

17.1 Introduction

- 17.1.1** Availability of timely and relevant information about the economic and social changes and the physical growth taking place in different parts of a region is a very important input to the process of urban and regional planning and development management. An information system when fully developed on these lines for MMR is expected to have capability to collect, store and analyse the data and retrieve information at the appropriate scale so that emerging trends in population growth and distribution, land-use, economic activities, housing and environmental conditions and level of services like transport, water supply, sanitation, and telecommunications are available. That would greatly facilitate formulating suitable policies and plans and monitor their impact on actual development. Development of such a centralised information system however faces numerous hurdles. For instance, there are a number of agencies involved in the task of development in their specific sector of activity and/or a designated part of MMR. Naturally, due to the narrow focus, those agencies collect and process the data specific to their sphere of activities. More often than not it is published at the aggregate level which does not meet the requirements of other agencies. The scale, content, frequency, tabulation and analysis of the information thus available vary a great deal and to obtain a coherent picture about regional growth of MMR is rather difficult. It is also observed that besides the published material, a large amount of valuable information remains dormant in individual files and record rooms which deserves processing and dissemination. Similarly, data available through new sources like aerial photographs, satellite imageries and computer media also need to be made use of.
- 17.1.2** The Bombay Metropolitan Regional Planning Board which prepared the Regional Plan-1973, did not suggest any concrete scheme of organising an information system to monitor the plan implementation although broad functions and responsibilities of a development authority were outlined (BMRPB, 1974). MMRDA constituted in 1975 under the MMRDA Act, 1974 to plan, develop and co-ordinate activities in MMR on a continuing basis brought into focus a need for building a systematic information system. The Section 12 of this Act gives legal powers to call for data and review any physical, financial and economic plan which may be proposed or may be in the course of execution or may be completed in MMR. Some efforts in this direction have already been made by collecting, collating and computerising the data obtained from various sources through their publications, regular contacts and persuasion.
- 17.1.3** A need is however felt to establish an information system by making a formal arrangement that would ensure regular flow of requisite information to MMRDA. The National Commission on Urbanisation has also strongly recommended setting up of information systems at metropolitan area level to support planning and development activities (NCU, 1988). What is needed is to emphasise the use of information as planning tool and the introduction of an annual planning report that helps appreciate current growth trends, monitor implementation of plans and projects and modify the policies if required. In essence information systems should lead to quicker response to changing circumstances.

17.1.4 To this end a review is first made of the existing data sources and their collection and dissemination procedures. Limitations observed in regard to analysis and distribution of information in light of regional planning needs are next described. The full use of existing data sources like property tax registers and development permissions records to generate relevant information is advocated and a need for launching new data systems is highlighted. The role of computer technology in facilitating development of information system with spatial dimension is brought out and necessary actions to establish and maintain a meaningful information system at MMRDA are suggested.

17.2 Existing Data Systems

17.2.1 The data necessary for planning and development of MMR range across a large number of sectors. Data pertaining to demography, employment, economy, housing, transport, telecommunications, water supply and sewerage, environment and local finance serve as the major inputs in policy formulation and plan preparation. It is clear that MMRDA has to depend on numerous Central, State and Local Government Agencies which are involved in such primary data collection and dissemination. A list of important sources with some of the characteristics is given in Table-17.1. It is seen that agencies like Registrar General of Census, Municipal Corporations, Directorate of Economics and Statistics, etc. are multiple subject data sources whereas, those like Mumbai Port Trust, Mumbai Suburban Electric Supply Company etc. are single subject data sources. By and large these agencies provide information on annual basis, the demographic census being the exception. It would be of interest to study the working of a few major data collection systems as given below :

Census

This is a basic source of information on demographic characteristics of population, migration, housing and economic status of population. This is a regular decennial operation started in 1872. A Registrar General heads the Census organisation and Directors of Census operations in various States and Union Territories are responsible for conducting the census in the respective areas. States are divided into districts, tehsils, villages, blocks in general and census wards, sections, circles and blocks in municipal urban areas for collecting and compiling the information.

There are three schedules which are canvassed to collect the information. One is a house list which covers the purpose for which house is used, materials used in its construction, number of rooms occupied by household, and number of persons residing in the household. Second is the establishment schedule which covers Census houses identified as establishments to collect data on products, average number of persons employed, the kind of fuel or power used and so on. Third is the individual slip which collects details about age, sex, marital status, nationality, birth place, literacy, working status, nature of work and so on. Besides these major schedules, a few schedules are canvassed for specific studies such as for degree holders and technical personnel, status of women, etc.

The Census data pertaining to Greater Mumbai are available at 88 census sections level for the last four Census years. The circle level data are not available for 1981 but are likely to be made available for 1991. The data for remaining part of MMR in Thane and Raigad Districts are available at village levels and for the identified urban

centres in the region. The processing of data is generally done on the main-frame computer system at Delhi. The usual policy of dissemination of census information is to bring out various reports in the published form. Though general population count and primary census abstract are quickly available, information on age-sex distribution, migration, housing etc. is available after a considerable time lag and actions are needed to make use of newer means of information technology to provide information to the interested users at the earliest. Recently, however, select Census 1991 data are being made available on floppy disks and through the terminals provided by the National Informatics Centre in the country.

National Sample Survey-1

The National Sample Survey (NSS) deals with socio-economic, industrial and agricultural statistics in the country by carrying out regular surveys. It was set up in 1950 and is now under the National Sample Survey Organisation in the Department of Statistics, Govt. of India with headquarters at Delhi. It covers the whole country through different survey rounds.

Inquiry on consumer expenditure is the regular feature in these rounds. Information is also collected from time to time on employment/unemployment, small scale industries, capital formation, building construction, livestock products etc. The sampling design is a multi-stage selection process systematically covering tehsils, villages and households in rural areas and town, blocks and households in urban areas. All possible precautions are taken to eliminate bias in sampling and effect of seasonal variation. The States participate in NSS on a matching sample basis (a sample of same size as that drawn by NSS).

The information collected by NSS is compiled and published in form of reports by the Central Statistical Organisation at the national level. Generally the tables are available at state level for rural and urban areas separately, except for a few special studies where tables are brought out at district level also. For Maharashtra, the NSS tables are published in 'Quarterly Bulletin of Economics and Statistics' a publication of State Directorate of Economics and Statistics. There is a time lag of about 5 to 6 years between collection and publication of the data.

Directorate of Economics and Statistics

The Directorate of Economics and Statistics was set up in 1946. It is entrusted with collection of statistics and co-ordination of statistical activities of all government departments for data collection and publication. Directorate has the head office at Mumbai, four regional offices and district offices at each district headquarters in the State.

The statistical information collected and compiled by the Directorate covers a wide spectrum. The subjects of state income, prices, capital formation, industrial statistics, labour and employment, sales and sales tax, health and family planning, education and housing are the major ones. In addition, Directorate participates in surveys carried out by NSS, processes the data about economic census and carries many ad-hoc surveys. The data are mostly processed on a mainframe computer located in Mumbai.

The information collected and processed by Directorate is published in a number of

publications brought out. Some of the well known of those are : Statistical Abstract of Maharashtra, Handbook of Basic Statistics of Maharashtra, Quarterly Bulletin of Economics and Statistics, Maharashtra - An Economic Review and Municipal Year Book of Maharashtra. The Tables generally give the information district wise.

Municipal Corporation of Greater Mumbai

The annual administration report of the Municipal Corporation of Greater Mumbai is a major source of information about its various planning and development works during the year. It covers the department of engineering, estate and land management, shops and establishments, public health facilities and so on. The report however gives the picture at the aggregate level about the activities and expenditure and thus, the spatial dimension is not reflected. A few other reports are also brought out from time to time for example, an annual report on the air quality in Greater Mumbai on the basis of recorded values of SO₂, NO₂ and SPM pollutants in the air. A special effort is therefore necessary to collect data on residential buildings and tenements, water supply to different users, roads constructed/surfaced etc. from different offices of the Corporation to obtain say, ward wise distribution.

City and Industrial Development Corporation

In addition to the Annual Report, CIDCO occasionally brings out a few publications giving information about the progress of its various activities in Navi Mumbai. One quite useful among them is the report of socio-economic survey of all households in various nodes of Navi Mumbai conducted in 1975, 1980, 1983 and 1987 (CIDCO, 1975,1980,1983 & 1987). Data on population, household characteristics, employment, vehicle ownership, travel pattern, available amenities and so on, thus give idea about the developments taking place at various nodes in Navi Mumbai. If such database is systematically built with appropriate links to the maps then it would be very useful in planning and monitoring developmental activities.

17.3 Limitations of the Current Systems

- 17.3.1** The data sources in MMR mostly operate under the framework of respective organisations' functional needs or statutory requirement. Naturally, the collection, analysis and dissemination of data are not necessarily geared to directly serve the policy planning and project formulation tasks of MMRDA. A few experiences are given below to illustrate the limitations faced while using the available data.

Housing Sector

An assessment of the annual stock of residential tenements that are being constructed in the MMR in public, private and co-operative sectors is very important in formulating housing plan and strategy. Except for Greater Mumbai it has proved impossible to obtain even such a gross figure. Even in case of Greater Mumbai the published figures are only about total number of units completed but their size-wise and detailed geographical distribution is not available. A systematic compilation of grant of occupation certificate or building permission records by the local authorities can generate such information. Again the number of units either demolished or collapsed during the year in different parts of MMR is not available. Similarly, the data on slums and other such non-formal housing are not readily available since 1976 when a special census was carried out in Greater Mumbai.

The information about investment in housing sector in MMR by the agencies like HUDCO, MH&FC, LIC etc. is available at a broad aggregate form which is not adequate to understand the trends.

Industrial Sector

Information on various parameters of industrial production for large and medium scale industries in MMR is provided by the Annual Survey of Industries (ASI). The processed data on capital, raw material, fuel, output, inventory and value added expressed in rupees and actual number of workers and mandays for different industries both in Greater Mumbai and MMR are made available to MMRDA as a special arrangement. However, similar information on small scale industries at MMR level is not readily available. Similarly, there is no formal system to learn about the new industrial units being set up or revived in MMR and their characteristics.

In addition to the above mentioned information parameters about industries, it is now becoming critical to assess their likely environmental impact. Since according to the new Industrial Location Policy for MMR, the suitability of new industrial units in different parts of MMR is governed by their polluting or non-polluting status, it is essential to estimate the likely pollution load for the specified production scale. In the absence of such industry related environmental information the task of ILP implementation or modification becomes rather difficult.

Regional Economy

Estimation of regional income is quite essential for judging the performance of regional economy. However, the information about state domestic product according to each district in the state is generally not made available mainly on account of methodological problems. The needed data for the full districts of Greater Mumbai, Mumbai Suburban, Thane and Raigad for a few years are provided by the Directorate of Economics and Statistics to MMRDA on a special request but regular flow of such information is not ensured. It is therefore difficult to evaluate the economic impact of industrial and other land-use policies operative in MMR.

It is increasingly realised that provision of infrastructure like roads, water supply, telecommunications etc. is falling short of MMR needs even when estimated on the basis of moderate norms. A time bound programme therefore needs to be drawn to augment the infrastructure and services. To facilitate this task the scale of infrastructure needs in various sectors and locations in MMR is to be determined. This cannot be assessed by undertaking ad-hoc surveys and only the constantly updated database on economic activities can prove useful.

Employment Sector

The data on employment brought out by demographic census give number of workers by place of residence which is of limited use in spatial planning. The economic census which is being conducted along with the demographic census since 1971 is a source of information on establishment employment. The data processing work is however entrusted to the Directorate of Economics and Statistics of the State Government. The information tables are usually brought out at district level. However, for city or regional level planning in MMR this information is far from adequate. The economic census 1980 data for Greater Mumbai at the census section level and for urban and rural part of the rest of MMR were thus manually copied down and processed in-house by MMRDA according to the specific needs. The data from economic census 1990 have been transferred to MMRDA for similar processing. Considerable time is however expended in this process which can be minimised if microcomputer compatible media are used.

The employment market information obtained from the employment exchanges of Greater Mumbai, Thane and Raigad Districts is far from satisfactory. The quarterly report on employment covering all the public sector establishments and private sector establishments employing more than 24 employees in Greater Mumbai is brought out but it is far behind schedule and those for Thane and Raigad districts have been practically stopped. Moreover, the information according to spatial distribution e.g. say ward wise in Greater Mumbai, is never published. The collection process is found to be weak as adequate manpower is not assigned for this purpose and no action is generally taken against those failing to file the quarterly returns. The quality of information has thus suffered.

Shops and Establishment Register maintained by the Municipal Corporation of Greater Mumbai also contains a wealth of data on employment in shops, commercial establishments, hotels, restaurants and theatres but, that is not published ward wise to know the changes taking place in the employment.

Transport Sector

Though basic information about physical characteristics of roads, bus transport, railways, port traffic, air traffic etc. is available fairly regularly, information about some of the important parameters from planning point of view is not forthcoming. For example, number of vehicles over the years are recorded but corresponding trip characteristics are not available, the average speeds on the important roads over the years are not available and so on. Similarly, important planning data about goods being carried by different modes to various locations in MMR are not available on a regular basis. The existing sources like PWD, MCGB and BEST have to expand the scope of their data collection efforts to continuously cover such parameters. It is also observed that a separate transport and traffic planning unit manned by qualified staff is not available in MCGB with the result quality and coverage of data collection is far from desirable. Presently, therefore, the preparation of transport and traffic management plans is based on one-time survey. No wonder, the new traffic management measure like road pricing cannot be evaluated properly in the absence of requisite data.

Environment

The data on levels of air pollutants i.e. SO₂, NO₂, SPM and NH₃ in MMR are compiled by MCGM for Greater Mumbai and Maharashtra Pollution Control Board for the rest of MMR, but, that on other pollutants such as Ozone, Hydrocarbons, Carbon Monoxide etc. are not collected so regularly. Since the observations are not collected simultaneously at all the air quality monitoring stations and for a uniform time period, the results are not comparable at times. Non-availability of the corresponding meteorological conditions data also limits necessary air quality model building process.

Information on water pollution in different parts of the region is not available so readily. The extent of various pollutant levels in water bodies in MMR and their sources are therefore difficult to identify to suggest remedial measures. The picture of environmental conditions in MMR remains incomplete to that extent.

Impact of growing number of vehicles on roads on the environment, particularly on air pollution levels, needs careful assessment. Periodic data about such parameters are not collected. The data on noise levels due to industrial activities and road traffic during different hours of the day are similarly needed for introducing appropriate measures.

In the absence of continually updated base level pollution data it becomes difficult to assess the environmental impact of new projects.

Local Finance

The annual budget is the sole document to learn about the financial performance of local authorities. Further, the reporting format is not uniform and leaves many gaps in ascertaining the intentions and performance on both physical and financial fronts. In the absence of such data the task of investment programming in MMR which is one of the important activities of MMRDA remains abstract and incomplete. Similarly, the task of MMRDA to extend financial support in the form of grants and loans to deserving infrastructure projects and municipal services of local bodies becomes difficult. There is no standardisation in accounting procedure that can produce uniform financial statements e.g. Income & Expenditure, Sources and Application of Funds and Balance Sheets. There is no formal mechanism by which financial data generated by different agencies and local bodies in MMR is passed on to MMRDA. A recourse is therefore taken to cull the information from various budget documents or through ad-hoc surveys. However, such approach to obtain the information is far from satisfactory.

Planning Information

A number of development plans and zone plans are being prepared for various municipal and non-municipal urban areas in MMR either by local authorities directly or through Town Planning and Valuation Department of Govt. of Maharashtra. There was no formal arrangement by which they were regularly communicated to MMRDA and only very recently Govt. of Maharashtra has asked MMRDA to review all such plans being formulated in the region and monitor their implementation.

As the traditional method of implementing development plan is being increasingly replaced by the market oriented measures like 'Transfer of Development Rights' (TDR) for reservations for parks and playgrounds and 'Accommodation Reservation' (AR)

for facilities like schools, the need for information regarding the building permissions granted in different parts of the city, houses actually occupied, types of dwelling units being added and so on is assuming vital importance. However, currently, no mechanism exists for capturing these development control aspects in both quantitative and spatial dimensions. This leaves a sizeable gap in planning information which is to be filled up by special efforts from time to time.

Maps at different scale provide a wide range of information for planning and development. There are about 1000 villages in MMR. Cartographic information in respect of those villages is found to be varying in quality. Most of the maps are very old and need urgent updating. For instance, the attempts by MMRDA to link property tax data of local authorities with the corresponding cadastral maps for an integrated analysis have suffered in the absence of availability of the maps at an appropriate scale. The non-linking of revenue maps with land-use and other thematic maps is a severe constraint in the integrated planning and deserves serious attention. The land revenue code may have to be amended to remove such a difficulty, if found necessary.

Land Information

Availability of good land record is critical in designing and implementing land-use and related policies. For instance, to formulate a market oriented land policy, information on ownership, prices, zoning and other restrictions must be easily accessible. To ascertain the land ownership and the exact legal title becomes a tedious task and that is one of the reasons for project delays. The upto date land information along with accurate and authentic map is therefore essential. There is no single source today which can provide such data readily.

Some Limiting Factors

The experiences stated above are not unique. Many of them have been documented at length in the literature on information system design and implementation in the developing countries (Coiner, 1972, Patkar and Phatak, 1985, Cartwright, 1987 & 1991). The unsatisfactory state of data collection and dissemination method can be attributed to organisational, technological and psychological factors. A few major reasons are listed below:

1. Data collection and processing is considered to be a secondary activity and, therefore, adequate manpower and other resources are not allotted to organise the data systems.
2. Data collection format is not reviewed and revised periodically to serve multiple purposes.
3. Data processing is done as a routine activity so that efforts to bridge the gaps and cross verification are seldom made.
4. Adequate use of computer technology for data analysis is not undertaken due to which many cross-tables which are of use to other agencies are not produced.
5. Dissemination of information through computer media such as floppy disk, cartridge tape, magnetic tape etc. is usually not done resulting in the inordinate delay in providing information to users.
6. Reluctance to part with data is also found to be an obstacle. Since holding of information gives certain powers to the person, there is a disinclination to part

with data.

7. Designing the data system to evaluate the intended effects is not considered as a part of the policy formulation and therefore requisite information does not get established simultaneously.

It is clear that design and operation of an information system has to counter all such inhibiting factors in course of its development.

17.4 **New Data Systems**

17.4.1 Before considering the new data systems to be launched to support strategic planning and management functions, it is worth noting that even the existing systems if well harnessed can provide valuable information. The routine administrative procedures also generate such data which could be of direct use in many planning and policy formulation matters. These systems collect lot of data but all are not processed because often those are not needed to meet the current demands of the organisation. For example, if records pertaining to change of land use or development permission granted by a Local Authority or the Collector in MMR are periodically compiled then it would be very helpful in monitoring the spatial development, updating of property tax record and estimating location specific demand for infrastructure facilities and public services. Similarly, the planning proposal submitted by an user seeking permission for commencement of construction work gives a significant data regarding distribution of dwelling units by size, use and location. The municipal records about shops and establishment can reveal information on the nature of employment and change in its composition over the years. All such recorded data can provide early warning system which can identify problems not foreseen so easily and indicate the likely problems arising in future. It would therefore be very useful to carry out exhaustive study of all the existing administrative data sources to know their content, coverage and potential use in inter-sectoral policy formulation and evaluation that will help in making the maximum use of the available data sources .

17.4.2 There is however a need for launching of a number of new data systems to bridge the observed gaps in planning information. Some of them are as follows:

1. Periodic household surveys to understand travel characteristics, income and expenditure pattern, health problems etc. This could be planned on the lines of NSS with suitable extensions for scope and sample size.
2. Yearly traffic counts at the selected cordon points and speed and delay survey at the major roads to know the effect of congestion.
3. Regular processing of data from remote sensing (satellite imageries) to monitor the urban sprawl and other physical changes taking place in the region.
4. Environmental management system where data on air, water and noise pollution are regularly processed along with relevant meteorological and other data which could be shared by all.
5. Slum information system which would help in monitoring the conditions and impact of various improvement programmes.

17.5.1 With the advances in computer science and technology it has become affordable even for small organisations to install a micro-computer of fairly large capacity to store and process the data with reasonable ease. The off-line storage media like floppy disc, cartridge tape and CD-ROM now provide virtually unlimited capacity to store data in a compressed form thereby further increasing the capacity of these media. The cost effectiveness of data storage and flexibility to process data in a number of ways are the advantageous features of modern computers which are to be exploited to the maximum extent. Moreover, dissemination of data through above mentioned computer media to the interested users can eliminate delay inherent in the conventional printing process. The convergence of computer and telecommunications technologies has resulted in networking of computers located at different places. Local Area Networking (LAN) and Wide Area Networking (WAN) make it possible to transmit data in digitized form even across the globe through satellite communication channels. The concept of distributed data processing is therefore gaining ground. All these technological advances offer a distinct advantage in organising information systems at different levels.

17.5.2 An important requirement for urban and regional information system is to store and manipulate cartographic information. A computer based Geographical Information System (GIS) is one appropriate tool for this purpose. A GIS integrates the functions of storage of spatial and attribute data, management, analysis, modelling and mapping information in digital form in a single software package. Its power to link spatial and attribute databases helps in designing suitable query system for information retrieval in a number of ways. Some of the well known GIS packages provide an interface to directly process satellite imageries and aerial photography and therefore enhances the scope of data coverage.

MMRDA Experience

MMRDA in collaboration with the Space Applications Centre of the Indian Space Research Organisation launched a project to develop suitable information system in the framework of GIS. In the first phase an attempt is made to organise the spatial and attribute data for MMR at a macro-level i.e. considered at 1:250,000 scale (SAC and MMRDA, 1992). The primary data pertain to the following spatial elements.

1. Administrative map - showing the boundaries of MMR and its eight sub-zones identified for the study.
2. Drainage map - showing details of drainage and adopted from the SOI toposheet.
3. Transportation network map - showing details of railways, road / highways etc. The roads considered are National Highways, State Highways, Expressways, proposed Freeways, and other District Roads.
4. Land use / cover map - showing land use level-I details. To analyse the change in land-use over a time-period, multi- date land-use maps are produced. The remote sensing data from Landsat-TM of 1985 and from IRS LISS-II of 1989 have been used for this purpose.
5. Flooding hazard map - showing the flood-hazard zones in MMR has been prepared from remote sensing data and mainly includes the areas affected by tidal flooding.

6. Soil map - showing various features of soil like details on texture, depth, type etc.
7. Physiography map - showing different physiographic units in MMR as interpreted from remote sensing data.
8. Air-pollution stations map - for the MMR data has also been incorporated into the database. Air-pollution data for these stations are also available as non-spatial data and have been associated with these points data.
9. Urban sprawl map - for the MMR. This shows the sprawl of the urban settlements in MMR over a time-period. Four-data sprawl information has been incorporated. This includes :
 - 1968 sprawl from SOI toposheet
 - 1975 sprawl as interpreted from Landsat MSS data
 - 1985 sprawl as interpreted from Landsat TM data
 - 1989 sprawl as interpreted from IRS LISS-II data
10. Significant elevation points - These points have been adopted from the SOI toposheet on 1:250,000 scale. About 2000 + such elevation points have been incorporated for the MMR. The selection of appropriate elevation points from the SOI toposheet on 1:250,000 scale is based upon the terrain.

A set of secondary elements have further been derived from the above primary elements for analysis purposes. These are : slope map, air-pollution iso-lines maps, coastline buffer zone maps etc. The non-spatial database consists of demographic, economic, air pollution, road transport network data linked on a one-to-one basis with spatial unit of information. The GIS software used is PC ARC/INFO ported on a PC/ AT - 386 computer system (4 MB RAM, 80 MB HDD, VGA Monitor) with AO size digitiser and AO size eight colour pen plotter.

The data have been organised and analysed using different GIS utilities to demonstrate possible areas of applications. In particular the following issues are addressed:

- Urban suitability assessment
- Environmental assessment
- Air-quality assessment
- Urban growth profile
- Land use change analysis
- Route analysis.

The scope of the analysis is increased by interfacing an appropriate mathematical model with GIS operations. In order to retrieve the information an interactive user friendly query system is also designed and implemented using the programming facility available in PC-ARC/INFO software. There are four modes in which a query can be made as described below. The design allows for switching from one mode to another within a query- session and also for taking plot outputs at any stage.

1. *Point-query mode*, allowing for pointing to features and obtaining information for that location. This is basically a spatial query operation.
2. *Box-query mode*, where an area of interest can be defined for obtaining information. This is also a variant of the spatial query operation.

3. *Attribute-query mode*, where information is obtained based on an attribute condition. This is basically a logical query operation but the attribute conditions are “pre-defined”.
4. *Customised-query mode*, where a query can be constructed as a logical condition on line, and information is retrieved accordingly.

In the next phase, data organisation at 1:50,000 scale (meso-level) is being undertaken and at 1:10,000 scale (micro-level). It is envisaged that information systems developed under GIS would prove useful not only in planning but also in design and management of utility services in the region. The potential application areas are: property tax management, civic facility location, transportation planning and traffic management, water supply and sewerage design and maintenance operations and disaster management analysis. Some work has already been initiated in this direction for example, the property tax data in respect of Vasai Municipal Council area are being computerised and all the available water supply details for Dombivali area including maps showing network have been organised under the GIS by MMRDA (Patkar and Sampathkumar, 1993).

17.6 Issues in Information System Design for MMR

- 17.6.1** MMRDA is basically a strategic user of the information and not the generator. Initially, however it has to help various data generating agencies to organise their systems for multi-purpose use. This would ensure the integration of information both sectoral and spatial dimensional. The issues involved are: deciding the level of data collection, measurement unit, frequency, format, cross checks, tabulation schemes, summary reports and dissemination form. As a planning and development agency for MMR, it follows that MMRDA should be able to keep track of important developments taking place in various parts of the region in all respects. It can therefore take up the role of ‘clearing house’ viz. receiving data from different sources, processing and making available the outputs to the users (interested agencies, academicians, etc.) in the specified form. MMRDA, presently, performs these activities selectively. What is necessary is to formally recognise this role so that suggestions made by MMRDA to various data collection and processing agencies get implemented. A review of computer facility available with MMRDA and other agencies is to be made and necessary augmentation in terms of hardware, software and manpower can be worked out to establish such a system.
- 17.6.2** In designing an information system for MMR there are three basic elements that need to be suitably manipulated. These are: i) data entity, ii) data source, and iii) geo-referencing. They have to overlap for completeness and relevance as shown in Figure-17.1. This means for data collection about any parameter, sources are to be identified and maximum possible disaggregated spatial unit of collection is to be specified. On the other hand, corresponding to any data source, fullest possible data extraction strategy and locational unit are to be determined. For retrieval, corresponding to any spatial unit, the data sources are to be identified and contents must be made available after necessary processing. It is clear that such an information system will have to be developed around a computer driven GIS. An information system with in-built flexibility and linked to a spatial unit can prove extremely useful in strategic planning and management for MMR.

17.6.3 The scope of information system at MMRDA in the first instance be limited to the needs of basic infrastructure planning and management in MMR. A modular approach is to be followed in developing the system. The issue of cost and benefit involved in the development of computerised information system also deserves attention. The cost elements are :

1. computer hardware and software,
2. skilled manpower,
3. infrastructure like air-conditioning system, voltage stabiliser etc.,
4. hardware and software maintenance,
5. computer consumables such as floppy discs, tapes, stationery, printer ribbons, plotter pens, etc.

Though the capital costs (1, 2 and 3 above) are heavy, they are generally incurred only once but the recurring expenditure (4 and 5 above) also becomes substantial in the long run and needs to be provided for.

17.6.4 The benefits of an integrated computerised information system are as given below:

1. faster availability of information,
2. wider distribution of information,
3. generation of new information due to flexibility in analysis,
4. greater consistency in reporting,
5. saving in storage space.

Some of the above benefits can be quantified but improvement in quality of decision making is the most difficult to quantify. Therefore, instead of traditional cost-benefit analysis, the approach of cost effectiveness needs to be adopted for evaluation of computerised information system (Phatak, 1973).

17.6.5 One critical issue in the installation of such an information system is that of availability of the trained manpower. MMRDA will have to play a major role in this direction by imparting the requisite training to the staff of various agencies both in designing and operating the system. If necessary, MMRDA should depute its staff members to the desirous local authorities to set up the system right from the selection of microcomputer and train their staff for this purpose.

17.6.6 It is clear that RIS for MMR will have components dealing with different sectors and each of those will have to be designed keeping in view their typical requirements and characteristics. One important among them will be transport management information system. Its scope and development could be as follows (WS Atkins, 1993). The basic data needed for transport management are in respect of land-use planning, trip matrices, network features, traffic intensities and economic performance. This has to be mode specific and matching to zoning system which is to be followed for all transport and traffic planning. Naturally coordination with a number of data generating agencies is necessary like municipal authorities, railways, BEST, MSRTC, RTO, PWD, CIDCO, IAAI, Department of Water Transport, Police Department and a few private sector groups like Mumbai Goods Transport Association and Western India Automobile Association. This system is to be organised around the available PC ARC/INFO software with MMRDA. In the first stage, MMRDA will establish formal contact with all the above mentioned agencies and collect the data in the specified formats. It will check the data and process under GIS

DATA ENTITY

Sector	Contents
Population	: PCA, age-sex, migration, town directory
Employment	: Establishment, workers, SC/ST, fuel used
Economy	: SDP, per capita income, sectorwise distribution
Housing	: Stock addition, slums, demolition
Transport	: O-D matrix, travel time, cost, modal split
Water	: Sources, capacity, consumption, rates
Environment	: Pollution levels, sources, regulations
Local	: Revenue, expenditure, loans, taxes

DATA SOURCES

Agency	Controlling Authority
Census	: Central Government
NSS	: Central & State Govt.
EMI	: State Government
ASI	: Central Government
MCGB	: State Government
CIDCO	: State Government

GEO - REFERENCING

Aerial	Network
MCGB - Wards/Sections	Rail
TMC - Wards	Road
KMC - Wards	Water
NMMC - Wards	Power
Urban Centres Villages	Telephone

Information System for Strategic Planning in MMR

Figure - 17.1

software through the existing trained staff so that quality of output is assured. In the next stage, the staff from other agencies be associated to process the data on the existing system within MMRDA and be trained in the use of GIS. In the third stage some of the larger agencies can acquire the GIS system and will act as satellite system to that of MMRDA. In the fourth stage most of the agencies are expected to install the compatible GIS systems to process the data in-house as per the standards prescribed by MMRDA. The exchange of databases among all these agencies would thus be greatly facilitated.

- 17.6.7** A broad outline of environmental information system for MMR is also available (GOM and Coopers & Lybrand and AIC, 1994). The database for such a system should contain records about air pollutants, water quality, water supply quantity, waste water, solid waste, noise levels and health status in different parts of the region and at the lowest possible unit of measurement. In the short run, MMRDA will have to take initiative to collect data on all the above parameters and subject to GIS analysis and demonstrate to different agencies the benefit of such a system. In the medium term MMRDA should increase its capability in image processing, air pollution modelling and software utilization for waste disposal strategies. All these requires improvement of linkages between MMRDA and other agencies and deciding about MMR's environmental priorities.

17.7 Institutional Arrangements

- 17.7.1** There is a need for regularly conducting a few specialised surveys to supplement national data system to know more frequently about physical and socio-economic changes in MMR. One attempt in this respect was made by MMRDA by commissioning a multi-purpose household survey in 1989 to learn about various household characteristics. Similarly, use and interpretation of satellite imageries to study the urban sprawl and other physical changes in the region on periodic basis with the help of the Space Applications Centre is undertaken by MMRDA. Further, an aerial photography of the whole MMR to generate suitable maps has been carried out by MMRDA with the assistance of the National Remote Sensing Agency. These exercises will have to be repeated to build a proper database and understand the development trends. In order to process such non-conventional data a Photo Interpretation and Mapping Cell is being set up within MMRDA which could also serve other agencies in MMR. A necessity is also felt for undertaking specialised surveys to understand employment situation particularly in the informal sector, infrastructure needs and facilities to be provided in different parts of the region. It is clear that utility of such databases is not confined to one organisation alone and therefore collective support to undertake these activities is to be ensured.
- 17.7.2** It is observed that organisations like Mumbai Port Trust, Mahanagar Telephone Nigam Ltd. and Maharashtra Industrial Development Corporation have commenced the use of GIS for organising some of their databases. A few other agencies in MMR like CIDCO and MHADA are also exploring this technology. Maps in digital form would be a critical input in all these efforts. It would be desirable to get base maps of the region at an appropriate scale digitised/scanned and shared by all. This can avoid duplication of labour and expenditure. Similarly, it should be ensured that the data files created under different GIS software are compatible for exchange. The work of such GIS data co-ordination can also be entrusted to MMRDA.

17.7.3 It is worth repeating that with suitable modification in data collection formats and processing procedure the existing data systems can generate significant amount of relevant information. Strengthening of those collection systems in terms of manpower and computational resources can go a long way in this direction. MMRDA can play an important role in this activity by extending the requisite support as described in Table-17.2. Recognition of this role of MMRDA by other institutions in MMR can greatly facilitate development of the necessary information system.

Inventory of Major Data Sources			
Sector	Source name	Agency Type	Frequency of dissemination
Demography	Census Birth and Death Register of Municipal Corporations and other local bodies.	Central Local	Decennial Annual
Employment	Economic Census Employment Market Information Annual Survey of Industries Inspectorate of Factories Shops and Establishment Register National Sample Survey	Central/State State Central/State State Local National/State	Decennial Quarterly Annual Annual Annual Irregular
Economy	Annual Survey of Industries National Sample Survey National Income Accounts Directorate of Economics and Statistics	Central/State National/State National/State State	Annual Irregular Annual Annual
Housing	Maharashtra Housing & Area Development Authority City & Industrial Development Corporation Municipal Corporations Municipal Councils National Building Organisation Housing and Urban Development Corporation Maharashtra Housing Finance Corporation	State State/Local Local Local National National State	Annual Annual Annual Annual Annual Annual Annual
Transport	Public Works Department Municipal Corporations Municipal Councils Mumbai Electric Supply & Transport Undertaking Maharashtra State Road Transport Corporation Western and Central Railway Mumbai Port Trust and Jawaharlal Nehru Port Trust Ports Department International Airports Authority of India	State Local Local Local Local Regional/Local Central/Local State National	Annual Annual Annual Annual Annual Annual Annual Annual Annual
Telecommu- nications	Mahanagar Telephone Nigam Ltd., Mumbai Telephones Indian Post & Telegraph Dept.	National/Local National/Local	Annual Annual
Water Supply & Sewerage	Municipal Corporations Maharashtra Water Supply And Sewerage Board Maharashtra Industrial Development Corporation	Local State/Local Local	Annual Annual Annual
Environment	Municipal Corp. of Gr. Mumbai Maharashtra Pollution Control Board.	Local State/Local	Annual Monthly

Table-17.1

Role of MMRDA In Information System Development		
Information Entity	Things to be done	Role of MMRDA
1. Housing Stock	<ol style="list-style-type: none"> 1. To ascertain the total housing stock being generated. 2. To know the spatial distribution of the housing stock along with wise distribution. 3. To make available this information on yearly basis to the user agencies. 	<ol style="list-style-type: none"> 1. To design suitable data collection format. 2. To extend the computational assistance required by any local size-authority in MMR.
2. Development Permissions	<ol style="list-style-type: none"> 1. To generate periodic reports to note the change of land use i.e. say from agriculture to non-agriculture. 2. To produce a list of Commencement Certificates granted for construction and also that of Occupation Certificates in major towns. 	To extend the computing facility to the smaller local authorities and the Collector's office if desired.
3. Property Tax Management	<ol style="list-style-type: none"> 1. To prepare computerised property tax database for properties under the jurisdiction of each authority 2. To prepare 1:500 scale maps showing the location of such properties. 	To take up the database creation work and link it to maps through a GIS, atleast initially.
4. Employment	<ol style="list-style-type: none"> 1. To improve the quality of data collected by EMI 2. To process and publish ward-wise Economic Census data for Gr. Mumbai and either village or tehsil-wise for the rest of the MMR. 	<ol style="list-style-type: none"> 1. To extend financial support to strengthen the collection and data-processing system of EMI 2. To undertake the data processing for MMR so as to generate relevant information.
5. Road Transport	<ol style="list-style-type: none"> 1. To undertake periodic speed and delay surveys to learn about congestion on roads. 2. Periodic collection of traffic volume counts on all major roads. 3. To link all the road characteristics and accident data with the road network under GIS. 	To collaborate with appropriate agency in conducting the surveys and data processing.
6. Rail Transport	<ol style="list-style-type: none"> 1. To estimate station to station suburban traffic volume being carried during the peak hours. 2. To bring out separate report on expenditure and revenue parameters in respect of suburban rail operation in MMR. 	
7. Industries	<ol style="list-style-type: none"> 1. Like ASI, the information pertaining to certain vital parameters of SSI should be regularly published. 2. Information with regard to new industrial units that are set up in MMR should be periodically published. 	To assist the Industries Dept. in establishing computerised information system to undertake much indepth analysis.
8. Environment	<ol style="list-style-type: none"> 1. To regularly bring out data on levels of hydrocarbons in areas besides other pollutants. 2. Information on water pollution at the selected sites should be made available. 3. Periodic surveys on noise levels due to industries and traffic should be carried out. 	To assist the concerned agencies in compiling and processing the data and link it to GIS.

Table 17.2