STRATEGIC TRAFFIC CRASH AVOIDANCE TRANSLATING SCATTER PLOTTING EVALUATION MODEL

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Abstract

Amongst various health and risk associated issues, Road safety is also now treated as a Public health problem as per the recommendations of the World Health Organization (WHO). This is so particularly due to a significant increase in the number of traffic injuries. Pakistan is adversely affected by the problem of fatalities. It is the common practice that issues of crash prevention is not given consideration in the context of strategic planning. The safety issues are only dependent on imbalanced Police data governing general cause over speeding which is surely not at all. The research focuses on the operational model for mega city Karachi. The idea is designed to emphasize the trends including severity in road crashes, victims, and major arterials. The idea integrates a connection between Engineering and Management with the help of an exemplary system and provision of suitable infrastructure. Different year’s data record is manipulated only to hit way forward actions that can be chosen for prevention. On the contrary, mathematical justification is provided to correlate the Trauma surveillance model as a guideline in recommendations. The overall balance of research is maintained on the basis of ground realities and data modeling.

Keywords : Road Safety, Traffic, Pakistan, Management, Accidents
I. Introduction to Crash Prevention & Avoidance

Traffic accident is somehow nowadays treated as severe safety issue leading towards major health problem at all. This is why because the injuries and fatalities that occur during road accidents correspond to major issues [VI]. The crash or accident happens at once but the dependents of the victims adversely affected with the same throughout life [II]. Prevention rather than remedy is more important and should be highlighted phenomenon in road traffic accidents. Unfortunately, the matter of road safety is not given much consideration in between the other issues of traffic and transportation management but symbolically the system of road safety is the key parameter of every agenda of transportation or infrastructure management [XVI]. It could be pavement design, geometric design, traffic engineering and management, level of service, calculation of flow parameters; in fact, every single concept of traffic is indirectly dependent on the issue of road safety [VII].

The problem of the increase in the number of traffic crashes cannot be sorted out only by overlooking the police reports, mentioning the two straight causes like over speeding and overtaking [XII]. It should give importance in a similar fashion as any surveillance system. Collection of judicial data as record keeping is not only the ultimate way; it requires a lot more than that. It requires certain applications of management tools with effective coordination between the government sector, police department and hospital or specific institution in which a victim is registered as the patient [XVII]. The story is not ended over here, in the long run; data modeling with the implication of analytical tools may be used for nominal outputs. Crash prevention is only possible if the graph of accidents of road users is proportionally decreased and this could be done by drawing impact studies of specific black spots [XIII]

II. Scope & Objectives of Research

The study is developed and transformed under the umbrella of following scope and objectives:

1. Identification and development of the conceptual framework for road safety and crash avoidance.
2. Operational characteristics of road safety management featuring safety audits and accident investigations.
3. Situational features of traffic crashes and non-compliance of road accidents in metropolitan city Karachi, Pakistan.
4. Complete data analysis of traffic accidents with improved and advanced mathematical justifications using analytical tools and techniques.
5. Understanding and findings of the Injury surveillance model for crash prevention established with discussed parameters in Karachi, Pakistan.
6. Understanding of crash prevention with the data collection obtained with strategic and stringent planning in major trauma centers of city,

7. Focusing on improved and operational models in place of existing ones.

III. Record Maintenance of Traffic Crashes – International Perspective

In the overall world of traffic, a deterministic approach is being utilized to accident analysis covering a wide range of procedures and at different levels of investigations. It is impossible to collect all information related to road users, road environment and vehicles for all times [XIX, XX]. At the initial run, as the diagnosis of analysis increases, the greater depth of detail demanded for each in any study is offset by a decrease in numbers. One of the most important parameter is the investigation of the type of accident, area, time and similar circumstances. Another stage shall be the examination by controlling or judicial bodies after confirming relevant stakeholders because they are responsible for improvement maneuvers [XIV].

As per the studies, the following necessary measures are functional for data findings of road safety matters in developing countries [XV].

a. Major findings of shortcomings of police requirements and available data.

b. Accuracy and reliability of recorded information.

c. Procedures for the implementation of the recommended system on the basis of existing conditions.

d. Transformation of Police data in standard format.

e. Data feeding and implications for analytical norms.

f. Recommendations and remedial measures.

Despite the fact, the practice for controlling road accidents is below the standard level in Karachi city. The police collected data is not in a position to take as a guideline for follow-ups however there are some non-government level organizations that have taken the initiative for this public issue. Apart from that, it is also important to own some responsibility by each user of this group which includes civic sense on top. If a country is interested to work for the betterment of infrastructure and development it is necessary to adopt and accept the real picture by its living ones. Road safety is the responsibility of the overall nation and it starts from an individual. Unfortunately, this city is lacking behind all these factors and similarly sacrificing in day by day increase of road crashes of different areas as discussed in the later part of the paper.
IV. Integration in Road Safety Management

Improvements in the problems of traffic crashes are important in the context of road safety. There may be several causes of an incident or accident but the system lacks proper management actions [XI]. This complaint is to be received from most of the organizations in the response to an accident. Integration in road safety management corresponds to be a balance between three E’s of transportation including Education, Engineering and Enforcement. If a system fails to produce balance in these three E’s then big problems will arise. Management works are substantially transformed with improved coordination between the stake holders of each project [V].

For a road safety project, the management action is dependent on the injury surveillance data base system while the system will ensure the daily updating of data by designated coordinators [IX]. In later sections of the paper, similar improved and operational models for a metropolitan city is also discussed. The discussion is presented keeping in view the gravity of the issue of road safety management and identified loop holes that must be filled out by analytical and modeling perspectives.

V. Direct factors of Traffic accidents data

For having the corrected measures in the context of road safety, designed criteria must regulate as a whole and might not be changed or altered in the long run as well. Extensive studies show the basic classification of injuries; namely minor, serious (major) and fatal injuries. By definition, serious and fatal injuries play a vital role in the improvement of any arterial of a city. Crash reporting standard criteria designates the combination of various identities in a single crash like the number of injuries and fatalities on a specific road w.r.t several spots, road users involved in identified spots, vehicles involved, involvement of pedestrians and passenger crashes, number of reported accidents in major arterials, comparison of different years of accident data record, percentage of different contributory factors of accidents etc. The noise in the data also demonstrates the set black spots and black roads of the city. By looking at the collected data in several ways, the generalized or specified recommendations may be drawn for future interventions.

One of the most important parts in crash reporting is the set-out aims and objectives of the road safety project. The buffer zone of collected data covering the number of arterials and type of hospital records should be identified in the preliminary phases of the project. This will ensure the credibility of the entire work [III].

VI. Road Safety Audits and Investigation Procedures

Audits and investigation techniques are very useful for road safety management processes. Implementation of audits and investigations must be applied in a standard formalized manner. Road safety audits are meant as a preventive measure and may be...
useful for construction work zones, applications during planning, design and construction phases, etc [I], while accident investigation is done for a particular incident in order to avoid future accidents. In both, investigations and audits, proposed engineering interventions and remedies are identified. The investigation is being carried out by a detailed designed formal questionnaire covering severity measures while it may vary from country to country as per the need and requirement.

In order to make a preference for black spots, severity indices may be calculated for different arterials. The audits and investigations are helpful in proposing effective calming measures, traffic control devices and features related to geometry and road furniture. Even in several cases, accidents causing friction effect is controlled with strategic safe pavement design procedures [VIII].

VII. Road Traffic Accidents in Karachi, Pakistan

Karachi is, in fact, a metropolitan and big city in terms of population and vehicle ownership. Karachi is covered with a number of arteries, collectors and local roads which need a lot of concentration in terms of traffic management issues. The importance of road safety agenda is enhanced in Karachi city when looking around the nature of the single road network. Each arterial has its own characteristics in terms of road user, route mapping and vehicle involvement.

There are numbers of roads and arterials in Karachi on which the severity index of road crashes is too high. The reported accidents are fatal and serious by nature. The black spots of Karachi involved Shahrah-e-Usman Ramz, Shahrah-e-Faisal, MA Jinnah road, National Highway, Chaudary Fazal Elahi road, etc. The identified vulnerable road user groups in most of the dictated studies are Pedestrians and Passengers. The idea will be more emphasized with an analytical study presented in the respective paper. The main contributory causes associated with the crashes of this city include improper traffic management, absence of traffic control devices, illegal cuts, wrong-way movements, violation of law and rules, dilapidated roads, weak enforcement actions taken by concerned authorities, etc [XVIII]. For the sake of reason, this metropolitan city is taken as an example for this research study. The nature of accidents is illustrated in pictorial views below.
VIII. Traffic Injury Data Surveillance System in Karachi City – Role Model

Due to the increase in the number of road traffic accidents and less signified police reports, the concerned stakeholders had joined hands in order to inaugurate a data injury surveillance system for the benefit, safety and prosperity of mankind. The centre Road Traffic Injury Research and Prevention Centre (RTIR & PC) was being developed with the coordination of Public and Private sectors including the Ministry of Health, Education sector, Medico-legal departments and Enforcing agencies as well. The focused objectives of the centre were [IV]:

1) Collection of accident data from major trauma centers of Karachi
2) Proper organization of data or organization of data base management
3) Detailed analytical studies from the collected data ensuring the type of roads, severity rate, vehicle involvement, severity in terms of road users and black spots. The data is to be analyzed using modern tools and techniques or software applications.
4) Comparative analysis of different months/ years data record with continuous collection of data and recorded interventions on respective roads
5) In addition to that, road safety audits and accident investigations on certain roads and major accidents respectively
6) Preparation of impact studies with the help of collected data
7) Formulation of justifications, proposals, reports and coordinated meetings for important stakeholders of the group
The entire data is to be collected from FIVE major hospitals of Karachi including Jinnah Post Graduate Medical Center (JPMC), Civil Hospital (CHK), Abbasi Shaheed Hospital (ASH), Liaqat National Hospital (LNH) and Agha Hospital (AKU). The department is synchronized in the following subdivisions:

1) Interviewing department
2) Data Punching department
3) Data operators and analytical department
4) Engineering department
5) Stakeholder’s group

The members are deputed in emergency centers of identified hospitals for the interview from the victims arrived or either from the attendants. The data is to be collected in a prescribed format designed on standard guidelines or by the coordination of panels involving Experts, Engineers and supporting staff. The collected data is then now reached in the hands of the data punching department which is refined from all errors and mistakes and presented on soft form rather than collected hard forms for further processing. The data operators and analysts perform a vital role for valuable outputs. At this point, the transformation of data is done in various ways; the practice is to be done for observing a single traffic crash from different angles which may be helpful in future safety actions. The recommended measures on the basis of observations and analysis are produced by the engineering department. The association of engineers is responsible for any proposed safety work ensuring standard operating procedures and guidelines. The implemented safety measures are proposed on the basis of analysis, practical exposure, availability of resources and material, the involvement of agencies, field experience and knowledge and interest of concern stake holder. Audits, investigations and impact studies are also carried out by the Engineering department.

IX. Analytical Facts & Figures – RTIR & PC

RTIR & PC has a variety of data or analytical works in order to present accordingly. Some analytical studies related to important aspects are discussed below with descriptions [IV]. As discussed earlier that data sets are categorized into Minor, Serious and Fatal injuries. The table below represents the severity rate of victims for tenure from Jan 2009 to Dec 2010. It is clearly shown in the table that approximately 25% of data is related to serious and fatal injuries require much attention for stakeholders.
Table 1: Severity rate of Traffic Accidents

|       |          |
|-------|----------|
| Minor | 48314 (76%) |
| Serious | 12821 (20%) |
| Fatal  | 2409 (4%)  |

Another study is related to identify the black spots and black roads of Karachi city ensuring the classification of road users in particular crashes.

Table 2: Road user severity on major Corridors

| Roads                     | Rider/Pillion Rider | Pedestrians | Passengers | Drivers |
|---------------------------|---------------------|-------------|------------|---------|
| MA Jinnah Road            | 1032                | 418         | 140        | 58      |
| Shahrah-e-Faisal          | 1005                | 407         | 129        | 50      |
| Korangi Road              | 775                 | 313         | 95         | 28      |
| Shahrah-e-Shah Suri       | 471                 | 154         | 43         | 16      |
| National Highway          | 363                 | 198         | 178        | 26      |
| NawabSadiq Ali Khan Road  | 555                 | 117         | 57         | 21      |
| ChFazal Ellahi Road       | 444                 | 214         | 48         | 19      |
| Main Korangi Road         | 262                 | 88          | 50         | 12      |
| Nishter Road              | 378                 | 130         | 28         | 9       |
| Site Avenue               | 268                 | 97          | 62         | 15      |
| Mauripur Road             | 229                 | 216         | 49         | 15      |
| University Road           | 306                 | 233         | 44         | 22      |

As per the above data of the year 2009 related to the involvement of road users on major corridors, MA Jinnah road is highly affected by the injuries of each class of road users. MA Jinnah road is one of the busiest and mobilized arterials of the city including the number of spots. Several safety measures were taken after the complete formulation and presentation by centre to respective stake holder group on this road. These include enforcement actions, proper traffic planning works, installation of road...
furniture and calming devices, etc. Afterward impact studies are also produced to create balance.

While considering the multiple-year analysis of traffic crashes for 2011 and 2012 below, it can be stated that vulnerable road user groups are Rider, Pillion riders and Pedestrians by all means of injury type. Most of the time safety measures are identified and highlighted by RTIR & PC keeping in the consideration of injuries of this road user group. Unfortunately, the transportation system lacks behind the working of the design road user group as per standard likewise the design controls and criteria and cross-sectional elements.

Table 3: Injuries and Fatalities of road user group

| Road users       | Minor | %age | Serious | %age | Fatal | %age |
|------------------|-------|------|---------|------|-------|------|
| Rider/Pillion rider | 29682 | 63%  | 6051    | 52%  | 853   | 37%  |
| Drivers          | 1322  | 3%   | 412     | 4%   | 94    | 4%   |
| Passengers       | 5623  | 12%  | 1527    | 13%  | 349   | 15%  |
| Pedestrians      | 10352 | 22%  | 3466    | 30%  | 971   | 42%  |
| Others           | 131   | 0%   | 105     | 1%   | 33    | 1%   |
| Total            | 47110 | 100% | 11561   | 100% | 2300  | 100% |

Data validation with Scatter Plotting

The above-discussed data is now presented for data validation using a scatter plot method. Basically, the data is represented in two ways, at the initial stage; it is analyzed in detail with the combination of different parameter groups while advanced data modeling is done as below.

Figure 2: Data validation on Injury Severity (Derived from Table1)
The above plotting is carried out with the earlier graphical representation of injury severity as minor, serious and fatal. This is quite evident from the above figure that a signified variation is obtained showing substantial difference only in minor and severe injuries. Mathematically this distance may become closer by intervening short term measures on specific locations. Normally these two injuries are not related to big infrastructure collapse or major fault of the road environment.

The above trend line is developed in an exponential format. The slope equations, standard deviation and variance are achieved for vulnerable road user groups that are Riders and Pedestrians. The negative R-value is clearly showing the diversified requirements of these road users. The difference between the two R values is nearly 0.08 which is negligible, transforming the idea that equivalent measures may be adopted for Riders and Pedestrians. Moreover, the passenger domain may also be facilitated with this.

This idea is more explained with the development of a scatter plot in between the severity of road user groups and major corridors. This is being generated with table 2 of the analytical part showing again the same pattern with minor modifications or a difference of 0.12 R-value.
X. Proposed and Improved Model

The discussed and functional model of RTIR & PC is performing effectively for the benefit of road users and mankind but there is always a room of chance in every project. In the conclusion part of this research, another improved and proposed model is presented and briefly explained below.

Following operational model components should be kept in mind while formulating a channelized solution in road safety project [19, 20].

1) Sustainable Funding source/ Generation: The funding agencies should be clearly identified with the scope and objectives of the project ensuring their sustainability.

2) Strong institutional framework: Leadership should not be promoted. The framework will be designed with less dependency.

3) Skilled staff: Range of expertise should be present in order to cover all project heads.

4) Positive relationship: Improved and strong coordination should be maintained among the stakeholders of project and market partners related to road safety.

5) Qualitative and Quantitative work: Aspects of road safety should be covered in all terms including indigenous research, data collection and analysis.

6) Media coverage: Media group should be introduced and promoted in identifying various types of crashes and intervention strategies on major roads for users.

7) Organogram: The program should be well designed with a conceptual hierarchy of managers, engineers and supporting staff in the context of designation. Overlook committee should be present for monitoring actions.
8) Individual Involvement: The public should have access to take part in providing the solutions for road safety. This will ensure their priorities on certain roads with respect to strategy applied.

This is quite evident that traffic crash problem in our country is a debatable question and requires much more attention to related stakeholder group. Road safety measures and solutions are no doubt present for the implementation but on the baseline management actions are also required which is only possible by integrating the above discussed steps. The stated research is also an example of a blend of management and analytical perspective of road crashes.

XI. Conclusion

The overall research is presenting the complete picture of the road environment and traffic accidents for Karachi city. As a matter of fact and with the evidence of macro-scale data analysis, certain road user group requires much more attention in all means. The strategy of study may be helpful and transformed for any city of a developing country with identified parameters and traffic requirements. This gives also an idea to bridge the gap between hospital management and the road safety engineering sector when coming to the development of the surveillance system for the benefit and saving lives of mankind.

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