them. You should ensure that this critical facility always works.

Give Better Tools: The tools and equipment given to the employees may require to be upgraded. Use of staplers, carbon papers, clip files, calculators, stick gum, paper puncher should be encouraged. These low cost tools/equipment affect productivity but are often not available in stores.

Location Diagram: When number of offices are more than one, a location diagram of all offices will be useful. It will indicate what offices should be closer.

Layout Diagram: As mentioned earlier, layout of office based on requirement of work can reduce movement and delays.

Thumb Rules

Work study/operations management will be required in your office when

- a person (or you) receives same file again. It not only requires time for processing but also increases delays and requires resources for handling. Decentralised decision making, giving job to knowledgeable workers and training of workers could be some solutions.
- a file/paper demanded from the clerk is not received in 10 minutes. Introduction of better filing systems and use of modern filing systems can be used to tackle the problem.
- work always pending or employees complain of high work load (working overtime without allowance). Improvement in labour productivity, using load reduction strategies and hiring of additional resources (manpower, computers) could be some solutions to the problem.
- office(s) has too many peons. Peons are required when the job is done on priority, number of handling are large or the operations are performed at large distances. Number of handling increase delays and require resources. Planning of work (scheduling), change in location of offices and layout of office, providing intercom service, encouraging *self service* will increase the productivity and reduce delays.
- a file received is thick. Thick file indicates slow decision making in the office. Thick files are result of too much of communication, too many papers demanded from the client, high paper work in the office, inspections by different authority etc. Introduction of simple procedures and decentralisation can reduce delays, improve productivity, save resources and reduce the thickness of files.
- frequent stockouts: Unless planned, frequent requests for supply (purchases) indicate stockout of stationery, printed forms, registers. It may be leading to stoppage or slowdown of work, use of non standard methods which in turn leads to delays and higher work load later.

- you scarce time is consumed to receive file/paper/phone call which not meant for you. It is an indicator of poor information and lac procedures prevalent in your system. Up to date telephone direc should be made and employees should be made known of the procedures.

- number of complaints/reminders exceed commendations. It indicat that the quality of the work performed by the system is poor. Finding t root cause of poor quality will increase commendation letters (at lea decrease number of complaints and reminders), reduce workload on th system, improve productivity, reduce fire fighting, reduce delays, sav resources etc.

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SECTION IN GOVERNMENTS

Work Smarter, Not Harder. -Peter F Drucker
Why Work ? -SK

Increase in population, their incomes and homogenisation of tastes continue to increase load on the government systems. More people today need government services for birth and death certificates, ration cards, driving license, line up for railway reservation, go to court, file income tax returns, demand passports, avail banking and postal services. Most, if not all, government services are provided below cost and sometimes free. Load becomes maximum wherever services are provided free. Expansion of capacity of the government systems has failed to keep pace with the growing load. Increasing gap between load and capacity has increased delays and exposed systems to corruption. In some cases the systems are choked and delays have become intolerable. For example, number of cases pending in the Indian courts is over 20 million.

A simple and most commonly thought strategy to reduce delays is to add capacity. Additional capacity requires financial resources to support manpower, space and equipment on fixed and recurring basis. In view of severe financial resource crunch faced by most states and departments it is unlikely that capacity expansion will be easy. Two other strategies to reduce delays are reduction of load and improvement in productivity. These strategies need little resources and can be implemented quickly.

Perhaps the most effective strategy to deal with the growing load and increasing delays is reduction of the load itself. It is sometimes possible to even eliminate the load. This strategy may not require additional resources. In addition, it may save existing resources (manpower, equipment and other costs) which can be diverted to departments hard pressed for resources.

The time load on the system can be expressed by simple equation

$$\text{time load} = \text{average time required for the service} * (\text{number of persons who are eligible/require/demand service for one time} + \text{average number of persons who repeatedly require/demand the service} * \text{average number of times a service is demanded repeatedly})$$

The load on the system can be reduced by lowering the values of variables in the above equation (reduce average time required for the service, reduce number of people demanding the service, reduce number of persons needing the service repeatedly, and by reducing the number of times a service is demanded repeatedly).

Examples from different systems which have used above strategies, whether or not the concern was to reduce the load or delays, are given below.

Eliminate load completely:

Few years back, the owners of TV and radio were required to obtain licenses from post offices. The licenses could be renewed for 1 to 3 years. The government has now abolished these licenses and hence the load is eliminated.

The Telecom department plans to withdraw its services for the distribution and the repair of telephone instruments. It again will eliminate the load.

Goods are checked for quality before despatching the same to the buyer. On receipt of goods, the buyers again check the quantity and inspect quality. If buyers and suppliers can build trust, the goods need not be checked twice. This strategy has been exploited successfully by the Japanese manufacturers and they have reduced delays as well as costs.

Reduce Load:

1. Reduce number of people eligible for/requiring/demanding service
Reduction in number of persons requiring a service is possible by increasing the price of the service or by changing the eligibility criteria.

Pricing: Since demand of most services depends inversely on its price, the load can be reduced by increasing the price. Recent hikes in passport charges (Rs 300 from Rs 60), STD call rates (by 25%), railway fares (by 6%), postal rates, and proposed banking charges are likely to reduce demand and hence load on the systems.

Reducing number of eligible persons requiring the service: High income tax limits, limiting PDS to non tax payers, reduction in number of industries requiring license, SEBI's decision to increase minimum lot size for the issue of primary shares (500 shares from 100 at present) will also reduce the load. Fast food centres use disposable plates/cups to reduce load (eligible cups/plates) of cleaning. UPSC can reduce number of eligible persons appearing in civil services examination by increasing the minimum age limit, reducing the maximum age, increase minimum qualification, reducing number of optionals etc.

Reduce frequency of service: When customers repeatedly requires same service, the load can be reduced by increasing the interval between successive services (reducing frequency). Service may be required repeatedly due to stockouts, time limits, poor quality of service and actions of customers.

Increase stockout period: Stockout period can be increased by providing larger service or by reducing the consumption rate. Since it may be difficult to reduce the consumption rate of a large population, the customer can be provided with larger service. Cooking gas agencies can introduce large size of gas cylinders, banks can issue thicker check books and pass books, passports can have more number of pages.

Increase validity period: When interval between successive arrivals is fixed it can be increased to reduce the load. Driving license, arms license, passports are valid for a given period. The customer comes again after when validity period expires. Similarly, bills for electricity/telephone/water are be paid after fixed intervals, salary is given after each month, bus/train passes are issued for one month. The load on the system can be reduced by increasing the validity of these licenses and increase in collection period for electricity/telephone/water bills. The decision to increase validity of personal passports to 10 years (from 5 years) will also reduce number of citizens requiring the renewal of their passports. Libraries can reduce its load by increasing the period of issue (14 days is a standard). Load on election commission will reduce if it conducts elections after longer period (7 years from 5 years at present).

Improve quality of service: Customers come again when quality of the service is poor. Load on the system can be reduced by eliminating errors in billing (telephone charges, taxes), giving better judgments (fewer adjournments and appeals), reducing breakdown of machines (buying better machines, undertaking preventive maintenance).

Action of customers: Actions of customers can also increase repeat load on the system (by coming again) when they submit incomplete and ineligible forms, loose their driving license.

Reducing number of times a service is demanded repeatedly

Repeating to one (or few) time service: Earlier state governments collected vehicle tax collected every year. Now most states collect vehicle tax only once. This strategy requires providing repeated service only once. If a city had 1 lakh vehicles and 10,000 new vehicles joined and same number became obsolete the number of transactions per year were

1 lakh. New strategy will reduce annual transactions by 90%. Load on UPSC for civil services examination can be reduced further if candidates are allowed to appear only once or twice.

A. Reduce service (processing) time:

Processing time can be reduced by involving customer as well as by improving the productivity of the system.

Self service or shifting workload to the customer: Time required to process a service can be decreased by encouraging the customers to do a part of the load. Self service is mandatory in most fast food outlets. Doctors (in government hospitals) often ask patients to help themselves in taking temperatures. Most international journals have reduced their typing and error correction load by asking the authors to send their articles on computer floppies. In cities most customers fill in their deposit/withdrawal slips, but in rural area the bankers often have to do this job (literacy mission is likely to reduce processing time of banks).

Use probability: Inspection is a major activity of government (*Inspector Raj?*) for control of traffic and pollution control, auditors check the conformity of rules, customs check incoming passengers, collectors inspect fair price shops and warehouses. Random checks can considerably reduce inspection load, save manpower and other resources. The disadvantage of this method is that there is waste of effort when a right item is checked and a loss when a wrong one is missed. Even number of random checks can be reduced by increasing penalties. A team from defence recently studied systems in the Academy. It has suggested that formal feedback can be taken from few and randomly selected probationers to reduce load.

Changing procedures: Admission rules of an university required copies of certificates from all candidates (around 30,000) when they applied for admission. It now demands certificates only from successful candidates. The university now processes certificates of only 200 students who are admitted to the course.

Improve productivity: Organisations can reduce processing time by improving productivity. Higher productivity increases capacity, reduces delays and reduces the cost of service. Methods of productivity improvement are given in books on operations management.

Privatisation: The government (state, central) are gradually allowing private sector to provide services which were monopolised by the government. Airlines and courier services are now also provided by the private sector. Fast growth of these sectors indicates that a large number of customers prefer services provided by the private sector. When full privatisation is not feasible, partial privatisation can be considered. Railways plans partial privatisation for running selective tourist trains, catering etc. Selective privatisation in Telecom, road transport are likely in near future. The government of Himachal is considering privatisation of health services. Privatisation may not reduce load but it transfer load from government departments to private sector.

Tailpiece

In Governments- Work Less. Think More.

BEFORE AND AFTER TQM

Success formula of the Japanese has been decoded. It is TQM. TQM defeated the west without bloodshed. The west paid heavily. It damaged their markets. Business schools did not recognise TQM. It is common sense. They said. But the businesses are smarter. Worldwide. They have adopted it. And now want to master. TQM success stories are being repeated. Everywhere. In all fields. Manufacturing. Services. And government.

We want TQM in two months. Because it improves the product quality. Still many believe so. Japanese think otherwise. TQM improves people. And people improve quality. Thus they took two decades. TQM transforms the organisation. Not just the product.

Philosophy

Economists say the firms maximise profits. The firms believed what economists assumed. Firms focused on innovations, expansions and promotion. To improve their future. But consumer was ignored. For decades. The Japanese valued the consumer. They discovered he provides bread and butter. Japanese improved quality. The consumer responded. He chose quality. Business thought he adopted Japanese.

TQM changed corporate philosophy of business. Profits come from consumer satisfaction. They agree. The consumer has won. Now he comes first. And the profits afterwards.

Approach to Quality

For statisticians, poor quality is a random phenomenon. QC inspected production. It separated poor quality products successfully. Best brains found good ways of using bad products. The rejects were reworked and repaired. And even sold. Poor quality created consumer complaints. Organisations responded quickly. After sales departments were created. To satisfy dissatisfied customer. Organisations experienced boom in size. And costs.

Sophisticated labs tested quality. Under standard conditions. It satisfied QC people. But not the consumer. For him quality is good only when product performs in his home.

TQM revolutionised approach to quality. TQM called for avoiding production of poor quality products. New approach demands imagination. Not better inspection.

Responsibility

Save on costs and reap profits. So goes the saying. That is obvious. So nobody questioned. The motto was clear. Reduce cost. The message was spread. Everyone committed.

The God designed nature. But R&D designs products. Designs were good. So would be the product. Processes were changed to satisfy R&D. Because design change costs more. R&D was not questioned. Because costs were important. Purchase people bargained hard. To buy low quality inputs. Because these were cheaper. And not easily available. Personnel department lead the way. They hired untrained people. To save lots of money. Top management wanted high utilisation of capacity. They refused preventive maintenance. And too saved money. It helped the Maintenance. They excelled in breakdown maintenance. Finance refused better machines. Because machines cost money.

Everybody measured tangibles. Commitment reached Zenith. Everybody did best. And costs fell. So did the profits. Everyone was surprised. They thought consumer is irrational. Even unpatriotic. Because he chose Japanese.

Market research revealed the quality has suffered. Everyone agreed. Though not easily. The motto trembled. Cost reduction efforts went astray.

Somebody was to be blamed. Production changes the form. So everyone blamed production. But production blamed everybody. Its logic was simple. R&D gave difficult designs. Which required better machines. But finance loves cheapest machines. So we changed the design. Personnel hired untrained workers. It gave no training. Workers gave poor quality. Top management discouraged maintenance. We kept production going. Despite poor quality. To meet deadlines of marketing. Purchase gave defective materials. GIGO was obvious. Production was right. Now nobody blamed anybody.

TQM opened the eyes. And attacked mindsets. Production cannot manage quality. Because everyone affects quality.

Trust

Do not trust suppliers. They increase costs. Have more suppliers. And become king. Get more for the same. It reduces cost and risk.

Risks and costs were transferred. From buyer to supplier. His productivity did not change. He refused to invest. Since his risks were higher. The quality suffered. Supplier's costs went up. Because buyer did not trust supplier. Supplier was no different. In long run the supplier lost. So did the buyer.

TQM says reduce suppliers. And trust him. But nobody knew how to trust. It took time. Trust finally developed. Supplier got big orders. He concentrated on production. And not on orders. He invested. Improved quality. Reduced cost. Took responsibility for quality. No more he dispatches poor products. Because he trusts you. And you trust him. Now everyone won. Buyer and Supplier.

Workers

Workers work with hands and managers with brains. Some books say Workers became robots. They did what was demanded. They delivered goods and not quality. Because quality was not demanded. When quality was demanded. Workers failed. Because all robots do. Training need was for Workers showed enthusiasm. Since men are trained. And not robots.

Communication

The world has become a village. People have come together. We have done wonders. Claims Telecom. People welcomed technology. Now they talk more but communicate less.

Communication problems are on increase. Japanese knew it. Boxes are best for communication. They discovered. Suggestion boxes were introduced. All empty. But workers filled them. With suggestions. New suggestions. More suggestions. Managers worked overtime. Because supply far exceeded their capacity. Workers had the day. They have demonstrated. They have brains. The change was dramatic. Now the workers suggest. And managers implement.

Costs

TQM scared managers. Because they are cost conscious. Quality programmes require large investments. They thought.

Cost reduction does not improve quality. Now everybody knows. Including you. Few know quality reduces costs. And improves profits. Better quality means more consumer loyalty. Hence higher sales. High volumes lowers costs. Better quality trimmed after sales departments. Organisations began to shrink.

output showed increase. TQM eliminated reworks, scraps and repairs. People who thrived on poor quality had no work.

Quality reduced inventory costs. Inventory departments saved large sums. From lower inventories, smaller staff and less space. And confusion. Obviously. Finance were jubilant.

Contracts

We cooperate because we are bonded by contracts. Modern economists tell us. Skills of production is measured by quantity produced and equipment utilised. So they produced and produced. Whether demand existed or not. They discouraged preventive maintenance. Because they wanted to produce. More than ever. They became champions in creating inventory. And not quality. Because quantity is easily measured.

The purchase did not want to be left behind. They bought cheapest inputs. Since they are best bargainers. Quality and schedules occupied back seats. They bought in bigger lots. Because low price and small quantities do not go together. They also created inventories. Bigger than production. But with a difference. Production created finished inventories. The purchase created raw material inventories. Both did wonders. But organisation suffered.

TQM created problems. Especially to personnel. Performance measures were changed. Team work was encouraged. Communication was improved. By reducing meetings. The work culture began to change. This time for better.

Consumer

TQM values customer. Today he is happy. Because he comes first. Wants of consumer are infinite. Economists say. Thus his aspirations will always change. So should quality. TQM will be an unending process. Wise men are confident.

Why Japanese

What makes Japanese click. Is it TQM. No. It is Kaizen. The continuous improvement. Kaizen in products. In standards. In designs. In suppliers. In machines. In everything. And everywhere. Nothing is perfect. So everything can be improved. Improvement should be continuous. Continuity requires commitment. Commitment comes automatically. When organisations care.

MANAGEMENT OF QUEUES

Woods are
..... sleep.

Man covers only few miles in a long life of 70 years since a large part of his time is wasted in queues. Queues are found everywhere. From post offices, banks, railway stations, bus stands, elevators where man waits for a service to repair shops and offices, where vehicles and files wait for processing.

Services like birth and death certificates, driving license, ration cards, passports are provided only by the government. Lack of competition, social concern to provide services below cost and lack of resources have limited the scope for quicker services in governments. Queue lengths and waiting time in India are becoming large due to increase in population and slow development of infrastructure. For example, over 2 million people are waiting for the telephone connection. Waiting time to get a telephone connection is over a year. The situation is no different for gas connections and house allotments.

Queue Formation

Economics

Economics gives macro view on the formation of queues. Queues are formed when demand exceeds supply. In competitive markets, queues do not exist since the demand matches the supply perfectly. Imperfection in the market due to control of price or supply (rationing, licensing, quotas) leads to formation of queues (Fig. 1).

Long queues before the kerosene shops, ration shops, petrol pump stations, railway reservations, waiting for the cab are due to control on price (below the competitive prices). Control on supply also leads to queues. Increase in prices of petroleum in 1973 led to large queues at gas stations when the US government rationed petrol to the car owners. In 1990, the Indian government reduced working hours of petrol stations to cut petrol consumption. It too led to long queues of vehicles at petrol pump stations.

Liberalisation and privatisation process initiated by the government will increase competition which in turn is likely to reduce queues.

Formation of queues can also be studied from operations management which gives micro, but a practical view. A queue system has customers, server(s) and waiting by customers (Fig 2). Queues are formed at a service station when an arriving customer finds the server busy. The customer waits in the queue until those ahead to him are served. Note that in any queue both customer and

servers can wait. When server is busy the customer waits and when there is no queue the server waits.

Often arrival time of customers cannot be predicted. Similarly, it is difficult to predict the service time for each customer since amount and type of service demanded by customers vary. However, average arrival rate and service rates may be constant over long periods. Due to random arrivals and service times queue can be formed even if average arrival rate is lower than average service rate. Needless to say, queue length will become infinite when average arrival rate exceeds the average service rate.

A queue has advantages and disadvantages. Generally queue is an advantage to the service centre and disadvantage to the customer.

Advantages of queues

1. Better utilisation of resources

A queue before a service centre ensures better utilisation of service centre. This in turn reduces cost and hence increases profits. Customer can benefit from queue if the organisation passes a part of the profits to the customer in the form of reduced service charges.

2. Capacity expansion

Queue certainty encourages the organisation to modernise or expand capacity which can increase its profits. For example a scooter manufacturer had a demand of 21 lakh customers for its product while its production capacity was only 1 lakh units. It could not have served all the customers even in two decades. Queue certainty encouraged the company to expand its capacity.

3. Increased prices

When queue exists the welfare of the customer is reduced since waiting time has a cost. The customers whose time cost is higher will be willing to pay more for the service if they could be served faster. The organisation can open additional service counter which charges higher price for the faster service. It will bring more profits to the organisation and may also reduce corruption.

Disadvantages of Queues

1. Waiting Cost

A customer in the queue spends time not for its own service but also for others who are ahead of him. Waiting is the most important disadvantage to the customer. Waiting cost for getting a service is given by following formula

$$\text{Waiting cost} = \text{Average waiting time} * \text{Cost of time}$$

Waiting cost is generally borne by the customer if he is not the employee of the organisation.

The above equation states that a system will become worse even if average waiting time for the service remains same since the cost of the time of the customer is increasing as is indicated by rising per capita income. It means improvement in services should be an ongoing exercise for the organisation to provide same level of service.

Another insight from the equation is that waiting cost of each customer will be different for same service since the incomes of the people differ. Thus higher (discriminatory) prices can be charged from high income customers if their waiting time is reduced.

2. Customer Loss

Customer may not join the queue or leave the queue if they find waiting time to be large enough to give up service or go elsewhere for the service. The organisation will lose profits from such customers. The cost of loss of customers is given by following equation

$$\text{Profit loss} = \text{Number of customers lost} \times \text{Average profit from each customer}$$

This cost is borne by the service organisation. The customer also bears the loss since he lost the opportunity to make the use of the service. The equation shows that customer loss will be higher for those services where queue length is large, waiting time is high or value of the service is high.

3. Loss in Quality

The quality of waiting entities (fruits, vegetables, blood bottles, chemicals and pharmaceutical products) is reduced when these are made to wait. Generally loss in quality increases with the waiting time.

Cost of loss in quality can be borne by customer as well as the organisation. When organisation has taken charge of these entities the cost is borne by it else the cost is borne by the customers.

4. Space Requirement

Customers are (often) physical entities. They require space for waiting. Since space is not free, it adds to service cost. Space requirement for information type customers- files, orders, messages is very small. The space requirement is given by following equation

$$\text{Space cost} = \text{Space cost per square foot (per megabyte)} \times \text{space reqd. per customer} \times \text{maximum number to be accommodated}$$

Cost of space is borne by the service organisation.

5. Corruption

High cost of waiting encourages customers to find ways to jump queues. Ticket black marketers at cinema halls, railway stations are well known services which help the customers to reduce waiting time by jumping. Thus corruption is closely linked to delays in providing services

Since a queue has both advantages and disadvantages, an optimum system is desired. Queue performance can be improved if more service counters are opened. It will reduce costs (waiting, customer loss, quality loss, space) but will increase cost of service. The optimum level of service counters should be one where marginal cost to the customer equals the marginal cost to the service organisation.

Queue Performance Indicators

In a queue system indicators of interest are utilisation of servers, length of queue and waiting time in queue. Utilisation of servers gives an indication if another server should be added, length of queue gives an idea of the space required to be provided to the waiting customers (aircrafts in a airport) and waiting time gives the cost of waiting.

Types of Queues

Queue types can be classified on the basis of configuration of servers, type of customer and type of service provided. Classification of queues helps to device strategies to improve a system.

1 Queue Types- Configuration of Servers

When complete service is provided by more than one servers, the sequence in which servers can be put is called the configuration of servers.

1. Single Channel Single Phase (SCSP)

When there is single server the queue is SCSP. The customers joins a queue if the server is busy and leave after getting the service.

Such queues are common in shops, post office, cinema halls. SCSP is shown in Fig 3a.

2. Single Channel Multiple Phase (MCMP)

When service is provided by more than one servers are present in a sequence it is called SCMP (Fig 3b). The customer moves from one server, and hence queue, to another. MCMP queues are common for getting no dues clearances, in banks for withdrawing money by cheques.

3. Multiple Channel Single Phase (MPSP)

This queue system has single queue but a number of servers in parallel (Fig 3c). Customer in the queue goes to the server when one is free. The customer takes service only from one of the servers.

MPSP queue is found in barber shop, railway reservations, trucks (customers) unloading at one of the platforms (servers) of warehouses.

4. Multiple Channel Multiple Phase (MCMP)

When number of servers are many and are in present in sequence as well as in parallel we have a MCMP queue (Fig 3d).

This is a general purpose queuing system. First three are special cases of MCMP.

II Queue Types- Type of Customers

Second useful classification of queues could be on the basis of type of waiting customers.

1. Man

A queue where men are the customers, requires special attention. When man is waiting he may refuse to join a queue, resign from the queue, try to jump the queues, may not accept all queue disciplines. When man is the customer, psychology can also be used to improve the performance of the queue.

2. Information

Orders waiting to be executed, files (computer) waiting to be printed, office files waiting to be processed are information type queues. New technology like TVs, fax, photostat machines, E mail, post, Voice mail can be used to improve such queues.

3. Material

When waiting entities are goods, they can be classified on their deterioration rates.

a. Decaying Material

Fruits, vegetables, sugarcane, pharmaceutical, chemicals, ice, blood bottles in a bank, waiting to be processed are decaying material. Such queues require faster services to reduce queue performance.

b. Other Goods

Although all goods decay, here those goods are included whose decay is negligible during their waiting times. Jobs waiting in a machine shop, trucks waiting for loading are such entities. Performance of queues where non decaying goods are the waiting entities can be improved even without reducing waiting time.

Queue Type- Type of Service

Third classification of queue could be on type of service provided

1 Physical Service

Often service required is one which requires the customer and the server to be physically close to each other. Job (customer) requiring processing by a machine (server), operation (service) of a patient (customer) are physical services. Physical service requires transportation of customer to the server or vice a verse.

2. Information Service

Services that do not require close physical interaction of customers and servers are information services. When telephones, fax etc were not popular the services like railway inquiry, money transfer from banks, payment of electricity bills, hotel reservation etc required the customer to go the server. Now with the expansion of information technology these are becoming information services.

Queue Discipline

When more than one customers is waiting for the service in a queue, a method of selection of customer for giving the service is required. Manner in which a customer is selected is called a queue discipline. First Come First Served is one such queue discipline. A number of other queue disciplines are possible for selection of customer for the service. Queue disciplines are based on arrival time, processing time, size of the customer, value of the service to the customer, or other attributes of the customers.

1. First Come First Serve (FCFS)

When a customer who arrives first is served first the queue discipline is called FCFS queue discipline.

FCFS system encourages customers to reach the service window early. When FCFS is used the customers often reach the service even before the start of the service. FCFS is the most common queue discipline when man is the waiting entity. People consider FCFS as a fair system and hence do not question wherever it is used. We shall soon see that FCFS is not a good queue discipline. FCFS is also called First In First Out (FIFO) by accountants and computer engineers.

2. Last Come First Served (LCFS)

When the last arriving customer is served first the queue discipline is called LCFS.

Boxes loaded last in the truck/godown are unloaded first. LCFS queue discipline comes due to the geometry and physics, and many times it is the only discipline possible. LCFS is also called Last In First Out (LIFO) by accountants and computer engineers.

LCFS is popular in self service departmental stores where items produced last are sold first. LCFS is also used in computerisation of records where records of latest years (1995) are computerised earlier than old records (1987). Labour unions recommend LCFS discipline for firing and re-hiring of labour during recession and recovery.

LCFS queue discipline is not used when man is the customer.

FCFS and LCFS queue disciplines are dependent only on arrival times of customers at the service stations. Next two queue disciplines are based on expected service (processing) time.

Shortest Service Time First (SSTF)

When customers are served in increasing order of their service time requirement the queue discipline is called SSTF. SSTF gives lower bound for total waiting time of all customers. We shall soon see this discipline gives the best (minimum total waiting time) results. SSTF is often used when jobs are waiting to be processed on machines.

4. Largest Service Time First (LSTF)
When customers are served in decreasing order of their service time the queue discipline is called LSTF. LSTF gives upper bound for total waiting time. This discipline gives worst (maximum total waiting time) results and hence not used in practice.

5. Random Selection (RS)
Customers can also be selected randomly for providing the service. This discipline treats all customers equally. Here luck of the customer determines waiting time.

Car/scooter companies, housing boards make a queue of customers by random selection in which they are given the product. RS can be used when service times of customers is same and arrival times not relevant or are difficult to determine. A major advantage of this queue is that the customers need not physically wait in the queue and this discipline helps to manage queue when very large number of customers are likely to reach the counter in a short time.

6. Priority Disciplines (PD)
Above disciplines ignore the value of the service to the customer. When some customers can be given priority over others it is called a priority discipline. FCFS/LCFS and LSTF/SSTF are special cases of PDs where priority is given to customers on arrival time and service time respectively.

Ladies/Aged/Children/disabled first, emergency cases first (in hospitals, fire fighting) are well known other PD. Priority disciplines require institutional arrangements and social support from the ordinary customers. Thus psychology and sociology needs to be used for providing priority disciplines.

7. Partial Alternative (Simultaneous Looking) Service (PAS)
When service rate required by the customer is far lower than the capacity of the server, a number of customers can be served partially in a sequence. Here it appears as if customers are being served simultaneously. Big (mainframe) computers can perform jobs in parts of a number of computer users. That is first a small part of job A is done followed by doing partial job of B. This cycle is repeated. PAS is used when grand masters play chess with a number of players.

PAS improves server utilisation, may reduce average waiting time of customers and encourages organisation to go for few but large capacity servers rather than many servers with small capacity.

8. Other Disciplines

There are a large number of other disciplines in use. In fact possible disciplines are infinite. When customers differ in more than one characteristics (attributes).

possible disciplines tends to explode. For example if jobs waiting at a machine differ in their size (space requirement) and service time requirement we can make queue disciplines as- largest size first/last, lowest service time first/last, first service to job with highest/lowest weighted average of two attributes, ratio of two attributes etc.

Impact of Queue Discipline on Queue Performance: Example

We had stated that FCFS is the most common queue discipline even though it is not a good discipline. We shall show with an example that how does selection of queue discipline affects the total waiting time of customers

Five customers- A, B, C, D and E arrive at a service centre in the same sequence. Their estimated service times are 5, 6, 2, 9 and 4 hours respectively.

Total queue time (waiting for those ahead in the Q to get their service. Customer's own service time is not included) for different queue disciplines is computed below

When the customers are served on FCFS basis the total waiting time of all customers in the queue is 51 man hours.

First Come First Served (FCFS) queue discipline

service sequence	A	B	C	D	E	
service time	5	6	2	9	4	
waiting time in Q	0	5	1	1	2	Total = 51
			1	3	2	

When the customers are served on LCFS basis the total waiting time of all customers in the queue is 53 man hours.

Last Come First Served (LCFS) queue discipline

service sequence	E	D	C	B	A	
service time	4	9	2	6	5	
waiting time in Q	0	4	1	1	2	Total = 53
			3	5	1	

When the customers are served on LSTF basis the total waiting time of all customers in the queue is 68 man hours.

Largest Service Time First (LSTF) queue discipline

service sequence	D	B	A	E	C	
service time	9	6	5	4	2	
waiting time in Q	0	9	1	2	2	Total = 68
			5	0	4	

When the customers are served on SSTF basis the total waiting time of all customers in the queue is 51 man hours.

Smallest Service Time First (SSTF)

service sequence	C	E	A	B	D	
service time	2	4	5	6	9	
waiting time in Q	0	2	6	1	1	Total = 36
					7	

A summary of total waiting time for four queue disciplines is given below

Waiting Time Summary

Q discipline	Total Q waiting time	
FCFS	51	
LCFS	53	
LSTF	68	
SSTF	36	worst best

Results indicate that a queue discipline affects total waiting time of customers in the queue. Thus queue system can be improved (here reducing waiting time) by selecting appropriate queue discipline and without hiring new servers.

It can be seen that SSTF and not FCFS, the most popular discipline, is efficient from society's view. When goal is to reduce waiting time and customers differ only on two attributes- service time and arrival times, SSTF is the most efficient and LSTF is the worst queue discipline. Other disciplines will give waiting time in the range given by SSTF and LSTF.

Thumb rule: Wherever it is possible to select a queue discipline do not choose FCFS. When man is not the waiting entity never use FCFS.

Some Strategies to Improve Performance of Queues

1. More Service Centres/Servers

Queue lengths/waiting time can be reduced by additional servers. However, additional servers cost money- fixed cost for space, equipment & furniture of teller, salary. Additional server can be added when cost of additional server is less than waiting cost reduced by it.

Libraries subscribe more than one copy of newspapers (servers) to reduce the waiting time of readers.

2. Efficient Service Centres/Servers

Queue systems can be improved by replacing/improving existing servers by efficient servers. Use of computers by railways improved the efficiency of servers.

3. Priority Queues

Separate queue for ladies/children/students/aged are also priority queues. Emergency cases in hospitals and machine shop are given high priority. Priority queues requires social support from the customers in ordinary queue.

Telephone department provides lightening calls to the subscribers, a priority queue, at eight times the regular cost. By providing priority services organisation can make more money.

4. Different Queue Disciplines

We have seen that FCFS discipline does not give good performance. Therefore different queue discipline can be chosen to improve the queue system.

5. Different Queue System

Queue systems were classified as Single Channel Single Phase (SCSP), Single Channel Multiple Phase (SCMP), Multiple Channel Single Phase (MCSP) and Multiple Channel Multiple Phase (MPMP). Change in queue system from one type to another can also improve the queue system.

Single window clearance concept transforms a SCMP queue system to SCSP. Now the customer approaches only one server and his travel time between various queues is eliminated. A post office reduced the waiting time from 1.28 mts to 0.31 mts by changing the alignment of servers.

6. Control Customers

As stated earlier arrival of customers is not predictable in most systems. If customers can be made to arrive at predetermined schedule the system can be improved.

Meeting officials by appointment is a step in this direction. Appointments ensure customer does not have to wait in queue for meeting the official (server). Many doctors also see patients only by appointments.

7. Actual Entities To Tokens

In this strategy the waiting of actual entity is replaced by a small token. The waiting entity (man in banks) is given a token. The man can estimate the expected service time. He may thus arrive at the bank a little earlier than the expected service time. The customer can go around and use his time efficiently (shopping, make telephone calls). This strategy does not reduce waiting time but gives flexibility to the customer to use his waiting time efficiently. Token system is popular in many hospitals.

Trucks waiting for their turn for taking grains from a busy and crowded grain market are allowed to wait near the shops for lack of space. Truck owners are given tokens and trucks wait at a parking located away from the market. Only those trucks are allowed which need loading.

8. Increase Service Hours

Increasing working hours of the servers can shift load to low traffic hours and thus reduce the waiting time. Automatic Teller Machines (ATMs) are now being installed by banks in major metros to provide round the clock service- including holidays. In addition to providing round the clock service it may also reduce waiting times due to shift in loads.

9. Productive use of customer's time (Self service)

The waiting time of the waiting customers can be better utilised by asking the customers to do themselves a part of total service required. Self service is essential in Kendriya Bhandar outside LBSNAA. If self service is discontinued waiting time will increase- thus requiring more servers.

10. Differential Price System

During peak load the waiting time becomes very large. The company providing the service can increase the service rates during these hours and may charge less in non peak hours. Such pricing system can benefit both the customers as well as the company. The customers off loading to non peak hours can get the service cheaply and the company can have better server utilisation during non peak hours. This strategy is used telephone department which has different rates for peak (office) hours and non peak (night & holidays) periods.

11. Pooled Queues

In a pooled queue a customer act as a multiple customer. That is single customer takes the jobs of various customers to the server. Now waiting in queue is done by one person and not all those requiring the queue. Thus time of all other customers is eliminated. This strategy can be used for collection of water, electricity. This strategy reduces the queue length of men and now only few persons have to wait.

12. Home Delivery

This service eliminates the queue altogether. Here the server comes to the customer and not the vice-versa. In addition to waiting time it also eliminates travel time of the customers. Doctors, groceries, car repair

13. Create Inventories

Creating inventories also reduce the waiting cost of the customer. A family having two gas cylinders can choose to wait in the queue at their convenience. Otherwise they had to rush whenever cylinder went empty.

14. Reduce work of the server.

Waiting time can be reduced if work of the server can be reduced. Use of computer, using Rs 500 notes instead of Rs 50 notes reduces the work of the server.

15. Reduce storage cost

When the waiting entities decay while waiting for service (blood bottles, sugarcane) their spoilage cost can be reduced. Putting waiting entities in cold storage reduces their spoilage rate and spoilage cost.

19. Keep Customer Busy

Giving magazines, playing music for the waiting customers can also improve the performance of the system. This strategy needs understanding of the psychology of waiting persons.

20. Give work to idle server

One of the disadvantage of additional servers is that it increases the idle times. If servers can be given other work during such periods the cost of service can be reduced.

21. Use Probability

A number of queues are such in which the service performed is inspection type. Passengers coming from abroad had to go for custom check up at airports. After Green Channel, only those customers need to wait in queue for custom check who bring goods in excess of free limit. Thus waiting of many customers is now eliminated. This strategy involved the risk of selecting wrong item (in quality control).

22. Make service information based

Buying railway ticket, renewing an issued book from library, transferring money, depositing electricity/water bills, watching cricket/TT match, attending lectures are information based services. To get such services customers travel to the service centre and wait in queues. However use of information technology can altogether eliminate travel to the service centre. Airlines tickets can be bought on phone, Telephone bills can be paid by post, football match can be watched on TV.

23. Automatic Telephone Answering Machines (ATAMs)

If the person you are calling has a telephone answering machine you need to wait in queue only once. If he not in the office, you can leave the message and thus need not go to the telephone booth over and again and wait in queue. Now you can send/leave messages even at odd times when calling charges are low.

24. Use TVs

Information technology allows simultaneous serving a large (sometimes infinite) customers at same time. Telecast of cricket matches has eliminated queues at ticket counters (rarely are the stadiums full). Use of TVs at railway stations can eliminate servers delivering information on arrival/delays of trains.

25. Use Psychology

When man is waiting in a queue one can use psychology. It will not reduce the waiting time but the customers can feel that they did not wait for long. Research has indicated that waiting time appears longer

1. When customer is not occupied
2. Anxiety of service is high
3. Uncertain waits are longer than known finite waits
4. Unexplained waits
5. Unfair queue discipline
6. Man is waiting alone
7. More valuable the service longer people wait
8. Q wait longer than service time wait.

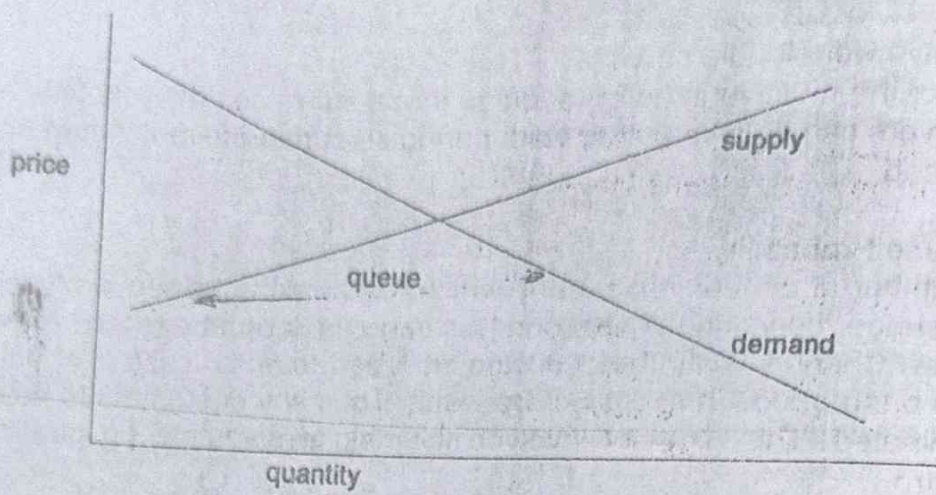


Fig 1

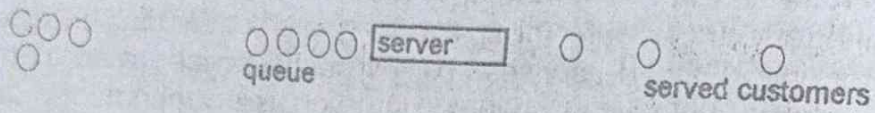


Fig 2

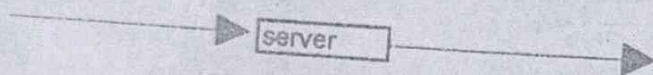


Fig 3a: Single Phase Single Channel Queue

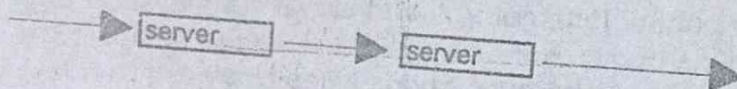


Fig 3b: Multiple Phase Single Channel Queue

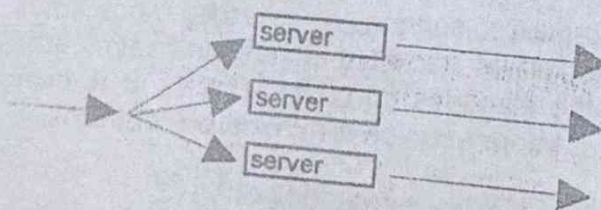


Fig 3c: Single Phase Multiple Channel Queue

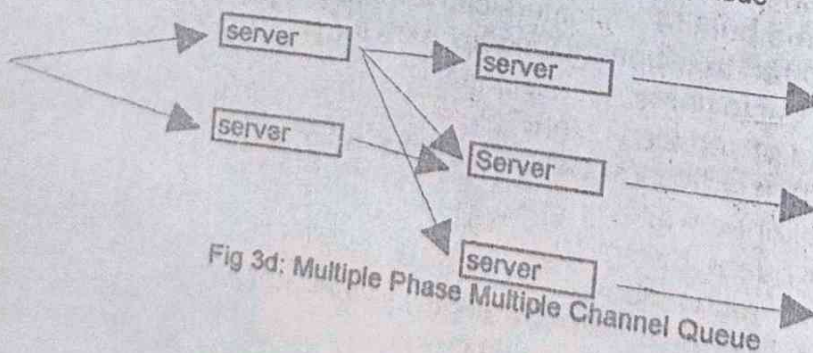


Fig 3d: Multiple Phase Multiple Channel Queue

43.2

DECISION MAKING FROM TRANSACTION DATA

Computers are increasingly being put to use in various departments/ organisations not only for data processing (engineering, accounting, simulation) and data transfer (LANs, WANs, networks) but also for transactions (railway reservation, computerised bank tellers, application processing in insurance, tax collection, electricity/water bills) purposes.

The primary purpose of computerising transactions is to reduce delays, reduce paperwork, improve efficiency, reduce cost and generation of useful periodic reports. The transaction data should be collected wherever computers are used for transactions since this data can be used for (re)designing and better operations of the system. Though most of the operations policies in practice are static, transaction data can be used to develop dynamic policies as well.

Since computerisation of transactions in the government will increase in future, we believe that examples given in the note will help to improve the system performance using transaction data. It should be noted in the passing that deciding on the information to be extracted is the job of the manager and not of computer expert since each database of transaction will be system specific.

Example 1: Computerised Railway Reservation System

People like computerised railway reservation system because it reduces their transaction time/cost (tickets can be purchased from any station and any window, NO paper work, quick queries on present status, no errors in fare computation, tickets give details of train number, date of departure, time of departure, fare paid, distance etc).

The data collected during transaction (reservation/cancellation) by computer can also be used for improving the system performance by extracting useful information.

Railway Reservation System has a **basic** database which contains information on Train Number, Days of Departure, Time of Departure, Stations at which Train Stops, Capacity in each Class etc.

Computerised railway reservation system can store the data entered by the window clerk on following attributes for each transaction made-

a. Name

b. Age

c. Sex

d. Train Number

e. Date of Travel

f. Money paid

g. Starting Station

h. Last Station

i. Class (AC, IInd class)

In addition following information can also be stored for each transaction by the computer automatically-

j. Date and time of reservation

k. Reservation site (Patna, New Delhi or Delhi) and window no.

For cancellation information collected for each transaction is

l. Train number

m. Money returned

n. Date and Time of cancellation

From the above data (a to n) we can extract information on-

A. Total number of tickets booked on each day (Monday, Friday, Holidays etc.)

B. Number of tickets sold for each train on each day (Monday, Friday, Holidays etc.)

C. Number of tickets sold in time intervals on each day (10 to 11 AM, 3 to 4 PM etc.)

D. Percent of tickets booked/canceled for each train for each station

E. Percent of males/females/children traveling by train

F. Number of tickets booked at each window/by each clerk

G. Train utilisation (tickets sold/train capacity in each class)

H. Number of days before the departure of train the seats are full etc.

Last two information require use of both transaction and basic databases.

Check yourself that these information can indeed be extracted from the transaction and basic data. As an exercise determine what other information can be extracted from above data].

Above information (A to H) can be also be computed for manual reservation counters but with great efforts, costs and delays. Computers will do this job in seconds and without having to write the program each time.

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b. Age
c. Sex

d. Train Number
e. Date of Travel
f. Money paid

g. Starting Station
h. Last Station
i. Class (AC, IInd class)

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The above information can be used for

1. **Monitoring Efficiency**

From F (number of tickets booked by each clerk) it is easy to find the fast/slow/inefficient clerks. These clerks can be trained to work faster and penalised/rewarded for their efficiency.

2. **Manpower Scheduling**

From C (number of tickets sold in different time intervals) we can know the peak hours. During these hours efficient clerks can be put to service. The information can also be used to decide if query services can be allowed or not during these periods.

3. **More/Fewer Ticket Windows**

Presently the number of windows at the reservation centres are fixed and all operate during the reservation hours. However, from A (tickets sold on each day- Monday, Holidays) and C (number of tickets sold in different time intervals) we can formulate a dynamic policy of opening more windows on rush hours/days and fewer on lean hours/days. It may help to reduce the cost and improve efficiency.

4. **More/Fewer Trains**

Although busy routes (Delhi-Bombay, Bombay Baroda) are known to railway officers but extent of weekly, daily, monthly fluctuations in the traffic can now be easily determined from total tickets sold for each train/how early the reservations are full. Using this information a dynamic policy of number of trains on each route during different weeks of the month/different days of the week can be made. It will help in better utilisation of trains and the trains/trucks having surplus can be deployed on other routes.

5. **Specialised Service**

The transaction database can easily tell proportion of females/children (from age and sex of the passenger noted) who travel on a given route without the company of adult males. If women/children demand specialised service (separate compartment etc due to (in)security reasons) it is easy to compute the number of such compartments required on each train.

Similarly, demand for specialised service (Doctor/nurse, special food) to be made available for the aged can be computed from the age of the passenger noted.

6. **Catching Black Marketers**
Black marketers buy large number of tickets and sell them to the passengers just before the departure of the train. If the demand of tickets is less then they cancel the tickets at last moment. If on any day a large number of tickets are canceled at last moment (even from separate windows) it may be easy to know that on these routes/trains black marketing is high. Steps can be taken to avoid this by running more trains on these routes, catching black marketers if their addresses are correct.
7. **Fare (Pricing) Policy**
If a reduced fare is being considered for the elderly persons (like in other countries) the likely impact on revenues can be computed. To compensate the lost revenue from the increased fare for young passengers the amount of fare increase can be computed.
8. **Types of Compartments on each Train**
From the transaction and basic database one can find on which routes the more profitable class (AC, 1st class) are popular. If on any train these classes are full most of the times then one can conclude that more bogies of these classes should be included to increase profits.

Note that every thing suggested above is also being done at present but on the information based on judgement. The transaction database will generate appropriate reports and can be used even by ones who are new to a particular station and do not know the local demand-supply characteristics.

We have shown few likely uses of the transaction data of the above system. The managers of railways who know the system better can tell many more uses of same transaction data. The exercise can be easily extended to airlines and bus reservation.

Example 2: Library System

A fully computerised library (from users angle) should have both the data on books as well as the transactions computerised.

For each book in the library the **Book Database** should have details on- Book Name, Authors(s), Book Number, Year of Printing, Edition Number and Publisher's Name. A more detailed database may include information on Address of the Publisher/Supplier, Price of the Book, Date of Purchase, Name of the person who Recommended the book etc.

The above data can be used to extract information on number of books available in each subject (Economics, Law) and field (International Economics,

Information Economics, Development Economics, Mathematical Economics, Agricultural Economics), books available for any author (all books of Nehru, Marx), books purchased from each publisher, books purchased in any year from particular supplier, number/costs of books (total, percent) purchased in any year on given subjects etc.

The book database can only tell about the status of number/cost of books by author/subject/field etc. but cannot give any information on the usage of books which is more important for improving the design and operation of the library. We shall briefly discuss how the library can be improved by computerising the transaction (issue and return of books).

The transaction of the books can be computerised by putting a PC at the counter and for each transaction following data can be collected-

- a. Name/code of the borrower
- b. Name/code of the book
- c. Date and time of issue

The counter clerk need to enter only the first two items, date and time can be automatically recorded by the computer from its internal clock.

When the book is returned additional information that can be collected are-

- d. Date and time of return

These four pieces of information on each book issued and returned can be used to improve the library working in a remarkable way. Even though amount of data to be collected per transaction is small, it is generally not collected and used in manual library counters.

Transaction data recorded can be used along with book database for improving the following operations

1. Book Purchase based on Reading Habits

Reading habits of individuals/group can be easily studied, using transaction database, from the maximum/minimum/average number of books issued in a given time/period, subject/field.

Above information will tell the most popular subjects- Fiction, Law, Economics, History, Culture, Management, Science etc. Popularity of books with the borrowers can give idea in which area more books should be purchased and number of books can be reduced for not so popular areas if resources are limited.

2. Issue Policy

Issue Period

As a norm most libraries issue books for two weeks or a month. The library can collect data on maximum/minimum/average period of return and use it to develop own norms. The norms can be made dynamic and longer during low demand and shorter during high demand periods.

Number of Books per Subscriber

Again, number of books allowed to a subscriber may be based on judgement, norm and not on requirement. Transaction database can be used to see whether generally/occasionally the subscribers issue few/all quota books allowed. If it is found that most subscribers have their quota books most of the times then more books may be allowed per subscriber.

Fines

It is easy to know from the transaction database whether few/many subscribers return books late. If many subscribers are found to return books after large delays the fines can be increased.

3. Manpower Scheduling

If the number of books issued are high (on Mondays, Holidays) more clerks can be put on counter. Such peak hours/days can be computed from the transaction database.

4. Book Issue Timings

If it is found that few books are issued before two/one hours from the closing of the library then issue of books can be closed early. It will save money to the library but those who issue late will be affected.

5. Discarding books

From transaction and book database one can find the books that have not been issued in last three/five years. Such books can be discarded if their future demand is likely to be low.

If a book has multiple copies, the two databases can tell most/few of these copies were in demand at same time. If a book has 10 copies and no more than 2 books were issued at one time then some of these copies (at most 8) can be sold off.

Sale of such books will bring money, make more shelf space and reduce maintenance cost.

Again we have illustrated various uses from small data collected for each transaction. The librarian can tell more potential uses of the data for improving the performance of the library.

Above two examples show that extraction of useful information from transaction for (re)design of data is not a job of an computer expert but of a manager who deals with the system. The manager can study the data collected and tell the computer expert what he wants. Based on this the computer expert will suggest the hardware (computer capacities) and software requirement.

In above examples appropriate tables will have to developed and data analysed before any policies can be formulated. Techniques of data organisation, summarisation and analysis will be required for developing the tables.

Tailpiece

Use computer data for overhauling your systems, which presently work on judgements.

INFORMATION SYSTEM SOFTWARE (ISS)

ISS computer software can be used to develop a wide variety of information retrieval applications. Some ISS applications for the trainees of the academy could be- crime information system, information system for DSP/SP/DIG/IG, election information system, forest information system, soil information system, information system for SDM/DM/commissioner/ tehsildar, record room information system, revenue information system, protocol information system, IRDP information system, JRY information system, family planning information system, national savings scheme information system, NLM information system, DRDA information system, Zila Parishad information system, information system for MD of a corporation, village information system, constituency information system, MLA information system, minister information system, chief minister information system, etc. ISS based information retrieval system can be developed for area, office, officer, scheme, programme, project.

While designing ISS, special care has been taken to ensure that applications can be developed quickly, computer knowledge required by developer as well as user is not high, and it can work on popular computers and software. Some characteristics of ISS are

- ISS applications are menu driven. Thus no expertise or training is required to retrieve information. Even school kids, who can recognise English letters on keyboard, can retrieve information.
- ISS can be used on any computer on which LOTUS, dBASE, WORDSTAR can run.
- ISS applications do not ask too many questions. In fact, exactly one key stroke gives the required information.
- Application of choice can be developed by anyone who knows word processing. Even PAs and stenographers can develop applications for you.
- Knowledge of word/text processing software like WORDSTAR, WORDPERFECT, MSWORD, editors of PASCAL, DOS etc. is required for data entry and updating.
- Present ISS can only display information. It cannot be used for data analysis.

ISS software has two files- ISS.EXE and READ_ME.TXT. The former file must be present in the computer to run the application. READ_ME.TXT file a help (text) file. You can view the help file on computer screen by typing TYPE READ_ME.TXT on the DOS prompt. Print of the help file can be taken by typing TYPE READ_ME.TXT>PRN on the DOS prompt.

In case of any problem, give floppy containing above two files of ISS and this handout to NIC professional or a computer programmer.

Steps involved in developing an application are given in READ_ME.TXT file. Exact contents of READ_ME.TXT (help) file are given below:

ISS

Information System Software (ISS) instantaneously displays data stored in text files. You can develop applications of your choice with little effort and in a short time. ISS is a menu driven software which makes it easy to use.

This file gives steps to develop applications of your choice. The two steps involved in developing an ISS application are given below

Step 1:

Create a title file named TITLE.TXT. TITLE.TXT should be a text file. This file can be created in WORDSTAR (non document mode) or in any other software which can create text files.

TITLE.TXT should contain menu items. Maximum number of menu items can be 25. Letters A to Y should be used for menu items. Letter Z is reserved to QUIT from the software.

A sample TITLE.TXT file is shown below, between two dotted lines.

INFORMATION SYSTEM FOR DISTRICT MAGISTRATE
(DISTRICT PUNE)

- | | |
|--------------------------|------------------------------------|
| A. District Profile | G. Guidelines for Literacy Mission |
| B. Facilities | H. Important Dates |
| C. Targets | I. Members of Monthly Meeting |
| D. Pending Cases | J. Names of VIPs, Media Persons |
| E. Employees In District | K. Ongoing Development Schemes |
| F. Revenue Collected | L. Funds Available |

Z. QUIT

Remember letter Z is reserved for QUITTING from ISS.

This file should not exceed 80 columns and 24 lines.

Step 2:

After making TITLE.TXT file, now you need to create data files. Number of data files should be equal to number of menu items (for example, 12 in above case. One data file each for A to L menu items).

The name(s) of data files should be FILE_A.TXT, FILE_B.TXT etc. You can go upto FILE_Y.TXT. That is, a maximum of 25 files having names from FILE_A.TXT to FILE_Y.TXT. Like, TITLE.TXT, these files should also be text files.

A Note:

To run the software following files should be present in same sub directory. ISS.EXE, a TITLE.TXT file and data files (FILE_?.TXT). ? takes letters from A to Y. If there are only 5 menu items in TITLE.TXT file then data files will be 5, from FILE_A.TXT to FILE_E.TXT.

Type ISS on the DOS prompt to run the software. The user will see the list of menu items typed in TITLE.TXT file. User can select letters A to Y to get the data on screen. Letter Z should be typed to quit from the system. When A is pressed FILE_A.TXT will be displayed. Similarly, file FILE_G.TXT will be displayed when letter G is pressed.

SDM INFORMATION SYSTEM (SIS)

SIS is a menu driven software developed for the SDM Dehradun. This system gives information on following 15 topics- Sub Division Profile, Facilities, Officers in District, No. of Employees in SD, Names of Employees, Duties allotted to SDM, Targets and Achievements, Inspections Done, Copies of Land records, Main Dues Collection, Other Dues Collection, Natural Calamities, and Distributed, Old Age Pension and Case Backlog.

SIS is an application which has been developed using Information System Software (ISS). ISS is explained in SK-94-CS-01.

Exact contents of help file (READ_ME.TXT) of SIS is given below

SIS

Sub-Divisional Magistrate Information System Software (SIS) instantaneously displays data related to Dehradun Sub-Division. SIS is a menu driven software which makes it easy to use.

SIS has 18 files. SIS.EXE is the system file, TITLE.TXT is the menu file, 15 data files from FILE_A.TXT to FILE_O.TXT, and READ_ME.TXT is a instruction file. Except for SIS.EXE all are text files.

IMPORTANT:

You can develop applications of your choice in Information Software System (ISS). Even SIS is also developed using ISS.

Copying ISS and SIS into floppies

We have loaded SIS and ISS softwares in machines kept in computer centre.

- ISS is loaded in ISS sub directory of C drive. ISS has two files- ISS.EXE and READ_ME.TXT.
- SIS is loaded in SIS sub directory of C drive. SIS has 18 files- SIS.EXE, READ_ME.TXT, TITLE.TXT and 15 files from FILE_A.TXT to FILE_O.TXT.

A DATABASE ASSIGNMENT

Major facilities available in 40 Nyay Panchayats of the Dehradun district are given in Appendix. The data is also available in dBASE file, LOTUS/EXCEL file. The field codes for dBASE file are given below

Code	Description
PANCHAYAT	Name of the Nyay Panchayat
POPU	Population of Nyay Panchayat (No)
VILLAGES	No of Villages in Nyay Panchayat
DW	Number of Villages having Drinking Water Taps
FPS	No of Fair Price Shops in Nyay Panchayat
COOP	No of Villages having Cooperative Societies
POST	No of Villages having Post Offices
BANK	No of Banks in Nyay Panchayat
PS	No of Villages having Police Stations
ALLO	No of Allopathic Dispensaries in Nyay Panchayat
AYUR	No of Ayurvedic Dispensaries in Nyay Panchayat
PHC	No of Primary Health Centres in Nyay Panchayat
VETS	No of Veterinary Centres in Nyay Panchayat
JBS	No of Junior Basic Schools in Nyay Panchayat
SBS	No of Senior Basic Schools in Nyay Panchayat
HS	No of High Schools in Nyay Panchayat

Part-I (DATA RETRIVAL)

Fill in the cells of tables 1 to 5.

Table 1 : Selective Data Retrieval

No	Facility Status	Total No of Panchayats	Villages in these Panchayats	Population of these Panchayats
1	Have population more than 5000 and Fair Price Shops less than 10			
2	Have Junior Basic School, High School but no Senior Basic School			
3	Have Banks and Post Offices			
4	Have Banks but no Post Offices			
5	No Banks but have Post Offices			
6	Neither have Banks nor Post Offices			
7	No Health Facilities			
8	Have Cooperative Society and Bank			
9	Post Office and Health Facilities			
10	Ratio of population to schools is below 500			
11	Have cooperatives but no banks.			
12	Health facility is below standards *			

* Assume standard is to have one health facility for every 3000 population.

2. Compute frequency of Nyay Panchayats for given population ranges.

Table 2: Population Distribution

Population (' 000s)	No of Panchayats
<3	
3-6	
6-9	
9-12	
12-15	
15-18	
18-21	
21-24	
>24	
Total	

3. Compute frequency of Nyay Panchayats having population and junior basic schools in given ranges.

Table 3: Contingency Table

		Junior Basic School (nos)					
		<10	11-15	16-20	21-25	>26	Total
Population (' 000 s)	<5						
	5-10						
	10-15						
	15-20						
	20-25						
	>25						
Total							

4. Compute following summary statistics for the Nyay Panchayats of Dehradun.

Table 3: Summary Statistics

Statistic	POPU	VILLAGES	DW	FPS	COOP	POST	BANK	PS	ALLO	AYUR	PHC	VETS	JBS	SBS	HS
Min.															
Max.															
Range															
Total															
Average															
Variance															
Facilities/1000 persons															
Population at which the facility first becomes available															

Hint: It will be easier to get above data from LOTUS..

5. Compute availability of following facilities for each of the Nyay Panchayats.

- Average Village Population (Col. 3)
- Number of Health Facilities (Col. 4)
- Health Facility per 1000 population (Col. 5)
- Number of Schools (Col. 6)
- High School to Senior Basic School Ratio (Col. 7)
- Senior Basic School to Junior Basic School Ratio (Col. 8)
- Number of Health Facilities per village (Col. 9)

Table 5: Density of Facilities

No	Panchayat	3	4	5	6	7	8	9
1	AJABPUR							
2	MUNDHAN							
3	GUJRARA							
4	BEGI							
5	PANDIT WARI							
6	SAHASPUR							
7	RANGAIU							
8	ANFIELD							
9	SABHA WALA							
10	BIRNAD							
11	KOTI							
12	SORNA							
13	RAIPUR							
14	RANI POKHARI							
15	MARKHAM GRUNT							
16	BHAU WALA							
17	NADA(BCNDAR)							
18	MINDAL							
19	MIYAN WALA							
20	KALSI							
21	SARONA							
22	KORVA							
23	BHANDROULI							
24	THANO							
25	SAHIYA							
26	DAGURA NAGAU							
27	DASAU							
28	JARI							
29	BHUNAR							
30	DHARAMA WALA							
31	JHAJRA							
32	AAM WALA							
33	MANURA							
34	BHANIYAWALA							
35	BHAGWANTPUR							
36	KHADI							
37	LANGHA							
38	SEWALA KALAN							
39	SHYAMPUR							
40	NARAYA							

Hint: It will be easier to get above data from LOTUS.

Part-II (DECISION MAKING)

6. Based on above tables list Panchayats which have facilities in excess. Also identify Nyay Panchayats which require new facilities.
7. List Nyay Panchayats whose banks are prone to robbery. Relocate the facilities to reduce bank robberies.
8. Civil supply department has sanctioned 5 new fair price shops for the region. Where would you locate these shops.
9. Identify 10 locations where pooling booths should be located for next elections.
10. Before elections MLA from Kalsi Nyay Panchayat had promised new facilities. Suggest what facilities should be located in this Nyay Panchayat.
11. Identify Nyay Panchayat which are politically active. (Hint: Some large villages may have few facilities and some small villages may have large number of facilities).

Fill in the blanks of problems 1 to 5 and submit this assignment sheet. Computer printout of problem 3 and 5 are acceptable. Part-II should be submitted on a separate sheet(s).

Logic used to arrive at the solution of problems 6 to 11 must be mentioned.

Appendix : Data for 40 Nyay Panchayats of Dehradun District

PANCHAYAT	POPULATION	VILLAGES	DW	FPS	COOP	POST	BANK	PS	ALLO	AYUR	PHC	VETS	JBS	SBS	HS
AJABPUR	14382	15	13	9	4		4	2					1	16	5
MUNDHAN	4682	30	30	4	1	1	1	1	1	1			1	14	1
GUJRARA	4166	22	21	7	1	3	0	0					0	9	2
BEGI	2821	13	13	5	1		0	0					0	9	2
PANDIT WARI	25900	19	18	18	1		3	2					0	9	2
SAHASPUR	17842	10	10	8	1		2	1					0	24	6
RANGAI	7099	30	30	3	0		1	0	3	1	1	1	1	15	2
JANFIELD	41751	22	22	7	0	1	2	1	1				0	23	4
SABHA WALA	10700	10	10	7	0		0	0					0	24	5
BIRNAD	8431	29	28	24	1		1	1					0	7	2
KOTI	4761	15	14	4	1	1	1	0	1		1	1	1	27	5
SORNA	5457	11	9	3	2		1	0	2	1			1	10	3
RAIPUR	23559	26	25	11	1	1	5	1					2	15	2
RANI POKHARI	11147	22	21	6	3	2	3	1					1	19	4
MARKHAM GRUNT	21005	15	15	14	1	2	4	1	3	1	2	0	2	22	4
BHAU WALA	7491	27	26	6	2		1	0			1	2	2	26	8
NADA(BONDAR)	3624	13	12	4	1		1	0	1	2		1	1	15	5
MINDAL	3032	10	10	5	0		0	0	1	1			0	10	1
MIYAN WALA	15863	10	15	9	1	1	2	0	1	1			0	6	1
KALSI	7684	37	37	8	1	1	3	1	2	1	1	1	20	5	2
SARONA	3770	17	17	0	1		0	0					1	19	2
KORVA	4200	18	18	8	2		3	0					0	9	1
BHANDROULI	3042	14	12	4	0		0	0	1	1			1	4	2
THANO	6224	36	36	4	1		1	0	1				0	9	1
SAHIYA	6554	32	32	6	1		1	1	1		1	0	21	4	1
DAGURA NAGAU	3815	21	19	4	1		1	1	1		1	1	19	0	
DASAU	4636	16	16	5	1		1	0					0	10	4
JARI	3393	12	11	3	1		2	0	1	1			1	10	3
BHUNAR	3341	15	15	2	2		0	0	1				0	10	2
DHARAMA WALA	12824	12	24	8	0		0	2					0	13	3
JHAJRA	18556	12	12	7	4		0	3	1	2	2	13	4	2	
AAM WALA	5269	18	17	5	1		0	0					0	12	4
MANURA	3849	17	15	1	1		1	0	1				0	12	3
BHANIYAWALA	15080	13	13	14	1		3	1	1	1			0	10	1
BHAGWANTPUR	9911	35	34	6	1		0	1	2	1	2	31	5	1	
KHADI	3668	26	27	2	1		0	1	3		0	19	2	1	

LOCATION AND MAP PLOTTING SOFTWARE (LAMPS)

Government departments have undertaken computerisation of massive data related to villages, talukas, police stations, crimes, criminals, arms licenses, development schemes, natural resources, elections, census, agriculture, industry, economy, meteorology, tax payers, court cases, school teachers, health workers etc. Ready-made softwares like dBASE, FOXBASE, ORACLE, INGRESS are extensively used for creating large databases.

Government officials are often given responsibility to manage people, resources, facilities in large areas. The area could be a forest, desert, valley, command area, agro-climatic zone, ward, constituency, village, taluka, district, division, state, nation. Government officials managing an area need computer softwares which can plot maps of interest.

Maps of interest in a given area could be locations of police stations, locations where banks are present but police stations are not, villages with population more than 5,000 but does not have a PHC, locations in a forest which have a particular type of tree on a particular type of soil, villages which neither have drinking water nor are electrified but have population more than 5,000, villages which have large cattle population but no veterinary centre, rest houses which are close to roads, agricultural mandis which are far from railway lines etc. Plotting of such locations on maps will be an useful aid to identify facilities which are concentrated, sparsely present, inaccessible, easily accessible, their capacities are deficient or surplus etc. This information can be used for location of new facilities (tubewells), relocation of existing facilities (fair price shops), expansion of existing facilities (schools), scheduling of resources (more police personnel in crime prone areas), networking (linking villages with nearest power station) etc.

Popular database softwares like dBASE and FOXBASE lack graphical and map making capabilities. Geographic Information Systems (GIS) are special purpose softwares which have capabilities of database processing and map plotting. These softwares are expensive, require sophisticated computers, need highly skilled personnel to operate, and these softwares cannot be easily copied (portable).

LAMPS is a free, simple and menu driven software for plotting locations of interest on maps. LAMPS works on most PCs and requires only a word processor to enter data. LAMPS can be used along with dBASE software to plot locations of interest on maps.

Installing LAMPS software

LAMPS software has eight files- LAMPS.EXE, HELP.TXT, ATT.BGI, CGA.BGI, EGA.VGA.BGI, HERC.BGI, IBM8514.BGI and PC3270.BGI. BGI files are needed for plotting maps and locations. All eight files should be present in same sub directory. For example, you may create LAMPS sub directory in a hard disk or a floppy and keep all eight files in this sub directory.

Six additional files are provided with LAMPS software which contain an example problem. The six files are MAP1.TXT (Map File), LOCA1.TXT (Location File) and, RES1.TXT, RES2.TXT, RES3.TXT and RES4.TXT (Result Files). These 6 files should also be in same sub directory as the 8 files of LAMPS software.

Operating the Example Problem in LAMPS software

1. Go to the sub directory containing 8 files of LAMPS software and 6 files of example problem.
2. Type LAMPS and press Enter key.
3. Logo of the LAMPS software will appear on the screen. Press any key to continue.
4. Main Menu of the software will appear on the screen. Menu shows options to define Map Location and Result files; reset all files; to see data of Map, Location and Result files on screen or printer; to plot Map, Locations and Results on screen; to see Help on the screen or printer; and to quit the software.
5. Choose option A to enter name of the file which has Map data. Type name of Map file as MAP1. Press Enter key.
6. Choose option B to enter name of the file which has Location data. Type name of Location file as LOCA1. Press Enter key.
7. Choose option C to enter name of the file which has Result data. Type name of Result file as RES1. Press Enter key.
8. Choose option D, E or F to see data of these files on screen. Choose option H, I or J to take a printer output of these files.
9. Choose option L to see plot of the Map. A map will appear on the screen.
10. Choose option M to see plot of all Locations on the Map. A map with locations, shown as points, will appear on the screen.
11. Choose option N to see plot of the Results on Map. A map with results, shown by circles, will appear on the screen.
12. Choose option O to see plot of the Locations and Results on Map. A map with locations and results will appear on the screen.
13. Now choose option C to enter name of the file which has another Result data. Type name of Result file as RES2. Press Enter key. Repeat steps 8 to 12 to see data files and maps.
14. To see other Locations of Interest, type Result File names as RES3 (or RES4) and repeat steps 8 to 12.
15. Choose option R to reset names of all files in use. This step is required for plotting new locations of other problem having different names of Map, Location and Result files.
16. Choose option Q to quit the software.

LOCATION AND MAP PLOTTING SOFTWARE
(LAMPS)

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Creating Data Files

To solve own problem you will have to make three text (ASCII) files one each for plotting map (Map File), all possible locations in the map (Location File) and desired locations in the map (Results File). The extension of these text files must be TXT. Text (ASCII) files can be created in softwares like WORDSTAR (non document mode), LOTUS (.PRN file), editors of DOS, dBASE, FOXBASE, PASCAL, BASIC etc.

1. It is suggested that original map and locations in it should be first plotted (or traced using a carbon paper) onto a graph sheet. The coordinates of locations and map boundaries can be noted on a sheet of paper.

Coordinates of Map boundaries and Arcs are entered in Map File. Names and Coordinates of locations are entered in Location File. Names of locations of interest are entered in Result File(s). As stated earlier, these should be text (ASCII) files.

Map boundaries and locations in the map do not change frequently. For example, boundaries of a district and location of villages do not change so often. Thus, utmost care should be taken to collect and enter data in Map and Location files.

2. **MAP FILE:** Map file contains coordinates of map boundary(ies) and arc(s). In addition, maximum and minimum coordinates, and type of boundary (continuous or dotted) desired are also mentioned in this file. LAMPS software plots map on the screen when option L is chosen on LAMPS MAIN MENU screen.

Open a text file in any word processor and start entering data in first line and first column of the file. First line of the Map file must have maximum values of X and Y coordinates of the map, separated by a blank space. Second line must have minimum values of X and Y coordinates of the map, again separated by a blank. Third line can have value -1 followed by blank space and -1; or -2 followed by blank space and -2. Choose -1 -1 in third line to plot a continuous line. If third line has values -2 -2 the boundary will be joined by a dotted line.

Coordinates of map boundary should start from line 4. Value of X coordinate should be followed by Y coordinate value. Values of X and Y coordinates should be separated by a blank space. Continue to enter coordinate values in separate lines of the file. LAMPS software joins first coordinate with second, second with third, third with fourth, fourth with fifth coordinate and so on to create map boundary or arcs. The process is continued until file ends or values -1 -1 or -2 -2 are encountered. Values of all coordinates must be positive integers.

Map of the example problem is given in Fig. 1 and its data file MAP1.TXT is given in APPENDIX-I.

3. **LOCATION FILE:** Location file contains names of all locations and their coordinates. When option M is selected in LAMPS MAIN MENU all Locations in this file are plotted on the map by small points. Present version of LAMPS software does not depict names of locations on the map. Map prepared in step 1 will be useful to identify names of the locations plotted on the computer screen.

Open a text file in any word processor and start entering data in first line and first column of the file. In line 1 enter name of the location followed by its X and Y coordinates. Value of X coordinate MUST start from column 22. Value of Y coordinate should follow X coordinate, separated by one or more blanks. Go to line 2 and enter data for second

location. Repeat the process until data of all locations is entered. Values of all coordinates must be positive integers. Number of locations should not exceed 300.

Length of location name should not exceed 20 characters. Names can be entered in upper case (RAMPUR), lowercase (rampur) or mixed case (Rampur). There can be blank space in the name (New Delhi).

Location File (LOCA1.TXT) of the example problem is given in APPENDIX-II.

4. **RESULT FILE:** Result File contains names of locations which are of interest or which meet certain conditions. For example, if locations in Location File are villages, Result File can have names of those villages which have electricity but not telephones. When option N is selected in LAMPS MAIN MENU the Locations in this file are plotted on the map by empty circles.

Open a text file in any word processor and start entering data in first line and first column of the file. In line 1 enter name of the first location. At column 22 enter value 1. Go to line 2 and enter name of second location and at column 22 enter value 1. Repeat the process until names of locations of interest are entered. Location names in this file **MUST** be present in the Location File. The sequence of names of locations of interest in this file need not be same as in Location File. Generally, number of locations in this file will be fewer than number of locations in Location File. As mentioned earlier, names of locations can have blanks but length of location name should not exceed 20 characters.

The names in Result File should have same case as in Location file. For example, if names of locations in Location File are in upper case (RAMPUR) the names in Result File should be in upper case (RAMPUR) and not in any other form (rampur, Rampur).

For same Map and Location Files, generally there would be more than one Result File.

Data of 5 Result files are shown in Appendix-III.

Creating Result Files from dBASE database

If your data is computerised in dBASE you can create files containing locations of interest easily. We shall use data of computer assignment SK-96-CA-D4. For example, CA04.dbf (a dBASE file) has following three fields of panchayats in a district- PANCHAYAT (a name upto 20 characters), BANKS (number of banks, a integer) and PS (Police Stations, a integer).

If your interest is in those locations which have police stations but no banks the following command

```
.use ca04
.list panchayat for ps>0 .and. banks=0
```

will show names of panchayats and their record numbers on screen. These panchayats can be plotted on LAMPS software if this data can be captured in a text file.

the following commands on dBASE dot prompt to store names of panchayats (without record number) in a text file.

```
use ca04
del ALTERNATE TO RES1.TXT
SET ALTERNATE ON
list panchayat for ps>0 .and. banks=0 OFF
SET ALTERNATE OFF
CLOSE ALL
```

These set of commands will create a RES1.TXT file (a text file) and store names of panchayats in the file. Edit this file to ensure that names of panchayats start from first column of row 1. Also change value 1 in column 22. Similarly, you can create other files which are of interest and whose names you would like to see on map using LAMPS software. Transfer these files in the subdirectory containing LAMPS software.

piece

LAMPS will be continuously improved to include additional facilities- option to print maps, data entry facility, will show relevant details of locations on the screen, will work on WINDOWS etc. To get latest version of LAMPS (or other new softwares) contact:

Sandeep Kayastha
Management Faculty
Kiroskar Institute of Advanced Management Studies
Harihar- 577 602. Karnataka.

APPENDIX-1

Data of Map File MAP1.TXT

220 120	continued	continued
0 0	below	below
-1 -1	last row	last row
30 15	-2 -2	140 80
10 30	90 30	155 85
20 50	70 20	150 75
40 55	50 30	140 60
55 50	70 40	130 60
70 40	-2 -2	130 70
90 60	90 60	120 40
80 90	120 40	-2 -2
120 110	135 35	135 35
150 100	130 50	150 40
140 90	120 40	150 20
155 85	110 60	170 40
165 95	90 60	150 40
180 80	110 60	140 60
170 70	110 70	170 70
180 50	90 60	160 60
200 60	100 70	180 50
205 30	100 80	170 40
210 20	80 90	190 40
190 20	100 90	210 20
190 40	100 80	-2 -2
180 10	140 90	180 10
150 20	120 80	170 40
135 35	120 70	160 60
100 20	110 60	150 40
90 30	130 70	-2 -2
70 10	120 70	140 60
40 20	110 70	160 60
30 15	100 80	-2 -2
-2 -2	-2 -2	155 85
30 15	100 90	170 70
20 30	120 110	170 80
35 35	110 90	165 95
20 50	100 80	-2 -2
-2 -2	-2 -2	170 80
35 35	110 90	180 80
55 50	150 100	-2 -2
-2 -2	-2 -2	70 40
35 35	140 90	90 30
45 25	130 70	
40 20	150 75	

Notes: Data in line 1 (200 and 120) should be same or greater than the maximum values of X and Y coordinates in Map or Location Files. (Note that actual maximum values are 210 and 110. Slightly larger values can also be given so that map does not touch the edges of the computer screen).

Data in line 2 (0 and 0) should be same or less than the minimum values of X and Y coordinates in Map or Location Files. (Note that actual minimum values are 10 and 10. Slightly smaller, but

negative, values can also be given so that map does not touch the edges of the computer screen).
 in line 3 (-1 and -1) means that map boundary should be continuous. Coordinates of map from line 4. The software first plots 30 15 point and joins it with continuous line with next point 10 30. Then this point is joined with next point 20 50. The process is repeated until -2 -2 is encountered. It indicates start of a new dotted arc on the map.

APPENDIX-II

Location of Panchayats
 is shown in fig 2 by
 following numbers

Location File LOCA1.TXT

AJABPUR	20	30	1
MUNDHAN	40	50	2
GUJRARA	35	25	3
BEGI	50	40	4
PANDIT WARI	70	30	5
SAHASPUR	100	40	6
RANGAIU	105	55	7
ANFIELD	107	64	8
SABHA WALA	105	70	9
BIRNAD	95	75	10
KOTI	95	85	11
SORNA	95	95	12
RAIPUR	105	90	13
RANI POKHARI	125	100	14
MARKHAM GRUNT	125	90	15
BHAU WALA	115	75	16
NADA (BONDAR)	113	68	17
MINDAL	120	67	18
MIYAN WALA	120	55	19
KALSI	130	40	20
SARONA	135	50	21
KORVA	135	65	22
BHANDROULI	130	80	23
THANO	145	85	24
SAHIYA	147	80	25
DAGURA NAGAU	155	75	26
DASAU	160	85	27
JARI	172	83	28
BHUNAR	173	77	29
DHARAMA WALA	155	63	30
CHAJRA	170	60	31
AAM WALA	170	50	32
MANURA	160	50	33
BHANIYAWALA	150	55	34
BHAGWANTPUR	145	30	35
KHADI	160	35	36
LANGHA	165	25	37
SEWALA KALAN	180	30	38

SHYAMPUR	200	25	39
NARAYA	200	40	40

NOTES:

Name of location should start from column 1 of line 1. Name of the location can be 20 characters long. Names can have blanks- like DHARMA WALA. Coordinates of X location should start from column number 22 or later. Coordinate of Y location should follow X coordinate after at least one blank.

Maximum values of X and Y coordinates entered in Map file (MAP.TXT) file should be greater than Maximum and Minimum values of X and Y coordinates given in Location file (see data in first two lines of MAP1.TXT file, Appendix-I).

APPENDIX-III

Data of Result File RES1.TXT (Police Station present but Banks not present).

DHARAMA WALA	1
JHAJRA	1
BHAGWANTPUR	1

Data of Result File RES2.TXT (Police Station not present but Banks present).

RANGAIU	1
KOTI	1
SORNA	1
BHAU WALA	1
NADA (BONDAR)	1
MIYAN WALA	1
KORVA	1
THANO	1
DAGURA NAGAU	1
DASAU	1
JARI	1
MANURA	1
KHADI	1
LANGHA	1

Data of Result File RES3.TXT (Neither Police Station present nor Banks present).

GUJRARA	1
BEGI	1
SABHA WALA	1
MINDAL	1
SARONA	1
BHANDROULI	1
BHUNAR	1
AAM WALA	1
NARAYA	1

Data of Result File RES4.TXT (Both Police Station and Banks present).

AJABPUR	1
MUNDHAN	1
PANDIT WARI	1
SAHASPUR	1
ANFIELD	1
BIRNAD	1
RAIPUR	1
RANI POKHARI	1
MARKHAM GRUNT	1
KALSI	1
SAHIYA	1
BHANIYAWALA	1
EWALA KALAN	1
SHYAMPUR	1

Note: Name of location of interest start from line 1 and column 1. Value 1 which must follow each location name should be in column 22.

100... b7

