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## FROM THE EDITOR

It gives us pleasure in bringing out this volume before you. We are thankful to them who have contributed their articles and made this publication possible.

The area of science and technology is vast and groups of people, around the world are engaged in this field. New technology and improved versions of products meticulously designed and perfected for efficient and smooth operation are coming up. As a result, the products from traditional techniques are becoming obsolete and are slowly being replaced by new versions.

A good example for this case is the solid state protective relays used in power networks to protect the different types of electrical equipment against fault currents and other abnormalities in the system. Solid state relays which are reliable, fast-in-response, modular-in-design, silence-in-operation and compact-in-size are slowly replacing the old fashioned electro-mechanical relays and so are the cases with other products.

All these may be attributed to the continuous developments that are occurring in the area. To say correctly, the research and development work is an on going process and ends on eternity.



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FROM THE EDITOR



# EARTHQUAKE SAFETY AWARENESS IN NEPAL: OBSTACLES AND REMEDIES

*Prachand Man Pradhan\**

## Introduction

Earthquake engineering is a young science and still scientists and engineers are seeking for knowledge for its advancement. Primarily, predicting the earthquake rupture time has still been a challenge. Amongst the natural hazards, earthquake, flooding and landslides are prone in Nepal and every time they strike, the consequence is devastating. In the year 1934, Bihar-Nepal Earthquake took the heavy toll of more than ten thousands whence the population density and the settlement was very less as compared to present context. Some 54 years later, in 1988, again the earthquake of Magnitude 6.6 stroke Nepal, causing thousands dead and about 9000 injuries. There are very small number of individuals in the country who are knowledgeable about the likelihood and consequences of earthquakes. Amongst them, very few are in this sector who put some effort to make people listen. Mainly such people are in the field of education or in the consulting service. In such scenario, it is unfortunate for a developing country to spread and implement earthquake safety and its importance.

Some countries, though possessing strong earthquake resistant design codes, are still facing problem implementing thoroughly, resulting partial success only. The enforcement strategy possibly being weak, the effectiveness is poor. The earthquake safety awareness scenario in Nepal is still in the preliminary stage. Various factors are affecting the awareness programs. As long as some of the obstacles mentioned below remain, the risk of earthquake hazard continues to wrap us.

## Difficulties and Solutions

### i) Changes in Government Policies and Job Placements

The government effort in the development of the earthquake safety awareness seems to be far unimaginable as per the uncertainty of the government policies. The officials too, being replaced in due course has been making the process irregular. Politicians at the national or municipality level do put up some interest in promoting seismic safety, however as their term of work keep on changing frequently, their interest do not come into action.

The stable government is necessary not only for earthquake engineering sector but for all development programs. Researches should be encouraged through government funding.

### ii) Code Revision Obstacles

After 1988 earthquake in Nepal, UNDP launched the Nepal National Building Code Development Project. The project aim was to assess the seismic hazard and seismic risk of building construction in Nepal, including the development of earthquake design strategies. The Nepalese code, which deals with earthquake resistant design of building, is somewhat a replica of the Indian Standard IS 1893:1984. However, after the 26 January 2001 earthquake (Moment magnitude 7.7) in Gujarat, India, the inadequacies of the Indian code was felt and soon the code was revised and published in June 2002 as IS 1893: 2002

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(Part - I). Their latest code has been improved with some rational approaches to achieve higher safety margin against earthquake forces [1]. Their code of practice is fortunately serving our geological profile as both the countries lie in the same tectonic plate; the Himalyan regions. The question is not only of revising our code but also enforcing it. Moreover, is it worthwhile to enforce the code which has been felt inadequate to take care of great earthquakes?

It can also be observed by simple Rapid Visual Inspection of buildings in various municipalities, mainly the Reinforced Concrete ones, are waiting for deep trouble in the time of big earthquakes. This is possibly because of the problem of enforcing the code to both design professionals and builders.

### iii) Less Importance to Local Experts

The country does not acquire sufficient useful scientific data of the past historical earthquakes. The seismometer records available so far, at some 21 locations spread around the country give the observatory reports of seismic events; however, due to the unavailability of accelerograph, advanced researches are being difficult. Unless some international organization puts up some interest in getting data; ironically, more for their own concern than for Nepal, the enhancement in this sector seems to be in quasi-static pace. The trend of relying on foreign experts has made our country hesitant in working independently. In many cases, national experts have the technical knowledge to undertake project work. However, the presence of foreign "expert" is considered necessary to influence higher levels of government, which otherwise would have been difficult to achieve [2].

### iv) Forgetting the Past Lessons

The lesson learnt from 1934 earthquake had unfortunately been forgotten by 1988. The RCC structures have replaced the traditional construction technologies. The consideration of new technology being popular without proper engineering design and construction practice has made the situation even bleak. In Kathmandu, for example, traditional Newari houses were built with pairs of vertical pegs in the roof rafters, which fixed the rafters to support walls. This practice largely discontinued. The mild steel slowly was replaced by High yield strength deformed bars (tor steel) which possess lesser ductility. Furthermore, the business trend setters have been influencing the construction field in recent days. In the situation where concrete Technology as well as the earthquake resistant design researches is yet to be well understood by large, the thermo-mechanically treated steel bars are taking over other steels. The ductility problem has been added up to make the scene even worse. In effect, the safety net provided by ductile action even in non-engineered design was eliminated.

### v) Lack of Coordinated Effort

Not too long after the first seismic hazard map being published in 1994 by the UNDP code project, other organizations too planned to undertake seismic micro-zonation of Kathmandu Valley. The latter published reports suggest diverted results from the previous one. The latter researches were considered to be carried out disregarding the original developer's ideas and views [2]. This gestures the disagreement between experts. If we intend to come out with any findings, the consorted and coordinated effort is necessary. Unfortunately, this seems to be lacking.



#### vi) Disregard to Simple Solutions and Technology

Even in the design and construction cases, simple, common sense could be used which would give inexpensive solutions. For example, the stirrups could be well bent to  $45^\circ$  so as to achieve better confinement, keeping the cost increment negligible. In the past days, it was difficult to persuade the builders and even owners in applying such simple methods. High water cement ratio is another big problem. The builders generally consider the concrete with bleeding action as superior grade mix, which is not the reality.

#### vii) Ignorance of Research Usefulness

The industrial organizations need to understand that in order to take market in the public, their contribution in research finance would be a good return. The structural engineering academic sector, which is the promising field, is far being ignored. The researches and findings through institutions definitely improve engineering practice to reduce earthquake risk. There are a lot of steel, cement and other construction material fabrication industries in the various parts of the world contributing financially in the form of grants, scholarships etc., for researches in earthquake engineering education. It is a complementary effort, which, further will payback indirectly in their business. The workshops and seminars on such activities in Nepal are countable.

Safety awareness program also includes disaster management. As such, the designers, public, rescue and relief personnel etc., need to understand each others job and responsibilities. Frequent workshops and trainings would be productive. Consorted effort from all sectors is needed at this stage.

#### Present Efforts; Brighter Sides

Once in a year, to mark the earthquake safety day, various organizations which deal with earthquake engineering and disaster prevention, do put up some effort in spreading the earthquake safety awareness to the public. Organizations like Structural Engineers Association Nepal (SEANep), National Society of Earthquake Technology (NSET), and various other institutions and organizations are working towards the awareness program. Some have focused their target in pre-disaster management while some are in for post disaster management. Joining this stream, Khwopa Engineering College, Bhaktapur, is running Masters Program in Earthquake Engineering. Institutions like this can work on researches for pre and post disaster sectors.

#### Recommendations

The earthquake safety awareness and its effectiveness depend upon various factors and some of the possible recommendations are pointed out as followings:

1. It requires a stable government to steadily move towards development. Every individual should feel his responsibility.
2. The earthquake resistant design codes need to be time to time revised and also made mandatory.
3. One should learn from past and try to avoid the mistakes done in past.
4. Local experts should be given due considerations as they are the ones who actually are in risk. They are the ones who know the ins and outs of the environment within the periphery.



5. New technologies are to be well studied before being implemented.
6. Coordinated effort in all levels of community is a must so as to achieve goal. Frequent workshops can play vital role.
7. Industrial sectors can play important role in supporting the research works in the field of earthquake engineering.

## Conclusion

So far, some of the barriers have been pointed out here and some might have been unrealized and unforeseen. If we are even slightly inclined towards having thoughts in reducing earthquake risk, it is time to act. Nevertheless, the effort put up by a small unit of organization has started giving some spark but still lot is yet to be done.

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## LAND POOLING SYSTEM IN THE KATHMANDU VALLEY - SUCCESSFUL IN FINANCING INFRASTRUCTURE BUT FAILURE IN ACHIEVING URBAN ENVIRONMENT -

Bijaya K. Shrestha\*, Ph. D.

### Abstract

The present trend of land pooling system practiced in the Kathmandu Valley is limited to small scale land development with formation of residential plots, successful only in financing basic urban infrastructure but failure in achieving lively urban environment. Absence of master plan and development control of the Kathmandu Valley, lack of planning standards and guidelines for land subdivision and infrastructure provision combined with poor technical and managerial capabilities of the implementing agencies namely Kathmandu Valley Town Development Committee and Municipalities and absence of other mechanism in financing the development cost other than contribution from the benefited landowners all have not only reduced the scope of using land pooling technique for large scale urban development but also limited the effectiveness of land pooling projects in realising the planning goals of city development. To reverse this trend, designating the land pooling area as 'comprehensive development zone' and formulating planning standard and urban design guidelines under the leadership of urban designer together with enhancing coordination and cooperation with the concerned line agencies (of infrastructure development) as a short term solution and preparing master plan and development control regulation at city level as a long term strategy is essential. Moreover, the strengthening of the implementing agencies and identification of alternative financing mechanism together with involvement of private sectors based on the scale, size and nature of the project is recommended.

**Key Words:** Land readjustment (pooling), Kathmandu Valley, Infrastructure provision, Urban environment, Master layout plan, etc.

### Overview

Land Pooling (LP) having different terminology such as urban land readjustment, land consolidation, land regroupment, land reform and land reordering is a two tier urban development technique. It comprises of land management and infrastructure allocation (and improvement) through assembling the groups of land parcels for unified planning, modifying them in terms of shape, location, size with selling some of the new reserved plots to recover the cost of redistribution and then finally returning the remaining serviced plots back to the land owners. These activities are planned and implemented within the urban development framework to realise the planning goals envisaged in the comprehensive master plan of the city. Moreover, it is a self-financing method that not only provides plots for private housing and public facilities but also brings a new dimension in public and private partnership. Since there is neither financial burden for the government nor risk of losing the ownership for landowners (Doebele, 1982), this technique of land development is much popular than other

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modes of land improvement such as 'Site and Services' and 'Guided Line Development' programs, where compulsory purchase or expropriation cause intensive resistance from the landowners, controversy in negotiation, irregular demands on compensation including longsome court proceedings thereby causing delay in project implementation, in some cases even cancellation (Yomralioglu, 1993).

Land pooling technique has been widely used in Japan, Korea, Taiwan and in some parts of Australia (Archer, 1997) with significant difference in their application but with varying degree of success. In the Kathmandu Valley too, this program has been implementing since 1988 to create serviced housing plots and to develop open spaces and community facilities. Nearly a dozen of land pooling projects has been implemented in the Valley alone and many others are on the pipelines (DUDBC, 2003). However, their critical review particularly in the context of urban development is yet to be done. Against this background, this paper aims to analyse the land pooling system of the Kathmandu Valley from two prisms - land and infrastructure development and urban planning and building construction - with threefold objectives. First, it analyses the key features of land readjustment techniques focusing on the integration of land development into urban environment in Japan and Korea. Second, it compares the international case study with the land pooling system of the Kathmandu Valley and then identifies its strength and weaknesses. Finally, it proposes some key strategy to improve the existing practice in the Valley.

### **Land Readjustment in Japan**

Japanese Land Readjustment (LR) is often described as a consensual, bottom-up style of planning and city building where neighbours initiate a process of consensus-building, build partnership with the government and work toward their common benefits - foundation of the LR projects (Nishiyama, 1988; Sorensen, 2000, 2002). Land readjustment technique in Japan, imported from Germany (Ishida, 1986) were in the beginning limited to agricultural land consolidation and irrigation improvement projects (Latz, 1989) based on the Agricultural Land Readjustment Act. However, enactment of new 'Land Readjustment Act' in 1954 has made widespread use of LR projects possible for peripheral city expansion, post disaster construction, new town and industrial development. In addition to this, the new comprehensive LR law provided formal rights to the lease holders of land to participate in the project implementing body, refined processes for review of action and replotting plans and above all empowered the national government to subsidise local government initiated projects.

Numerous factors help to synchronise the land development and infrastructure provision of LP areas with the urban planning at city level. First, the implementing agency and mechanism of execution is determined based on the nature and scope of the LR project. Private sector (group of landowners or land readjustment cooperative formed by landowners) is generally limited to small scale new land development located in suburban areas aiming to increase their land utility and urban services whereas the public agencies in different forms - (a) municipality of city, town or village, (b) prefectural government, (c) national authority, (d) public corporations locally or centrally set up (Nagamine, 1986) - are involved on the large scale projects associated with the main infrastructure improvement, urban redevelopment and disaster recovery. Local governments can implement LR projects only on the designated areas of the city plan. They need to pass the LR programs in the form of an ordinance and must get approved by the Prefecture Governor (CPA, 1995). However, it is not difficult for local municipalities to designate the LR areas within their boundaries. Not only local bodies but administrative agencies can also perform the projects under the same conditions as public bodies when the project has national importance and needs to be completed in short period



(Miyazawa, 1982). Individual and Cooperatives are given wider scope for land development on the Urbanisation Coordination Area (UCA) in the city perimeters whereas Public Agencies and Corporations are generally engaged in the built up area including Urbanisation Promotion Area (UPA) and City Planning Areas (CPA) (Hayashi, 2002). While applying LR method for infrastructure development such as arterial road, railway station and other similar structure, significant amount of area surrounding the structure is also included in the projects so that the whole site can be developed in a comprehensive planned manner avoiding the separation of the area by arterial road or railway line. The land developed by private sector other than through LR technique is regulated through the new Development Permission System, which requires the provision of its own infrastructure such as road, sewer system and even land for park in any private development over 0.1 ha in UPA areas and gives the planners legal authority to withhold the permission in substandard development (MOC, 1991). Such provision of engaging both the public and private agencies in land development task based on their capacity is the unique feature of Japanese LR system.

Second, consensus among all landowners, lease holders including project affected persons is essential in individually initiated projects (two third in the case of projects initiated by Association) which not only contributes in smooth implementation of the project but also helps in sharing the project cost. However, projects of city wide impact and national importance implemented by public agency can be initiated even without landowner's agreement. This technique has been widely used for the benefits of wider community.

Third, public exhibition of the project plan and detailing and ultimate review of them either by the Governor of the Prefecture or the Minister of Construction is compulsory for all types of LR projects, irrespective of project initiators. In the case of Association initiated projects, the Governor exhibits the program (comprising of road layout, public facilities, and a rough schedule) for two weeks and people affected by the project can submit written complaints during that period whereas the cases of public implemented projects differ: the Governor refers the complaints to the local City Planning Council in the municipality lead projects and the Minister of Construction takes action on the complaints after getting advice from the Planning Council in the case of public corporation initiated projects (LRPO, 2001). Such mechanism has helped to satisfy the affected community as well as to ensure the layout of the plots and other detailing in consistence with the master plan and zoning regulations of the city.

Fourth, those government implemented projects having city wide impact are largely covered by public finance through central and local grants besides sharing by the benefited land owners. Moreover, if the land readjustment area includes the development of major infrastructures that are serving to city, region and nation-wide importance, relevant agencies in charge sometimes ready to finance for their portion of responsibility thereby minimising the extra land contributions from the participating landowners. Such provision has not only strengthened the cooperation and coordination among the central government and local municipalities but has also encouraged the local communities to participate on LR projects for the benefits of themselves as well as for the betterment of the city.

Fifth, the municipal government staffs are involved in different ways in the projects initiated by individual and Association not only to strengthen the managerial and technical capability of private sector but also to frame those projects within the city development plan. It reinforces the public private partnership and strengthens the smooth project implementation.

Finally, scientific method is used in replotting the area and in calculating the contribution ratio



by considering the 'evaluation method' of land value or the 'areal method' or combination of both. The evaluation is normally based on the street-value method, which uses three indexes namely street coefficient (the condition of the street, its width, slope, existence of sidewalk, continuity and so on), accessibility coefficient (the proximity of railway stations, bus stops, schools, parks, and other facilities, and the lot coefficient (density of area, soil condition of the lot, etc.) (Hayashi, 1982). This street value is adjusted based on the land market prices in the area judged by sales or by such indexes as the property tax evaluation. The 'areal method' is based on the area itself, which is adopted where land prices are similar or where a poor street pattern renders the street-value method inappropriate (Yomraliglu, 1993).

### **Land Readjustment in South Korea**

Initiated by the colonial government after the enactment of Colonial City Planning Law in 1934, the Land Readjustment (LR) scheme has been extensively implemented as an ideal tool for urban development in South Korea since 1937 not only in the transitional zones outside the old central districts but also in the redevelopment of the war destructed areas. From 1934 to 1984 in the period of 50 years, there were 397 land readjustment projects with a total area of 43,580 ha. of land. Korean land readjustment projects have numerous distinct features, differ from the techniques used in other Asian countries. First, the land readjustment programs have been used to fulfil the goals of urban development in different time periods. Whereas the reshaping of the plots and realigning of the circulation system in order to reconcile the peripheral areas with the existing old settlement has been the primary concern in the land readjustment programs up until the end of the 1950s, the focus of the later programs in the late 1960s and 1970s shifted to provide housing and urban services for both the existing residents and the new arrivals (Lee, 2002). Numerous land readjustment projects implemented on the urban peripheral 5 to 15 km south of the Seoul's city centre in the late 1960s were successful to disperse the city population from the crowded sections north of Han River.

Second, land readjustment program has been primarily used as a tool for financing the installation of infrastructure network and providing lands for housing. Unlike in Japanese cases where most of the financing comes from the central government and the public works fund with only a minor portion from the projects especially for those projects which cater larger society, in Korean cases, they received little financial support from the central government even for major infrastructure works, and so has to be entirely self-financing.

Third, though landowners and other private bodies are eligible for the project initiation, most of the projects both in large cities and in smaller towns have been executed by the public bodies, namely local municipalities. Private sector finds little interest in involvement in land readjustment process not only due time consuming and difficulties in dealing with local communities but also because of lack of financial support from the public agencies.

Land readjustment techniques in Korea after the enactment of the 'Residential Land Development Promotion Act 1980' became more refined and comprehensive in regulating the urban growth. The changes can be perceived at least in three different aspects. First, this act shifted the overall responsibility of land development from local to central government and provided the latter especially the Ministry of Construction, wider and more direct supervision over the relevant activities of the municipal governments. Earlier local municipalities used to act as both the administrator and the developer. Since the role of municipal governments is limited to their physical boundaries, they sometimes lack a broader perspective of urban development at city level and hence their initiated projects could have conflicting objectives with the city and national development plan, as the case of expansion of Seoul by local



government against the national goal of regulating excessive growth of the capital city. Second, new land readjustment projects have also provided non-residential urban functions and community facilities to create a truly comprehensive urban environment against the earlier practice of producing lots for mainly middle income housing acting as a mere dormitory section of the city. Third and last, land readjustment programs initiated by the central government are not only bigger in size and scale but also include the housing for low income family through cross-subsidy schemes. A sizeable portion of land at 'Bongmyon-Sinbong' project in 'Cheongju' was given to public housing developers (Korean National Housing Corporation or local municipalities) at below market price to enable them to build low priced multi family housing units (Lee, 2002). The reduced revenue was covered up by the sale of the remaining cost-equivalent land at market prices largely to the investment-minded higher-income groups. In the 'Gaepo' project too, the City of Seoul built 4260 apartment units for the low-income and homeless households while the KNHC also built a large number of units targeted at low-to middle-income groups. Though the government started purchasing method for urban development from the 1980s, nonetheless, the central government's involvement in urban land development, need of self sustaining in development project, financial difficulties prevalent within the municipal governments and other factors have highlighted the importance of land readjustment as a viable means of land development and town planning and this will continue in future too.

### **Land Pooling System in the Kathmandu Valley**

To address the rapid urbanization of the Kathmandu Valley causing urban sprawl and inadequate infrastructure development, the government of Nepal took a bold step during the late 1980s by establishing a new Ministry of Housing and Physical Planning in 1988 (now renamed as Ministry of Physical Planning and Works) and enacting the Town Development Act 1988. Numerous projects such as 'Site and Services' implemented in Dallu (1977), Kuleswore (1977) and Galfutar (1982) could not yield satisfactory results due to intense public protest, delay in the project completion, huge infrastructure cost, unrealistic plot prices, misuse of down payments and in selection of beneficiaries. Learning lessons from the past projects, the Government of Nepal has not only converted the earlier Dallu Site and Service project into Land Pooling (LP) scheme but has also initiated numerous land pooling programs in different locations of the Kathmandu Valley from the 1988.

The Town Development Act 1988 provides the legal basis for implementing the land pooling projects in the Kathmandu Valley stating the guidelines for securing landowners approval, government approval and preparation of the replot map including legal process of preparing land title certificate (HMG, 1988). It has also empowered both the central and local government for project implementation. The land pooling system of the Kathmandu Valley can be broadly categorized into three stages. First, the project site is decided either by the planning agency based on the feasibility study or by the landowners and tenants themselves (at least consensus of 75% of total numbers) by requesting to the government agency. After approval from the public agency, 'Users Committee' comprising of the stakeholders and the 'Project Management Committee' consisting of experts and local officials are formed (Joshi, et. al, 2000). New construction on the site is controlled through an enforcement of moratorium. Also, a Land Management Subcommittee (LMSC) is formed to review the project's progress, approve the project's annual budget and resolve the land related disputes.

In the second phase, after implementing arrangement and project office establishment, land records and cadastral maps of the project site are collected. A site survey is also necessary to



confirm the area of each landowners and the project boundary. In many cases, there are discrepancies in the plot area mentioned in the landowner's certificate and in the actual site, which needs to be resolved before preparing layout plan and provision of infrastructure. In addition to these, contribution ratio and quality of infrastructure provision is also decided. Minimum developable plot size allowed is not be less than 80 sq. m. whereas the minimum street front is generally kept 6m with plot depth of two and half times the width of the plot. This scheme is to be supervised by the Project Management Committee and needs government's approval before implementation.

The last stage is sending of the final replotting map to the survey office for preparation of new cadastral map and of delivering the new land owners' certificate. For the operation and continuous maintenance, the ownership of the open space, park and playground including community structures are transferred to the users committee whereas the infrastructure such as road, drainage, electricity, drinking water and so on are handed over to the concerned line agencies of the government.

### **Financing Infrastructure and Urban Services**

So far, eleven land pooling projects have already been completed in the Kathmandu Valley alone producing a total of 7184 plots for mainly housing and other activities from 239.55 hectares of serviced land. Another fourteen projects on different location of the Valley are on the pipelines either on the feasibility study stage or on the preliminary planning phase, which will produce 67,980 number of plots (without plots of the Manahari, Madhyapur Thimi, Bhaktapur) on 1484.5 hectare of lands (DUDBC, 2003).

Both the government and the landowners have benefited from these projects particularly in financing the urban infrastructure in many ways. First, about 5980 landowners in the completed eleven land pooling projects have contributed 82.27 hac. of land in total for road, open space and the reserve plots. All the development costs including for infrastructure provision were covered from the selling of the reserve plots (18.98 ha in total) to the highest bidder. On the one hand, the government without financial burden was able to carry out land development and provide infrastructure, and on the other hand, all the landowners in lieu of contributing some part of their lands were able to receive regular size of plot without wastage of land and facility of vehicular road, open spaces and other amenities in their neighborhoods. This developed site is far better than the earlier situation of the site - irregular shaped plots with irregular network of pedestrian path. As fragmented small parcels of land are consolidated into a new building parcel, the land use is maximized and the cost of the serviced plots is many times higher than the previous one.

Second, unlike other infrastructure development projects such as road construction, park creation or riverfront development, where the benefits are often unfairly and partially shared, in land pooling projects, the development costs and benefits are fairly shared by all the participants. Moreover, development cost of a land pooling project is lower than any other type of land development. Owners of land, leaseholders and other persons within the project area can maintain their everyday life and business activities without interruption during the project period. As all the landowners participate in the process of land pooling process, they will get a chance to build community among themselves. The land value in the land pooling project areas of the Kathmandu Valley has increased from 300% to 600% (Karki, 2004). Third, the existing cadastral records and land registration books are updated and reorganized. In other words, it has provided an opportunity for simply and inexpensively resurveying the land and demarcating new and clear lines. The government's tax revenue improves due to



increased land value.

### Weaknesses in the Existing Land Pooling System in the Kathmandu Valley

After relating the land readjustment techniques practised in Japan and Korea, numerous weaknesses in land pooling system in the context of the Kathmandu Valley can be identified at two levels: land development and infrastructure provision and master layout plan and construction of buildings.

#### Land development and infrastructure provision

First, though the completed land pooling project has successfully developed about 239.55 hac. of lands with 7184 number of housing and other plots in the Kathmandu Valley (Table 1) so far, this amount of developed land and produced housing plot is insignificant to fulfil the housing demand of the Valley (need of 3,273 hac. land and 1,96,376 dwelling units by 2011 assuming the household size of 5 with gross density of 300 pph) and to address the present trend of rapid urbanisation (with 6% annual population growth in Kathmandu).

**Table 1.** Completed land pooling projects in the Kathmandu Valley

| S. No. | Project name    | Project area (ha) | Total no. of plots | No. of owners | Implementation period | Designated project period year | Year taken for project completion | Delay of the project (Yr.) | Implementing agency    |
|--------|-----------------|-------------------|--------------------|---------------|-----------------------|--------------------------------|-----------------------------------|----------------------------|------------------------|
| 1      | Sainbu          | 22.5              | 760                | 536           | 1991-2003             | 5                              | 12                                | 7                          | TDC, Lalitpur          |
| 2      | Dallu           | 20                | 691                | 455           | 1991-2003             | 5                              | 12                                | 7                          | KVTDC, Kathmandu       |
| 3      | Kamal Vinayak   | 7.3               | 205                | 170           | 1991-1996             | 2                              | 5                                 | 3                          | TDC, Bhaktapur         |
| 4      | Gongabu         | 14.4              | 406                | 376           | 1988-1996             | 4                              | 8                                 | 4                          | TDC, Kathmandu         |
| 5      | Nayabazar       | 44.25             | 1569               | 1312          | 1995-2003             | 4                              | 8                                 | 4                          | KMC                    |
| 6      | Liwali          | 34                | 770                | 667           | 1995-1998             | 3                              | 3                                 | 0                          | Bhaktapur Municipality |
| 7      | Gopikrishna     | 10.9              | 292                | 242           | 1995-2002             | 2                              | 4                                 | 2                          | TDPIC                  |
| 8      | Sinamangal      | 36                | 1070               | 964           | 1995-2003             | 4                              | 8                                 | 4                          | TDPIC                  |
| 9      | Sinchitar       | 26.9              | 920                | 812           | 1996-2003             | 4                              | 7                                 | 3                          | TDPIC                  |
| 10     | Lubhu           | 13.5              | 243                | 207           | 1993-1996             | 2                              | 3                                 | 1                          | TDPIC                  |
| 11     | Bagmai Corridor | 9.8               | 258                | 239           | 1992-2001             | 2                              | 9                                 | 7                          | TDPIC                  |
|        | <i>Total</i>    | 239.55            | 7184               | 5980          |                       |                                |                                   |                            |                        |

*Note:* KVTDC – Kathmandu Valley Town Development Committee; TDC – Town Development Committee; TDPIC – Town Development Plan Implementation Committee; KMC – Kathmandu Metropolitan City; MPPW – Ministry of Physical Planning and Works. Source: (KVTDC, 1999, DUDBC, 2003).



In the period of 27 years (1976-2003), Nepal was able to produce just 280.35 hac. of serviced land from 15 projects, whereas Japan developed 3,82,035 hac of land (11,234 projects) in the period of 46 years (1954-2000) and South Korea produced about 43,580 hac. (397 projects) in the period of 50 years (1934-84) (Table 2). Compared to Nepal, Japan and South Korea have been producing annually about 800 and 84 times respectively more land from the land pooling mechanism in the past many years.

**Table 2.** Comparative study of area developed through land pooling system in different countries

| Country            | Period      | Year | Land developed (hac)       | Land developed per year (hac) | Remarks |
|--------------------|-------------|------|----------------------------|-------------------------------|---------|
| Japan              | 1954-2000   | 46   | 3,82,035 (11,234 projects) | 8305.10                       | 800 X N |
| South Korea        | 1934 - 1984 | 50   | 43,580 (397 projects)      | 871.61                        | 84 X N  |
| Nepal              | 1976-2003   | 27   | 280.35 (15 projects)       | 10.38                         | 1 N     |
| (Kathmandu Valley) | (1988-2003) | (15) | 239.55 (11 projects)       | (15.97)                       |         |

In the case of Kathmandu Valley, it has been producing annually on the average of 15.97 hac. of land in the past 15 years. The average annual building permits issued by the Kathmandu Metropolitan City (KMC) alone is 3619 (permit record 1999 to 2001), whereas the government sector has produced just 8095 (7184 from land pooling and 911 from site and services) housing plots in the last two and half decades (1977-2003). Moreover, about 23% of the serviced plots in the case of 'Gongabu' Land Pooling project (6 years after the completion of the project) and 86% in the case of 'Sainbu' Land Pooling project (2 years after the completion of the project) are still vacant due to speculative nature of the landowners. In other cases, these serviced vacant plots are resold several times without building construction, just for the capital gains between transactions.

Second, those landowners with larger plots have benefited more than those tenants or persons who own a small house on a small plot who is primarily interested in the use value of the land, not the investment value. Moreover, the land contribution has made small plots too small to be sold later, resulting in a net loss in both use value and exchange value.

Third, designation of the project area for commercial use, residential precinct, open space, and so on in the new layout plan carries a different value per square meter land. For instance, a lot in front of the commercial road will have higher land value than a plot fronting the narrow residential precinct. Sometimes, it is difficult to provide equity to all landowners. Those plots on the flat lands are easy and economical to develop compared to the marshy land, hilly or rocky areas. In the large project, the development of street and other urban amenities can take years and those plots with provision of urban services in the beginning will have much advantages than other sites developed at the end. Also, the present method of calculating the contribution ratio does not address such complicated issues.

Finally, need of land owners' consensus in the project from concept to completion means quality and quantity of the physical infrastructure, contribution ratio and other decisions are influenced by landowners rather than actual need basis. For instance, landowners in the 'Bagmati Corridor' Project were ready to participate in the program only after agreeing on the cancellation of the open space allocation in the layout plan. For public utilities such as electricity, telephone line and so on, the project area needs to be depended on government's line agencies.



### Master layout plan and construction of building - urban environment

As land pooling projects basically focus on land development and physical infrastructure provision, its integration with urban development through layout plan preparation and building regulation is weak in the context of Kathmandu Valley. The reasons are numerous.

First, numerous land pooling projects in the Kathmandu Valley are limited to conversion of irregular plots into regular one with provision of vehicular access to each plot. Layout of street network and urban block with provision of open spaces is carried out on the basis of trade off between the local landowners and project staffs. As planning and urban design guidelines do not exist at city level, these detailing are site specific, vary in each project and above all are unscientific and ineffective (Table 3). The need to maintain self-sufficiency in the project financing combined with the pressures from the land owners for maximum return have significantly reduced the area allocation for open spaces and road network including provision of public facilities. For instance, despite having comparable project area in 'Liwali' and 'Sinamangal' residential developments, open space allocation varies: 2.8% in 'Liwali' and 5.3% in 'Sinamangal.' The 'Sainbu' Project provided about 12.9% of open spaces whereas it was just 3.4% in the case of 'Sinchitar' for similar project size and type. Similarly, land contribution accounts 29.6% in 'Gongabu' Project compared to 56% in 'Sainbu' land pooling.

Table 3. Land use allocation in the land pooling areas

| S. No | Project name    | Project area (ha) | Road (%) | Open spaces (%) | Selling plots or Reserve plots (%) | Land contribution (%) | Serviced plots to be returned (%) |
|-------|-----------------|-------------------|----------|-----------------|------------------------------------|-----------------------|-----------------------------------|
| 1     | Sainbu          | 24.57             | 22.8     | 12.9            | 20.3                               | 56                    | 44                                |
| 2     | Dallu           | 20                | 25       | 7               | 8                                  | 40                    | 60                                |
| 3     | Kamal Vinayak   | 7.32              | 21.5     | 4.2             | 6.8                                | 32.5                  | 67.5                              |
| 4     | Gongabu         | 14.33             | 17.5     | 5.2             | 6.9                                | 29.6                  | 70.4                              |
| 5     | Nayabazar       | 40                | 22       | 4               | 4                                  | 30                    | 70                                |
| 6     | Liwali          | 33.45             | 23.6     | 2.8             | 7.1                                | 33.5                  | 66.5                              |
| 7     | Gopikrishna     | 10.88             | 22.7     | 3.8             | 7                                  | 33.5                  | 66.45                             |
| 8     | Sinamangal      | 35.97             | 20.3     | 5.3             | 7                                  | 32.6                  | 67.4                              |
| 9     | Sinchitar       | 27.5              | 18.8     | 3.4             | 10                                 | 32.2                  | 67.8                              |
| 10    | Lubhu           | 13.5              | 17.9     | 4.4             | 9                                  | 31.3                  | 68.7                              |
| 11    | Bagmai Corridor | 9.8               | 19       | 0               | 2.7                                | 21.7                  | 78.3                              |

Source: (KVTDC, 1999; DUDBC, 2003)

Second, these projects have neglected the social aspects of urban life and thus failed to improve the community environment as a whole. Lack of socio-religious activities, retail outlets including other facilities needed for daily life have created inconvenient and monotonous life in the housing estates, developed through LP technique. Street network and open space allocation is not only inadequate in quantity to accommodate variety of functions - passive quiet area for adult, safe and privacy areas for women, recreation and playing field for youngster and



children but their qualitative design feature is also weak in terms of shape (irregular shape and size left over after plotting of the serviced lands in the best location) and location (divided into five small plots along the hi-tension line at 'Gongabu' residential neighbourhood). As the layout plan is limited to land subdivision without any land use designation and building use enforcement, and this combined with absence of master plan at city level has left the land use and building construction upto the individual landowners. In many cases, the residential buildings have been converted on ad hoc basis into elementary school, health care centre and other public facilities as per market demand. Haphazard coming up of such facilities has in fact created new set of problems of street congestion, poor streetscape and above all intensification of earthquake vulnerability.

Third, absence of master plan at city (and Valley) level has dramatically reduced the effectiveness of LP projects in the Kathmandu Valley right from the site selection to the detail layout plan and land use allocation. Land pooling system in present context is not suitable as a method for planning the overall development of the city as it must be carried out in many small projects in conjunction with an overall master plan. The sites of 'Gongabu' and 'Bagmati' Corridor projects lie on the flood plain area and are not suitable for housing development. The land subdivision and layout design in almost all the cases has failed to incorporate the site context and climatic study including integration with the surrounding existing areas.

Fourth, the inclusion of urban poor and homeless families is not possible in the present LP scheme of the Kathmandu Valley due to lack of public fund and landowners' eagerness to get maximum serviced lands. In fact, the major beneficiaries are land owners having larger plots who are least interested to contribute more lands for low income public housing.

Fifth, almost all the land pooling projects were delayed by many years except the case of 'Liwali', implemented by Bhaktapur Municipality (Table 1). Those projects executed in the early 1990s namely 'Sainbu', 'Dallu' and 'Bagmati Corridor' Projects were delayed by 7 years whereas 'Gongabu', 'Nayabazar' and 'Sinamangal' projects were extended 4 years beyond their designated project period. Even in the 'Gongabu' area completed in 1996, target populations for full use of infrastructure is yet to be achieved whereas new residential building typology is coming up which is totally different from the previously built houses due to long development time. Finally, LP requires a large number of experienced staffs to carry it out, including land appraisers, surveyors, urban designers and project administrators, which is missing in the case of Kathmandu Valley. The key role of urban designers in preparation of layout plan and formulation of building design guidelines is yet to be acknowledged not only by local landowners but also by the public implementing agencies.

## Conclusions and Recommendations

Compared to the land readjustment techniques of Japan and Korea, land pooling system in the Kathmandu Valley is successful in a narrow sense in one dimension only, i.e., development of housing plots with provision of basic infrastructure. However, the other dimension i.e., integration with building components and urban planning does not exist at all. This practice can be comparable with the LR technique of Korea before the enactment of new Residential Act 1980 and that of Japan before the formulation of new Land Readjustment Act 1954. Absence of comprehensive master plan and development control at city (and Valley) level coupled with lack of alternative mechanism for financing the projects other than by selling the reserve plots have not only severely limited the use of LP projects for large scale urban development but have also disconnected the infrastructure provision from building designs and their use. In such situation, the LP can not be used as a tool to create a habitable and



sound urban environment.

In the case of Korea, involvement of central government agencies with increase in size of the LR area have made it possible to address numerous problems of urban poverty, low income group and monotonous urban environment through cross subsidy, whereas the same objectives are achieved in Japan through public financing and in some cases sharing the cost among the concerned government agencies though the involvement of central government. In both cases, existence of the comprehensive master plan of the city with development control regulation helps to integrate LR projects into urban development works. While past land readjustment schemes mainly focused on the residential aspect and depended upon the city center or adjacent districts for other types of urban services, the recent developments in these cases are more comprehensive and provided a higher standard of commercial, service, and educational facilities of their own, and perhaps employments sources as well.

In the case of Kathmandu Valley numerous policy recommendations are suggested to improve the existing practice of land pooling. First, numerous government agencies working at different layers such as Ministry of Physical Planning and Works (at central level), Kathmandu Valley Town Development Committee (KVTDC - valley level), Municipalities (city level) and Local Ward Office (ward level) in coordination and cooperation with the professional bodies (Regional and Urban Planning Society of Nepal - RUPSON, Society of Nepalese Architects - SONA, and Nepal Engineers' Association - NEA) and people engaged in building industry should prepare a comprehensive master plan and zoning regulation with clear vision and objectives of Kathmandu city (and Valley) level. How better land pooling projects are executed but absence of such document limits the scope of land pooling for financing the basic infrastructure only without achieving desirable urban environment. Moreover, land subdivision act should be prepared and development permit system should be enforced to regulate the present trend of haphazard land development particularly implemented by private real estate company and individual land brokers.

Second, in the present context where the master plan of the valley is yet to be prepared, for the time being the land pooling area should be designated as a 'comprehensive development zone' and then planning standards and guidelines in terms of layout plan, street network, open space provision and other amenity requirements including urban design and building construction guidelines should be prepared for better urban environment. Such guidelines can be further refined based on the site context and project nature while applying at individual LP site.

Third, many line agencies responsible for urban infrastructure provision such as road, sewer system, telephone and other utilities are often working in different cities of the Kathmandu Valley with little coordination and cooperation. If these works are integrated and coordinated in the process of LR project, then it brings considerable advantages not only for the participating authorities or agencies in achieving the cost efficiency and effectiveness in development operation in terms of time, negotiation and land management but also for the local community in forming better urban environment. At the time of land pooling, the type and quality of infrastructure can be determined based on the site context, location and financial capability of the landowners. For instance, in low income community of low urbanized sites, the provision of septic tank in each house may be more economical rather than providing central drainage system, which can be installed later on by local government after the improvement of density and growth of settlements.

Fourth, private sector should also be allowed to execute the land pooling projects but should



be limited in size and scale and if possible in location too. However, clear guidelines and planning standards including infrastructure detailing should be provided. As the fund other than the reserve land revenue is usually necessary in the early stage, a mechanism of providing funds either in the form of grants or low interest loan should be made available by the public agency. The loan from the commercial bank increases the development cost which landowners may not be interested. Similarly, large scale land pooling projects of national importance and city wide impact should be financed or subsidized by either central government or local municipalities or by both besides the contributions from the benefited landowners. At present contribution of 30% of land by landowners is just sufficient to provide road network and limited open space, which is not sufficient to create vibrant and lively residential neighbourhoods.

Fifth and last, strengthening of the managerial and technical capabilities of Kathmandu Valley Town Development Committee and Local Municipalities is essential. Though, the Local Self-Governance Act 1999 allows decentralization of power for urban development and management of urban areas to the local municipalities, weak institutional arrangement, shortage of trained human resources and poor financial base all have constrained the local municipalities even to perform the daily activities. Same case is true for Kathmandu Valley Town Development Committee. It seems that land pooling is extra task for them. Nonetheless, from another perspective, land pooling projects can be an opportunity to demonstrate the capability of local government in utilising local resources and building community in the face of financial constraints.

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# NEPALESE ARCHITECTS AND CHALLENGES AHEAD

*Prof. Bharat Sharma\**

We have entered the threshold of new Time domain with ushering of new millennium. Perhaps it will be very timely and pertinent to reflect over the past and think seriously to define new role of Architects to face challenges and opportunities of 21st century.

This is definitely a real challenge to our architectural professional community both at Micro, Community Specific situation as well as at Macro - level much beyond our national boundaries, at Regional as well as Global levels.

The challenge is not at the same scale and level and magnitude universally. Some countries with long history of architectural professionals are well endowed and prepared to take up challenge of redefining the roles of Architects in fast changing Global context where the concept of "Think Globally" and "Act Locally" for the welfare of respective society and mankind is fast picking up.

I Guess Architecture is no more narrowly confined to just primacy of one single discipline only. It has to perform very well both at singular creativity as well as be very part and parcel of multidisciplinary creativity where actors of creation could be various.

The dogma of Nationalism being tied to Architecture of particular country perhaps does not hold good any more as impacts do not restrain to the frontiers of any particular country because with Globalization the Architecture too is getting cosmopolitan. This is where redefining the role of Architects deems necessary with onset of new era.

In Nepalese context the scenario is typically different. Starting from early sixties till to - date we have over 200 Architects. We are a small community in Nepal as compared to number of Civil Engineers.

Society of Nepalese Architects (SONA) was born in 1990 only. Prior to that architects had no option but to be member of Nepal Engineers Association (NEA), which was only of its kind in those days. There was crisis of IDENTITY and ENTITY as an architect had to identify as an "architect-Engineer" and not simply as an architect.

This was the situation when SONA came into being to establish and promote the profession in the community.

With slow pedal SONA has been primarily concerned with organizational set-up ad activities aimed, at advocacy of architectural profession.

But efforts of society of Nepalese Architects (SONA) have not been significant enough so far to make the Government and private sector more cognizant and aware about meaningful Social Role that architects could play if given the right opportunity.

Exhibition of the works of Architects and involvement of SONA in preparation of Building bye-laws for Kathmandu and participation of some of its members in preparation of National Building code could be qualified as professional role. But however it has to be mentioned that architect's active and meaningful role is yet to come so as to establish a respected" NICHE" in the Society.

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Active participation of architects in delivery-system of Housing as basic need of the society has not been laudable enough. Perhaps after HABITAT-2, more concerted effort had to be made which did not come at all.

Nepal is very rich in its cultural Heritage and built-environment of some of our Human-Settlement of Kathmandu valley. The seven prominent sites in Kathmandu valley, enlisted in world Heritage and Lumbini the birthplace of Lord Buddha pose great professional challenge to the architects in context of conservation. The fragile Natural as well as Built-Environments of above mentioned sites are in jeopardy.

Though SONA in the past has given thought to form "Council of Architects" with back up of an Act it has not materialized to-date. Perhaps a council could play pivotal role in institutionalization of architects' community.

It is strongly felt that apart from promotion and propagation of "innovative architecture it is high time to redefine the role of architects with new millennium, so that new avenues could be explored and opened up for social cause. Housing sector is very pronounced one which is more complex than simply doing architectural designs.

Research in innovations, technique, technology, materials, and land development for expanding the access to the disadvantaged group could be some of the challenging works. Reach and affordability as well as credit play key roles in Housing sector.

Human Habitat, Spatio - Economic Settlement planning with Urban - Rural interface with concern for urban design are some of our totally unexplored areas.

In exclusive domain of just prevailing architectural design works, it is worth to ponder over state of art which is rather not heartening.

Architectural Metamorphosis Scenario has not been that encouraging. In fact some of our past glory has lost the gloss.

If we care to think over Metamorphosis of our contemporary Architecture particularly in Kathmandu valley, a very chaotic collage of architectural products are alarmingly visible. The mushrooming of mostly anything but creative and utilitarian architecture is definitely a bad testimonial to be proud of. Except few architects including seniors and juniors rest are not serious enough to provide creative designs to the society and scene is bizarre. So talking about metamorphosis in the absence of Profession heat, Societal action, and Ethical pressure, a coveted transformation is not feasible unless the present nasty trend is stopped by the architects themselves and the society is taken into professional confidence. It is a challenge to be taken for better self-esteem of architects. Then only a healthy architectural professionalism will blossom.

Another area of big challenge for the architects is to come out with viable design solution for various architectural functions.

As the country is very prone to earthquake an architect has to take this dimension in all seriousness. The design should be architecturally palatable and structurally sound with the least cost. Affordability is a factor to be taken seriously. Visionary role on the part of the architect becomes desirable. Architecture is not only creative but utilitarian and very social too hence there is societal responsibility closely following the architect.



# A BRIEF OVERVIEW OF MIMO WIRELESS COMMUNICATION AS A SIGNIFICANT TECHNICAL BREAKTHROUGH IN MODERN COMMUNICATIONS

Madhup Khatiwada

**Abstract** – This paper presents an overview of Multiple-Input Multiple-Output (MIMO) system which is an emerging technique used in wireless communication. Firstly, we will present some background research leading to the discovery of the enormous potential of MIMO. We will then present the principles of MIMO along with the theoretic capacity, which will depict MIMO as an extraordinary bandwidth-efficient approach to wireless communication. Finally, we will discuss some of the spatial multiplexing detection techniques with some Monte-Carlo simulations to show the performance of these detection techniques for different antenna configuration.

## 1. Introduction

In recent years, one of the growing sectors of the communications industry has been wireless communication providing high-speed and better quality information exchange between mobile devices. Some of the major applications of wireless communications include internet-based mobile communications, video-conferencing, distance learning, wireless home appliances etc [1]. However, supporting these applications using wireless techniques poses a significant technical challenge.

From a technical point of view, the vital challenge faced in wireless communications lies in the physical properties of wireless channels. These physical properties can be described in terms of several distinct phenomena, including ambient noise, propagation losses, multipath and interference [2]. In addition to all these challenges, there is an increasing demand for higher data rates, better quality service, and higher network capacity. To meet these needs there is a requirement for new techniques that improve the spectral efficiency and increase the reliability of system.

Multiple-Input Multiple-Output (MIMO) technology promises a cost-effective way to provide these capabilities. A MIMO system comprises a wireless communication link with multiple antenna elements in both transmitter and receiver. MIMO takes advantage of the multipath scenario by sending a single transmission from the transmitter antenna array to bounce along multiple paths to a receiver. Transmitting data on multiple signal paths increases the amount of information transferred in a system [3]. Thus the system is able to handle more information and at a faster rate than a single-input single-output (SISO) scenario with a single path.

MIMO was conceived in the early 1970s by the researchers at Bell Laboratories while they were trying to address the bandwidth limitations that signal interference caused in large, high-capacity cables [4]. However it was not thought to be practical in that era because of the high expense incurred in generating the processing power necessary to handle MIMO signals. Later, with the advancement of technology and cost reductions in signal-processing schemes and with the need to meet the increasing demands, the researchers were compelled to reconsider MIMO for wireless systems [3].

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Multiple-input multiple-output (MIMO) architecture has emerged as a popular solution to the incessant quest for increased capacity in modern wireless communication systems. It promises enormous capacity with a marginal increase in cost and complexity. This technology is now poised to penetrate large-scale commercial wireless products and networks such as broadband wireless access systems, wireless local area networks (WLAN), third-generation (3G) networks and beyond [2].

A MIMO system comprises a wireless communication link with multiple antenna elements in both transmitter and receiver as illustrated in Figure 1. A vector of signals is transmitted from the transmitter antenna array simultaneously and then travels through the wireless channel. These signals are then received at the receiver antenna array which combines the signals in such a way that the quality of the communication in terms of Bit Error Rate (BER) and data rate is significantly improved for each MIMO user. MIMO systems are based on a space-time signal processing architecture where time is complemented with space or distance which is obtained from the spatial distribution of antennas in the transmitter as well as the receiver. Space-time processing in MIMO systems basically increases data rate (spatial multiplexing) and link reliability (space-time coding).

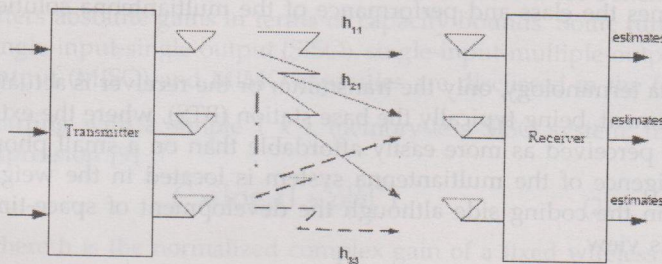


Figure 1 A MIMO Communication System Model

An interesting feature of MIMO is that it exploits the multipath scenario, a pitfall of wireless transmission communication, to its advantage. MIMO benefits from it by transmitting data on multiple signal paths which increases the amount of information transferred in a system

which in turn increases the number of users it can serve. Some of the key advantages of MIMO communication can be identified as follows.

Extraordinary high spectral efficiency (from 30-40 bit/s/Hz) and large fade level reduction 10-30 dB) are the prime advantages [5]. Among other benefits that the system provides are a reduction in co-channel interference (5-15 dB), a flexible architecture through Digital Signal Processing (DSP) and diversity order, which is two times higher in MIMO than in Single-Input Multiple-Output (SIMO).

### 1.1 MIMO System Equation

In a single user MIMO model with  $N$  transmit and  $M$  receive antennas, the MIMO system equation is given by or in matrix form

$$\begin{bmatrix} r_1 \\ r_2 \\ \vdots \\ r_M \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} & \cdots & h_{1N} \\ h_{21} & h_{22} & \cdots & h_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ h_{M1} & h_{M2} & \cdots & h_{MN} \end{bmatrix} \begin{bmatrix} s_1 \\ s_2 \\ \vdots \\ s_N \end{bmatrix} + \begin{bmatrix} n_1 \\ n_2 \\ \vdots \\ n_M \end{bmatrix} \quad (1)$$

where  $H$  is the channel matrix of size  $M \times N$ ,  $r$  is the  $M \times 1$  received signal vector,  $s$  is the  $N$



$\times 1$  transmitted signal vector, and  $n$  is an  $M \times 1$  additive white Gaussian noise vector with zero mean and variance  $\sigma^2$ . The channel matrix  $H$  is the factor by which the signal is amplified and is also known as the channel coefficient. The element  $h_{ij}$  in the channel matrix  $H$  represents the complex gain between transmitter antenna  $j$  and receiver antenna  $i$ .

## 2. Principles of Space-time (MIMO) Systems

Consider the multiantenna system diagram in Figure 1. A compressed digital source in the form of a binary data stream is fed to a simplified transmitting block encompassing the functions of error control coding and mapping to complex modulation symbols (BPSK, QPSK, QAM, etc.). The latter produces several separate symbol streams which range from independent to partially redundant to fully redundant. Each is then mapped onto one of the multiple TX antennas. Mapping may include linear spatial weighting of the antenna elements or linear antenna space-time precoding. After upward frequency conversion, filtering and amplification, the signals are launched into the wireless channel. At the receiver, the signals are captured by possibly multiple antennas and demodulation and demapping operations are performed to recover the message. The level of intelligence, complexity, and a priori channel knowledge used in selecting the coding and antenna mapping algorithms can vary a great deal depending on the application. This determines the class and performance of the multiantenna solution that is implemented [6].

In the conventional smart antenna terminology, only the transmitter or the receiver is actually equipped with more than one element, being typically the base station (BTS), where the extra cost and space have so far been perceived as more easily affordable than on a small phone handset. Traditionally, the intelligence of the multiantenna system is located in the weight selection algorithm rather than in the coding side although the development of space-time codes (STCs) is transforming this view.

Simple linear antenna array combining can offer a more reliable communications link in the presence of adverse propagation conditions such as multipath fading and interference. A key concept in smart antennas is that of beamforming by which the average signal-to-noise ratio (SNR) is increased through focusing energy into desired directions, in either transmit or receiver [6].

Indeed, if one estimates the response of each antenna element to a given desired signal, and possibly to interference signal(s), one can optimally combine the elements with weights selected as a function of each element response. One can then maximize the average desired signal level or minimize the level of other components whether noise or co-channel interference.

Another powerful effect of smart antennas lies in the concept of spatial diversity. In the presence of random fading caused by multipath propagation, the probability of losing the signal vanishes exponentially with the number of decorrelated antenna elements being used. A key concept here is that of diversity order which is defined by the number of decorrelated spatial branches available at the transmitter or receiver. When combined together, leverages of smart antennas are shown to improve the coverage range versus quality tradeoff offered to the wireless user [6].

As subscriber units (SU) are gradually evolving to become sophisticated wireless internet access devices rather than just pocket telephones, the stringent size and complexity constraints are becoming somewhat more relaxed. This makes multiple antenna elements transceivers a possibility at both sides of the link, even though pushing much of the processing and cost to the network's side (i.e., BTS) still makes engineering sense [6]. Clearly, in a MIMO link, the



benefits of conventional smart antennas are retained since the optimization of the multiantenna signals is carried out in a larger space, thus providing additional degrees of freedom. In particular, MIMO systems can provide a joint transmit-receive diversity gain, as well as an array gain upon coherent combining of the antenna elements (assuming prior channel estimation).

In fact, the advantages of MIMO are far more fundamental. The underlying mathematical nature of MIMO, where data is transmitted over a matrix rather than a vector channel, creates new and enormous opportunities beyond just the added diversity or array gain benefits. This was shown in [7], where the author shows how one may under certain conditions transmit independent data streams simultaneously over the eigenmodes of a matrix channel created by TX and RX antennas. However, to our knowledge, the first results hinting at the capacity gains of MIMO were published by Winters in [8].

### 3. MIMO Capacity

MIMO systems promise substantial improvements over conventional systems in both quality-of-service (QoS) and transfer rate. In addition to these benefits, it has been shown that MIMO offers absolute gains in terms of capacity bounds. Some fundamental results which compare single-input-single-output (SISO), single-input-multiple-output (SIMO), multiple-input-single-output (MISO) and MIMO capacities are discussed in the following paragraphs.

Starting with a simple  $1 \times 1$  memory-less SISO system, the capacity here is given by the expression [9]

$$C = \log_2(1 + \rho|h|^2) \quad (2)$$

where  $h$  is the normalized complex gain of a fixed wireless channel and  $\rho$  is the SNR at the receive antenna.

When the number of receive antennas is increased, the capacity of the system improves with the increase in antenna numbers. Hence in the SIMO scenario, the capacity is given by [9]

$$C = \log_2\left(1 + \rho \sum_{i=1}^M |h_i|^2\right) \quad (3)$$

where  $M$  is the number of receive antennas and  $h_i$  is the gain for each receive antenna. An interesting feature of equation (3) is that the average capacity of the system increases logarithmically with any increase in the value of  $M$ .

Similarly, in the case of MISO where the system has  $N$  transmit antennas, the capacity becomes [9]

$$C = \log_2\left(1 + \frac{\rho}{N} \sum_{i=1}^N |h_i|^2\right) \quad (4)$$

The normalization of the SNR by  $N$  ensures that a fixed total transmitter power is used. In this case as well, the average capacity of the system increases logarithmically with an increase in the value of  $N$ . This makes it evident that increasing the number of antennas in both transmitter and receiver will make the system capacity better, but only in a logarithmic way.

In the case of MIMO with antenna diversity at both receiver and transmitter, the expression for capacity is given by [8, 9]



$$C = \log_2[\det(I_M + \frac{\rho}{N} HH^H)] \quad (5)$$

where  $\psi$  means transpose-conjugate,  $I_M$  is the  $M \times M$  identity matrix and  $H$  is the  $M \times N$  channel matrix. It should be noted here that  $N$  equal power uncorrelated sources are assumed at the transmitter.

An important conclusion drawn from equation (5) is that the mean capacity grows linearly with  $m = \min(M, N)$  [6] rather than logarithmically as in equations (3) and (4).

#### 4. Spatial Multiplexing Detection

As mentioned earlier, MIMO exploits spatial multiplexing techniques in which multiple data streams are transmitted simultaneously and on the same frequency from the transmitter, which may or may not have the channel state information (CSI), using an antenna array.

The detection operation at the receiver end of the MIMO link is called Spatial Multiplexing Detection (SMD). SMD is basically an operation in which the received signals are combined to obtain an estimate of the transmitted signal. SMDs are basically classified into two categories viz linear detection and non-linear detection.

##### 4.1 Linear Detection

Linear detection is relatively simple to implement and has less computational complexity which in turn reduces the processing time in the receiver. However, these receivers have intermediate performance. Some of the common types of Linear Detection techniques are Selection Combining (SC), Equal Gain Combining (EGC), Maximum Ratio Combining (MRC), Zero Forcing (ZF) and Minimum Mean Squared Error detection (MMSE).

Linear detection is a simple process in which the received signal vector is multiplied with a weight matrix to produce the signal estimate.

$$\tilde{s} = W^H r \quad (6)$$

where  $\psi$  denotes hermitian transposition. The weight matrix  $W^H$  is chosen at our disposal. The weight matrix varies according to the particular linear detection scheme employed. Note that  $\tilde{s}$  will be quantized to produce the signal estimate  $\hat{s}$ .

##### Zero Forcing

Zero Forcing (ZF) is a linear spatial multiplexing detection scheme which is simple and widely used. As the name suggests, this scheme forces the interference to zero. However, it may sometimes result in noise inflation. The weight matrix for ZF is given by

$$W^H = H^{-1} \quad (7)$$

for a system with same number of transmit and receive antennas ( $M = N$ ) and

$$W^H = (H^H H)^{-1} H^H \quad (8)$$

From the above equation, it can be concluded that although ZF nullifies all the interference it has the potential problem of noise enhancement.

##### Minimum Mean Squared Error

Improved performance compared to ZF can be obtained by attempting to minimize both interference and noise at the same time. This is done by the Minimum Mean Squared Error (MMSE) detection scheme, which is a trade off between noise inflation and



interference suppression. The weight matrix for MMSE detection when it is assumed that  $E|s_{ij}|^2 = 1$  is given by

$$W^\psi = H^\psi (\sigma^2 I_M + H H^\psi)^{-1} \quad (9)$$

which is also equivalent to

$$W^\psi = (\sigma^2 I_N + H^\psi H)^{-1} H^\psi \quad (10)$$

where  $I_M$  and  $I_N$  are the  $M \times M$  and  $N \times N$  identity matrices respectively.

It can be seen that in this case, interference is not totally nullified as in the case of ZF but the noise term is less inflated than that of ZF.

## 4.2 Optimal Detection

Maximum Likelihood (ML) is the optimal detection scheme but it has very high computational complexity and hence becomes the most time consuming detection procedure. The procedure is non-linear and basically consists of a search through all possible signal vectors.

### Maximum Likelihood

ML is the optimal detection scheme and has a high computational complexity. Although the performance is superior to any other linear detection techniques, it is the most time consuming detection procedure. Moreover, its complexity increases with increases in the number of antennas or the size of the signal constellation.

The ML detector has the desirable property that, under the statistical assumption on  $s$  being i.i.d. random variables uniformly distributed over a constellation  $S$ , it minimizes the probability of error,

$$P_e = P(s \neq \hat{s}) \quad (11)$$

The likelihood of  $s$  is obtained by minimizing noise power, the ML estimate of  $s$ , i.e.  $\hat{s}_{ML}$ , is given by

$$\hat{s}_{ML} = \underset{\hat{s} \in S^N}{\operatorname{argmin}} |r - H\hat{s}|^2 \quad (12)$$

Thus, the ML detector chooses the message  $\tilde{s}$  which yields the smallest distance between the received vector  $r$ , and hypothesized message,  $H\hat{s}$ .

## 5. Simulations and Results

In the previous section, various spatial multiplexing detection schemes are described in detail. This section presents comparisons between BER for the different detection schemes. The results presented here are obtained from Monte-Carlo simulations performed in MATLAB. The channel is considered to be at fading Rayleigh and the modulation scheme to be BPSK for simplicity in simulation.

Figure 2 shows a comparison in terms of BER for different SNR conditions for different detection schemes in a 4-4 MIMO link. It is clearly revealed in Figure 2 that ML has the best performance being an optimal detection scheme. ZF is observed to have the worst performance of all.



Similarly, Figure 3 and Figure 4 show comparison of BER in different SNR conditions for different detection schemes in a 2-2 and 6-6 MIMO link. The pattern of the curves is similar to the 4-4 scenario, but it is seen that the system performance increases in any detection scheme as the number of antennas is decreased. Figure 5 is an example of this in which the MMSE detection scheme is shown for 6-6, 4-4 and 2-2 MIMO links.

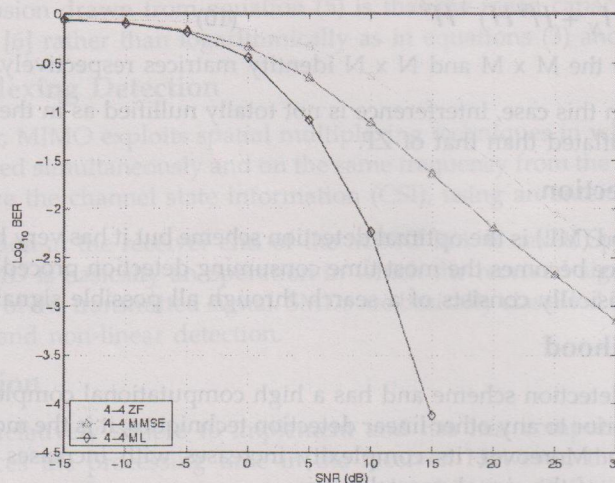


Figure 2 Comparison of BER for ZF, MMSE and ML in a 4-4 MIMO link

## 6. Conclusions

This paper reviews the major features of MIMO links for use in future wireless networks. We see that the great capacity gains which can be realized from MIMO. Whether we achieve this fully or at least partially in practice depend on a sensible design of transmit and receive signal processing algorithms. It is clear that the success of MIMO algorithm integration into commercial standards such as 3G, WLAN, and beyond will rely on an implementation of appropriate diversity and detection schemes.

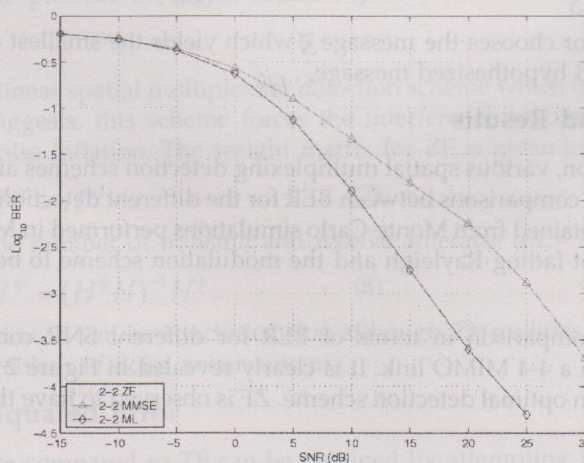


Figure 3 Comparison of BER for ZF, MMSE and ML in a 2-2 MIMO



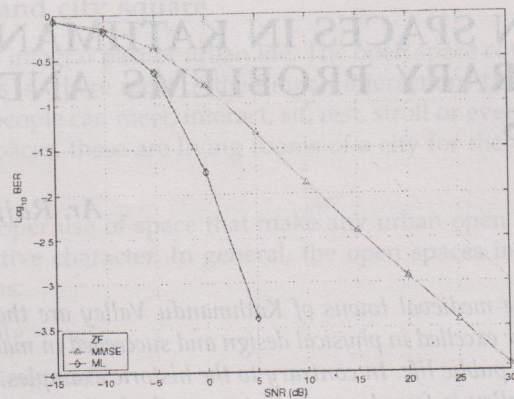


Figure 4 Comparison of BER for ZF, MMSE and ML in a 6-6 MIMO link

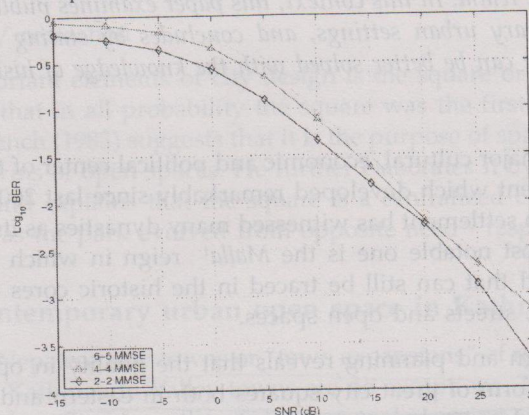


Figure 5 Comparison of BER for 6-6, 4-4 and 2-2 MIMO links using MMSE

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# URBAN OPEN SPACES IN KATHMANDU VALLEY: CONTEMPORARY PROBLEMS AND HISTORIC PRECEDENTS

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## Abstract

*The historic squares of the medieval towns of Kathmandu Valley are the examples of successful urban open spaces that have excelled in physical design and succeeded in making a built environment that highly encourages the public life. In contrary to the historic examples, the contemporary trend of open space design in valley is found unsatisfactory as the built environment is not conducive to creating a better public realm. In this context, this paper examines public open space from both historical and contemporary urban settings, and concludes by stating that the contemporary problems with open space can be better solved with the knowledge of historic precedents.*

## Background

Kathmandu Valley is a major cultural, economic and political center of the Kingdom of Nepal both in past and at present which developed remarkably since last 2000 years. The valley in its long history of human settlement has witnessed many dynasties as its rulers. Among many political periods, the most notable one is the Malla<sup>1</sup> reign in which the outstanding built environment was created that can still be traced in the historic cores of Kathmandu Valley towns in their buildings, streets and open spaces.

The history of city design and planning reveals that the quality in open space design was achieved in past in the form of great city squares both in eastern and western parts of the globe. But in contrast, modern cities confronted wide disapproval for having lost the traditional spatial qualities in the creation of ill-defined urban spaces, and modern planners and designers were blamed for lack of concern towards the historic precedents. This is very much true with Kathmandu Valley too, if we closely examine its contemporary urban fabric.

The urban open space design in contemporary urban development of Kathmandu Valley demonstrates numerous problems starting from lack of open spaces itself to their poor design, improper or lack of use and lack of maintenance. In contrast, interesting enough are the urban squares of historic cores where the public open space was given due consideration in city design.

At present, it is observed that the greater Kathmandu or Kathmandu Valley exhibits two distinct scenarios of open space system (Sharma, 2006). On one hand, there is a successful case from past in the historic cores where there are numerous open spaces found in the form of Durbar Squares (Palace squares), market squares, Chowks (courtyards) and Bahals and Bahils (Buddhist monasteries). On the other hand, incompetent open spaces developed in the last few decades are also observed in the newer areas of the valley. In this context, historic precedents are to be explored for the fact that the traditional urban spaces still serve as the best models for contemporary open space design.

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<sup>1</sup> After Lichchhavi rulers, the Malla kings ruled the Kathmandu Valley towns for almost 600 years from 13th to 18th century AD. This political period is also referred to as the medieval period of Nepal.



## Urban open space and city square

Public open space is an integral part of urban life. The open space covers a significant amount of urban fabric and this is where most of the human interactions take place. Open spaces are places in a city where people can meet, interact, sit, rest, stroll or even be there for no purpose. More than breathing spaces, these are living rooms of a city for they are the centers of urban activity.

It is an activity and proper use of space that make any urban open space lively and vibrant, also giving it a distinctive character. In general, the open spaces in their role of supporting human activity serve as:

- Spaces of assembly •
- Space of transaction/trade
- Movement space
- Place of leisure / recreation

One of the most important elements of city design is the square or plaza (Moughtin, 1999). Krier (1979) explains that in all probability the square was the first way man discovered of using urban space. French (1983) suggests that it is the purpose of space that distinguishes the squares from other forms of open spaces. He further elaborates it by contrasting the squares with the city parks, and explains that the square is a centralized concept and a nucleus of urban activity where as the park evolved from opposite need - respite for traffic, commerce and crowds.

## Problems with contemporary urban open space in Kathmandu Valley

It is observed that all Nepalese new towns or "town expansions" of recent origin have evolved "unplanned" and the Kathmandu Valley towns are no exceptions. The newer urban areas of Nepalese towns never benefited from the modern rational planning approach (Adhikari, 1998). The contemporary physical growth of urban Kathmandu is an urban sprawl and exhibits the following problems with open space design.

### *i. Haphazard urban growth*

Unlike the traditional approach of city building in the medieval period based on socio-cultural settings and religious patterns, the contemporary physical growth of urban areas in Kathmandu Valley is taking place with no vision. There are only few planned neighborhoods and residential quarters. Obviously, this leads to the lack of concern towards better open space formation for public purpose. On the other hand, the planned urban areas are also found unsatisfactory in open space design.

### *ii. Urban sprawl and loss of continuity with historic urban fabric*

The urban developments efforts made during post *Malla* period including *Rana*<sup>2</sup> developments clearly overruled the traditional dogma of *Malla* town planning, and in contrary with the compact settlements of the past, the sprawl started with no concern towards the historic urban fabric. This is one of the causes of having no concern toward open space formation in newer urban areas.

<sup>2</sup>Rana Prime Ministers ruled Nepal for the period of 104 years until 1951 AD and contrilonted in rubar development.



### iii. Lack of open space

There have also been cases in neighborhood formations where there are no designated open spaces in any form except for the street space. In newer urban areas of Kathmandu Valley, the substandard amount of open spaces is inadequate as it is observed that even the planned neighborhood areas have open space provision of less than 5% of total developed land<sup>3</sup>.

### iv. Lack of sense of enclosure in open space

Unlike historic open spaces, the few available open spaces in newer urban areas lack proper enclosure to define a "space". This is evident in multiple factors such as the layout of surrounding buildings lacking continuous façade formation, different set back provisions, the scale and proportion of space and the surrounding buildings, and varying building height profiles (Shrestha, 2005).

### v. Disappearance of urban elements in open space

Almost all the newly formed urban open spaces of the valley demonstrate lack of urban elements such as temples and others in them to make the spatial setting functionally efficient as well as visually exciting. Even if the elements are present, the presence is not conducive to better open space design. The futile attempt to provide some greenery in the form of landscaping seems insufficient.

### vi. Loss of identity

The newer urban fabric being a result of haphazard growth no longer demonstrates any identity. We seem to ignore the fact that open spaces are one of the most character defining features of the traditional Kathmandu Valley towns. There is a lack of visual coherence or character in contemporary urban settings because of no proper open space opportunities.



Fig.1.: Newly developed urban areas of Kathmandu Valley in New Baneshwor and Dally areas

Source: Author

### vii. Changing social values and life styles

The social fabric has changed drastically since medieval period due to the many reasons

<sup>3</sup>The historic city areas in their compact settlements have more than 10% of land dedicated for the open space.



including the economic and technological developments as well as the western influence. This has brought changes in people's lives and has also made impact upon the way people perceive and use open spaces. The participation in public open spaces is decreasing day by day with the change or transformation in socio-cultural patterns.

### Historic urban squares of Kathmandu Valley

Kathmandu Valley flourished highly during the *Malla* rule. As the patronage of *Malla* rulers and the artistic genius of "*Newar*"<sup>4</sup> artisans combined to create a unique feature of medieval Nepal, with no doubt, it was the period of advancement in all forms of art including architecture and town planning. It is during the *Malla* reign that the Kathmandu Valley was divided into three kingdoms namely Kathmandu, Patan and Bhaktapur by King *Yaksha Malla* in late 15th century. The subdivision of valley into three kingdoms encouraged the arts to flourish through keen competition with each other as is reflected in the development of royal palaces and squares, major shrines and temples and other public squares (Pruscha, 1975). The Royal Palace and the surrounding urban spaces (Durbar Square) and other major urban squares within the Kathmandu Valley towns all date from the following three centuries.

In the three major cities of Kathmandu Valley, we can observe a set of urban squares which includes a Durbar Square and other market and residential squares. Durbar Square holds the central place while other market and semi-public and private residential squares have been laid out in different residential quarters. In these varying natures of urban squares, the hierarchy is primarily based on socio-cultural activity yet has got underlying differences in the physical aspects such as the shape and size of square, presence of urban elements, the degree of enclosure, etc.

The urban squares are found widely distributed in a city in close relation to the locations of residential quarters. The *Newar* principle of open space system is always guided by its distribution throughout the urban fabric. The idea of conception of squares in relation to the streets makes them accessible with the spatial linkages made fluent and convenient.

In Kathmandu Valley towns, Durbar Squares are located almost in the heart of the town, and is the center of urban activity. These squares hold a significant position in a city as they have been positioned at the intersections of main streets thus providing a true setting for its location. The presence of variety of urban elements in these spaces contributes to making a square functional as well as visually pleasing.

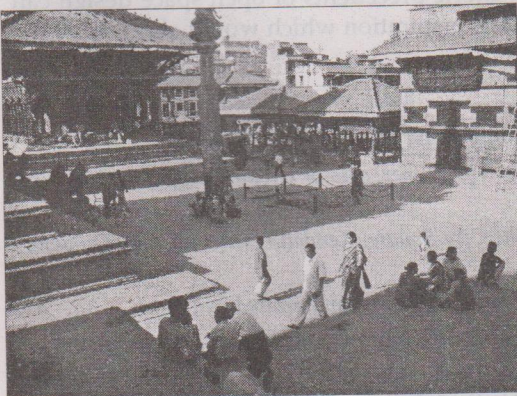


Fig.2: Historic urban open space at Patan  
Durbar Square  
Source: Author

The residential quarters immediately next to the Durbar Square create settings for other categories of urban squares. The market squares are formed at nodal points and always marked by the intersection of streets. These are remarkable for their heightened urban space senses and consist of many elements of urban interests<sup>5</sup>.

The residential neighborhood squares are fairly large sized enclosed spaces and physically separated from the major streets. These squares tend to be comparatively private domains which serve the various domestic purposes and the social activities take precedence over economic activities.

<sup>4</sup>Newars are the original inhabitants of the Kathmandu Valley who are solely responsible for its outstanding growth.

<sup>5</sup>Some of the markets squares are found exceptionally outstanding than the Durbar Squares as in the case with Taumadhi and Dattatraya squares in Bhaktapur town.



The urban squares of Kathmandu Valley towns have never been empty spaces instead they can be viewed as an agglomeration of different elements or forms. And hence, it is not unusual to find the presence of several urban elements such as temples, Buddhist *chaityas* (shrine), *patis* (public rest houses), *dabalis* (open platforms), vertical linear elements, stone water spouts and chariots (temporary elements) assembled in them. In shaping of these squares the major roles of the urban elements in square design are as space defining elements, functional elements, cultural and religious objects and objects of visual significance defining "a sense of place".

In its urban squares, the valley exhibits an array of spaces of socio-cultural importance. Apart from being a physical process, the city building thus becomes a socio-cultural as well as religious phenomenon which is well testified in the responsiveness of city squares that have been shaped according to the needs of the society. The urban spaces respond to occasional but ever occurring series of festivals and ceremonies while at the same time, they create setting for a continuous daily life.

### Conclusion

The urban squares of the medieval towns of Kathmandu Valley are the excellent examples of successful urban design which are indeed the outcome of wise and creative process of city building. Primarily responding to the socio-cultural activity, the historic cities have maintained a wonderful hierarchy of urban open spaces. The physical layout of urban squares in their shape, size and enclosure are found highly responsive in making of a perfect urban space. The historic urban squares should be appreciated and acknowledged for having attributed with several urban design qualities and above all, for timeless quality for their effectiveness and usefulness even at present.

To solve the problems with contemporary urban open space in Kathmandu Valley, there should be controlled urban growth with due consideration of public amenities including the open space. For the newer areas of the valley, quality open space design should be one of the prime concerns in urban design and development process as was the case with the historical developments. There should be guidelines for physical design of the city which would ensure the formation of quality public open space. The historic precedents of open space design can be and should be the source of knowledge as well as inspiration which would also ensure the continuity with the past urban features.

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# WEB MINING

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## Abstract

Large amount of information is available in the web, WWW or the World Wide Web. Web is very fertile in the area of data mining. Web mining is at the junction of many other fields like database, artificial intelligence, knowledge management, etc. In this paper we are showing one of our product and its comparison with categories in web mining. The product has been developed to extract information from the World Wide Web. It includes different sections for different purposes. Extraction of the web page contents such as tags, text, hyperlinks, scripts, and images links are in content mining portion. Analysis of structural view of the web page and comparison between two pages is done in structure mining section. The system also includes recent technologies such as multimedia mining (for images and audio) and product manipulation using web service for the shopping cart system. It helps individuals and organizations who want to customize their information or product to their intended customers. This system helps people, organization and other applications around the world to interact with one another through web service.

**Keywords:** B2B (Business to Business), B2C (Business to Customer), Knowledge Management, Multimedia Mining, Web Services, etc.

## I. INTRODUCTION:

Web mining is the term of applying data mining techniques to automatically discover and extract useful information from the World Wide Web documents and services. Evaluate the Web Mining techniques for efficient Business Application and Implementation.

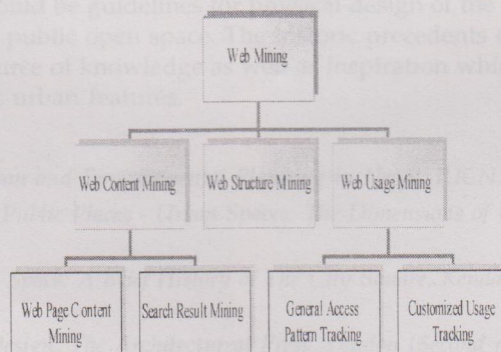


Fig 1: Web Mining Taxonomy

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Table 1: Web Mining Classification

| Web Content Mining                                                                                                                                             | Web Structure Mining                                                                                              | Web Usage Mining                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Webpage mining, extracting information from the contents existing in web pages. In this case the data in use can be text, HTML pages, Multimedia elements etc. | Discovering useful knowledge from the structure of hyperlinks (in-links and out-links).<br><br>Ranking web pages. | General access pattern tracking (General Access logs)<br><br>Customized access pattern tracking (Usage Profile)<br><br>Discovering user access patterns from Web usage logs<br><br>E.g. Web server access logs, proxy server logs, browser logs, user profiles, registration data, user sessions or transactions, cookies. |

Table 2: Web Mining Category View

## Web mining

|                               | Web Content Mining                                                                                          |                                                                 | Web Structure                                    | WebUsage                                                         |
|-------------------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|--------------------------------------------------|------------------------------------------------------------------|
|                               | IR View                                                                                                     | DB View                                                         | Mining                                           | Mining                                                           |
| <b>View of Data</b>           | -Unstructured-Semi Structured                                                                               | -Semi Structured<br>-Web site as DB                             | -Links structure                                 | -interactivity                                                   |
| <b>Main Data</b>              | -Text documents<br>-Hypertext documents                                                                     | -Hypertext documents                                            | -Links structure                                 | -Server logs<br>Browser logs                                     |
| <b>Representation</b>         | -Bag of words,<br>-Terms, phrases<br>-Concepts<br>-Relational                                               | -Edge-labeled graph<br>-Relational                              | -Graph                                           | -Relational Table<br>-Graph                                      |
| <b>Method</b>                 | -Machine learning<br>-Statistical<br>(including NLP)                                                        | -Proprietary algorithms(modified)<br>association rules          | -Proprietary algorithms                          | -Machine learning<br>-Statistical(modified)<br>association rules |
| <b>Application Categories</b> | -Categorization<br>-Clustering<br>-Finding extraction rulest<br>-Finding patterns in text<br>-User modeling | -Finding frequent sub- structures<br>-Web site schema discovery | -Categorization<br>-Clustering<br>-User modeling | -Site construction, adaptation, and management<br>-Marketing     |

(Kosala and Blockeel) [12]



### A. Web Mining Importance:

Data mining has been applied traditionally to databases (i.e. the structured data). Information on the Web is unstructured or semi-structured. To deal with these types of data web mining plays a great role.

### B. Challenges of Web Mining:

Huge amount of information but easy to access.

Coverage of information is very wide and diverse. It is the first source of information seeking in all kinds of topics for almost everyone (e.g. weather, news, products, vocabulary, etc.)

Includes all types of information like structured tables, text, image, audio, etc., Semi-structured with HTML code, Hyperlinks among pages within a Web site and across sites are available, information is redundant.

## II. OBJECTIVES OF THE STUDY

Objectives of the study are following:

- a. Evaluate the Web Mining techniques for individual as well as efficient Business Application purpose.
- b. Extracting structured, unstructured and semi-structured including multi-types of data from the web (e.g. texts, tags, scripts, images, audio etc. also includes online image search i.e. image search engine).
- c. The improvement of site design by knowing the structure of the web page, and comparison between the web pages.
- d. Using web services for the improvement of marketing is business and improving the interoperability between the organizations (B2B and B2C applications).
- e. Mining the multi-types of data.
- f. Improving knowledge of web services for websites in Nepal.

## III. WHAT ARE THE STEPS PERFORMED?

In this paper we have shown the implementation of content mining and structure mining. In content mining extraction is done for texts, scripts, tags, images, hyperlinks and audios, and other multi-type (multimedia mining) of data. In structure mining, structural view of the web page is generated in tree form; comparisons between two or more web pages are done. Web services which are very important today is also implemented in this system. It is more important in case of distributed systems where different applications have to share tasks since it is not component based and platform independent, language independent and has much more benefits over component systems which are platform dependent. Client and server applications must agree upon the platform, and language dependency, which are overcome by web service technology. We have used others web service (like link to amazon.com) and our own web service too as a shopping cart system. Some of the warehousing technique i.e. storing of extracted data (texts, images etc.) is also implemented for the future reference in this system.

Some Of the Screenshots from this System Are Given Below:



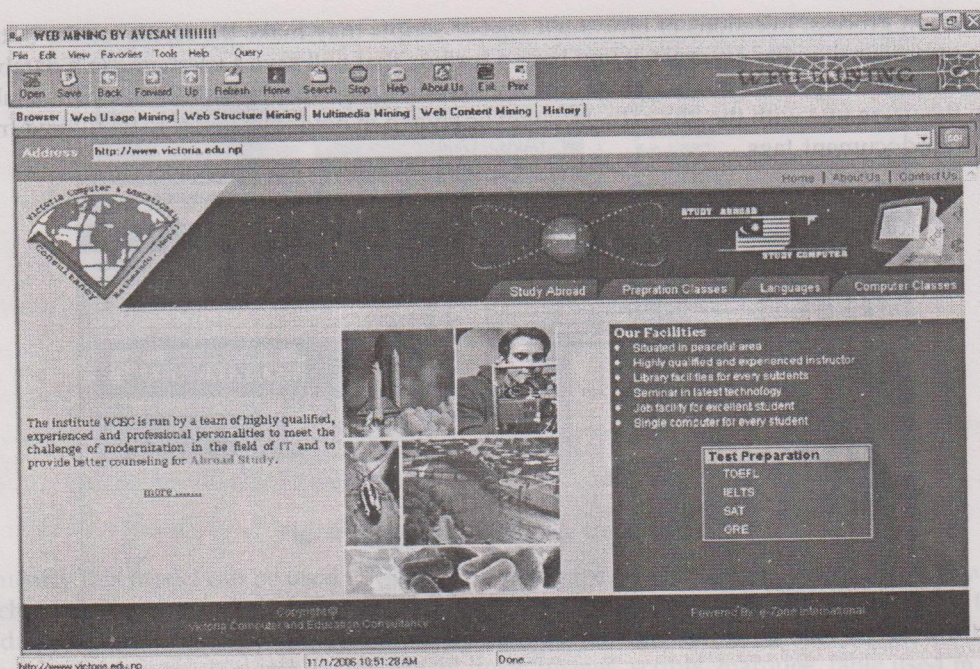


Fig. 2: Creation of a Web Browser

It is the first portion of our mining tool which is shown in Figure 2 above. It consists of 'address bar' which is used to navigate the URL address. When the 'GO' button is fired it navigates to the given URL. Then the web page is displayed in the browser.

Here when user put the URL address and is fired then it navigates to the URL address through the http request to the web server. So we use function called as Navigate (URL).

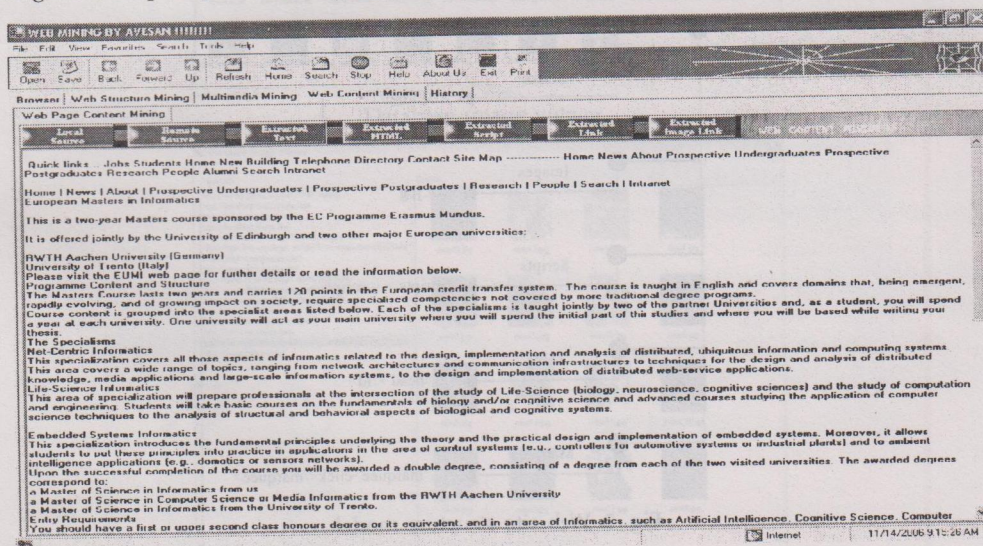


Fig. 3: Extracting Text using the browser



Extraction Process: Injections of unwanted tags or scripts may make the results or the output data unpredictable. For example, if you have a textbox that will save a username in a database and the user entered is **<b>HisName</b>**, and another page displays all the users in a table, then the username with the **<b></b>** tags will be shown in bold. The text is to be filtered from the web document tags.

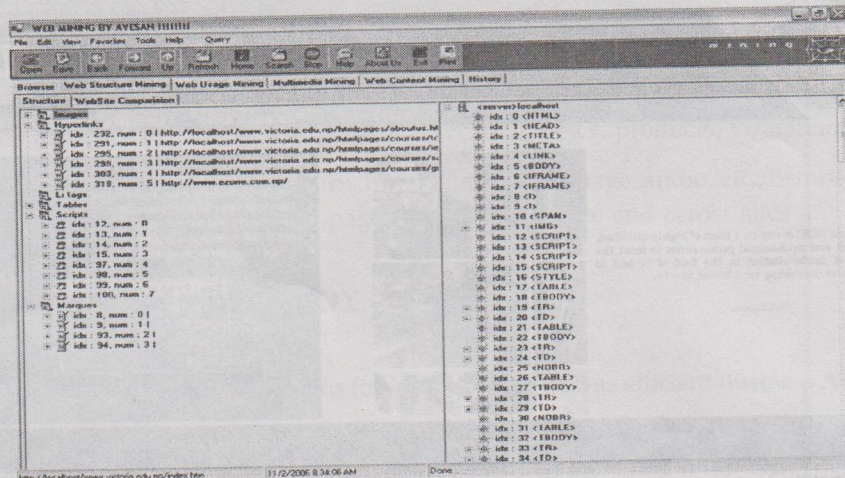


Fig. 4: Finding the Web Page Structure

In this study we have generated the entire structure model underlying the link structure of the web. It is used to study the topology of the hyperlinks with or without the description of the links. In a web page we have different types of elements i.e. single document consists of links, images, multimedia and other required contents, these all contents makes structure of the web. We show all the structure of the web in the tree structure model as shown in Figure 4.

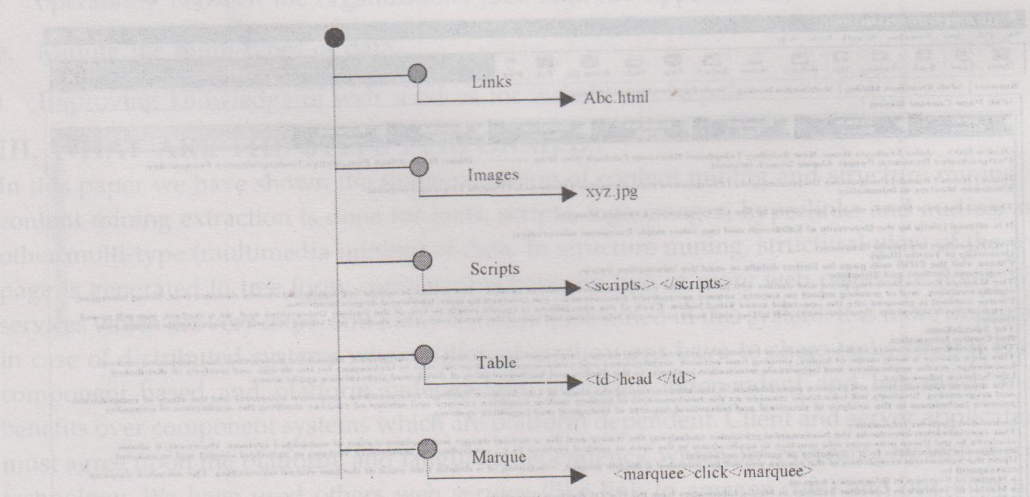


Fig. 5: Web site structure model

Here we have extracted all the structure in the tree node style as shown in Figure 4 above when clicked on the web structure tab.



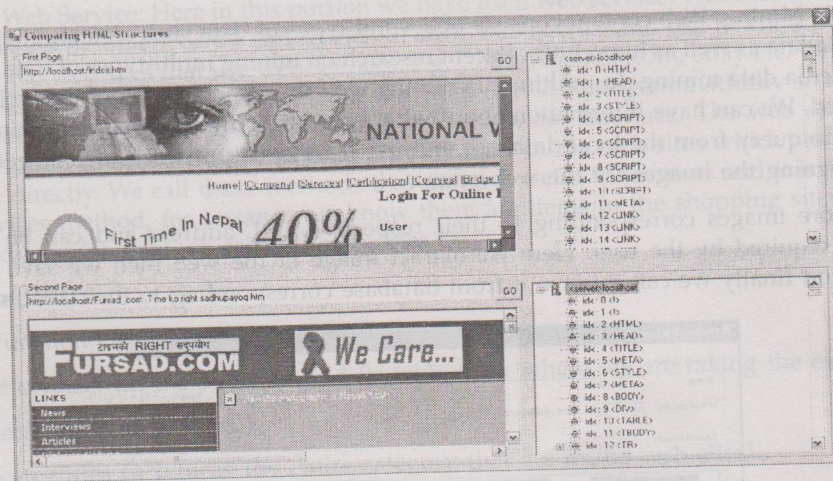


Fig. 6: Performing Web Page Comparisons

Similarly this model can be used to categorize web pages and is used to generate information such as similarities and relationship between different web sites. Here we can enter the URL address which is navigated and we can see the structure of the web site. Again we have navigated two web sites and we can see all links, images, scripts, marquee, table used in that particular website which can be then compared easily. This is shown in Figure 6.

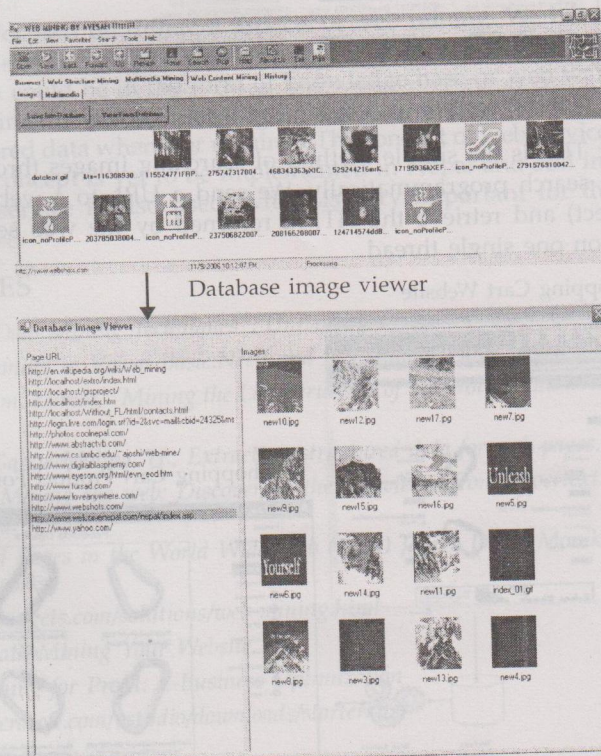


Fig. 7: Image Parser with Database Image Viewer



Multimedia Mining: Web content consists of several types of data such as text, image, audio, video, metadata as well as hyperlinks. Recent research on mining multi-types of data is termed as multimedia data mining. In multimedia mining we can extract images of the web sites we have visited. We can have information about what type of the images we are seeking for. We even can do query from the local database and use it for own purposes such as getting idea about designing the images for the web pages.

We can store images corresponding to their respective URL address and can be accessed whenever required by the user. Here we extract image of the web then we save it in our database and finally we can retrieve it from database corresponding to their URL's address.

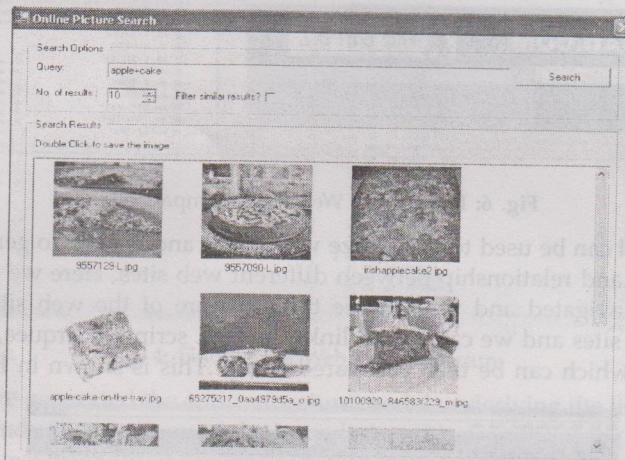
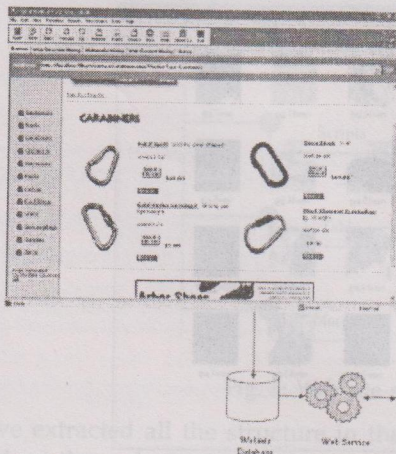


Fig. 8: Online Image Search

Online Image Search: This is the simple method of searching images through the web. It is used to query image search programmatically. We send a URL to a web server (using the `HttpWebRequest` object) and retrieve the HTML returned by the web server. It fetches all images (thumbnails) on one single thread.

#### Shopping Cart Website



#### Shopping Cart Product Form

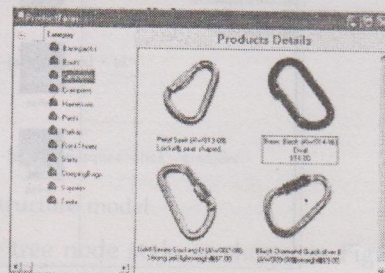


Fig. 9: Web Service Used In Shopping Cart System



Building Web Service: Here in this portion we have used web service. Web service can be used that is created by others or we can create our own web service and use it. There are different international web sites that use web services, e.g. CNN, Amazon.com, eBay etc. We have used the web services of the Amazon.com and shown in our GUI programmatically so that we can do different operation given by Amazon but through our interface. The web services once created is used to access those functions that are used in the web sites which are kept in the database directly. We call those methods that may be useful to the user and it is through the web services method, for instance we know there are items in the shopping sites according to their categories now we can call categories by

```
<WebMethod()>
```

```
Public Function GetCategories() As String()
```

Here we connect to the database and its table from where we are taking the elements.

```
categories() = ("ProductType")
```

Return categories (it returns the entire category that are in the web sites).

Similarly we can access all the products that belong to the category too by web services method.

```
<WebMethod()>
```

```
Public Function GetProducts(ByVal catName As String) As IBuyLibrary.Product()
```

Returns all the products of that category.

#### IV. CONCLUSIONS

In this paper we focused on different aspects of web mining. We have suggested categories in web mining. One of the categories i.e. web content mining is the recent interest in information integration, which could be in the form of knowledge base or web warehouse. We have also explored for multimedia mining and tried to make a multimedia data warehouse so that we can mine the required data whenever required. The concept of web services is also implemented. The web mining concept is yet to be implemented in Nepal and still in research based in the world. The web service is also used, which is very important for the business as well as individual purpose.

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