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Traffic Monitoring and Driver Behavior Modification System

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I. Executive summary:

The overall goal of the project was to reduce the toll of road death and injury in Costa Rica by reducing travel speeds and increasing headways on interurban and urban roads. To do this, we transferred a technology (Marom) for population-based electronic roadside monitoring of vehicle speeds and headways. The system is based on infrared sensors and retroreflectors and concurrent video-photos of license plates, a back-up data processing and storage unit, and printouts of warning letters or fines. The system is more reliable and accurate than radar, impervious to radar detectors, without microwave hazard, and operable at night.

The project's accomplishments were:

(1) An urban community-based intervention program in Israel based on the use of the Marom field unit and on-line down-road intervention showed that photo warning letters delivered downroad are followed by drops in in-town travel speeds, injuries and deaths. The Costa Rican Government has committed itself to introducing this modification in 1995.

(2) We transferred the Marom field units and the Data Processing Unit to Costa Rica, following field testing by the Israeli Police. In Costa Rica, a ten man team of the Traffic Police of the Ministry of Public Works and Transport was successful in operating and maintaining the units. The system, though more costly initially than hand-held radar guns, was found to be user friendly, and to have much higher outputs and superior cost-effectiveness ratios for detection. Income from fines is expected to help put its operations on a self-sustaining basis. The project led to passage of a new Transportation Law permitting electronic enforcement (March - April 1993), and distribution of new license plates with properties compatible with the optical resolution properties of the Marom video system. Both steps were expedited by our findings showing that average and maximum travel speeds of vehicles without license plates were much higher than those with plates.

(3) Social workers supervised by the CR PI carried out an in-depth study of working conditions of professional drivers in twelve commercial trucking, bus and taxi fleets. The study laid the groundwork for tie-ins between the in-house safety programs of these companies and their use of Marom DPU data on speeding and speedgating to identify high-risk situations or sub-groups.

(4) The Consejo De Seguridad Vial and Costa Rican Travel Police have put the Marom system to use in everyday detection and deterrence. Through 1994, data lists on vehicle identity, speed and headway violations, time and place were published weekly in the newspapers. Daytime operation, usually in mornings, yielded outputs of more than 500 vehicle observations per hour on two interurban roads. Data were collected for average, 90 percentile, and maximum speeds and percentage vehicles exceeding 90 kph from sequential sitings on two roads (MD00 and RD00) from December 1993 through May 1995. The percentage of drivers exceeding 90 kph dropped on the faster road (MD00) from 27.8% in early 1994 to 23.2% to 15% and then to 8.5% in Jan-Mar 1995, and the slower road (RD00) from 9.5% to 5.7% and then to 3.9% in Sept 1994. Headway gap trend changes were not discernible. There was also a suggestion of a drop in mean speeds on the high speed road-- MD00 (monitored up to four times per month) and a less clear cut trend on the less frequently monitored lower speed road- RD00.

(5) Controlled follow-up is necessary to evaluate the strength, persistence and robustness of the first preliminary findings and impact on road death and injury. In August, the data processing unit was not yet connected to the Costa Rica mainframe computer for vehicle registration. Full benefits from the transfer of the technology require the setting up of a team to apply epidemiologic principles for study design and program evaluation.

The high tolls and costs of road death and injury in developing countries mandate low-cost interventions, technological and otherwise, which produce swift and large results. Even small reductions in average and maximum speeds and increases in headway intervals are now recognized predictors for large reductions in death and injury. The project's accomplishments in urban settings (Israel) and interurban settings (Costa Rica) indicate that this outcome is an achievable result.

II. Research objectives.

The overall goal of the project is to produce a large decrease the toll of road deaths and injuries from motor vehicle crashes in Costa Rica. The specific objectives were:[1]

(1) to transfer and set up a system for roadside electronic detection and deterrence of two high risk driver behaviors, speeding and tailgating in Costa Rica

(2) to train Costa Rican scientists and officials to operate and maintain this system, and evaluate its impact and effectiveness

(3) to use the system and the intervention methods it triggers for monitoring speeding and tailgating and reducing their frequency

(4) to develop and test, together with an interdisciplinary team of Costa Rican scientists and governmental officials, intervention methods based on use of the system and its data processing unit

The case for action for this project derives from the high risks for road death and injury in less developed countries (LDC"s,) their high human, social and economic costs, the prospects of rising tolls with more vehicles and drivers--(especially young ones,) heavy vehicles and drink--despite seat belts, better crash packaging in vehicles, environmental improvements, and drink-driving campaigns.[2-5] We question the fatalistic premise implicit in the literature that the rising death and injury toll--in absolute numbers--is an inevitable built in by-product of rapidly increasing motorization and more roads in developing countries. In Costa Rica, in 1990, 418 persons (342 male) died on the roads.[1]

In LDC"s, gross disregard of traffic rules is endemic, speeding and tailgating are frequent, and enforcement is frequently an exercise in tokenism, as we were able to show in Costa Rica. In LDC"s as well as developed countries (DC"s), new technologies for detection and deterrence of high risk traffic behaviors offer promise for rapidly cutting into this toll.[7] The problem is that most of these technologies are ineffective, inefficient, unreliable, and not user-friendly or durable. Radar guns, in particular, are not reliable, compromised by radar detectors, and may be associated with microwave health risks when used as hand held guns.[6] Patrol cars are inappropriate, costly and wasteful.[1]

In the 1980's and early 1990's, there have been several trials demonstrating the capacity of electronic road side monitoring for rapidly cutting interurban death and injury tolls in DC"s.[7-9] These trials have been buttressed by an abundance of data on the relationship between increased speed limits and travel speeds, reduced headway intervals and increased injury and death risk.[10-15] These data state the case for attempting to produce a major reduction in the road death and injury toll in LDC"s by reducing the prevalence of these behaviors. Can we get the same quick large reductions in road death tolls that were achieved in infant mortality in many third world countries by public health programs in sanitation, nutrition and immunization?

The scientific research context:

In the 1970's, 80's and 90's, intervention studies showed the relationship between reductions in average and maximum travel speeds and reductions in death and injury tolls.[16-18] Studies in Finland showed that an array of interventions, ranging from warning letters to fines, achieved deterrent effects lasting up to six months for high risk driving behaviors in detected drivers[17]. More recent work has shown that these systems, together with community generated information campaigns and environmental modifications, can impact on risks for urban pedestrians, by reducing speed levels of vehicles. Conversely, there is now a well-established scientific consensus from well-controlled studies, that driver training, defensive driver courses and mass communication have been the golden calves of road injury prevention.[19,20]

Finally, the technology we developed offers the opportunity to exploit the principle stated by Geoffrey Rose that small reductions in the severity of risk factors in the entire population are far more effective and cost-effective in saving lives than case-finding directed at very high risk individuals in the small right-sided tail of the distribution curve.[21,22] But the technology we have developed can be used to reduce risks in both "sick populations" and "sick individuals."

The innovative aspects of the technology:

The monitor system is a roadside detection technology based on infra-red sensors of beams retroreflected from pre-positioned optical mirrors for measuring vehicle speed, headway and length and synchronized video-photo snapshots of vehicle and license identity. A back-up data processing unit enables analysis (real time or delayed) of all data in terms of time, place, behavior and vehicle ID. The ability to measure tailgating (headway interval) makes it possible to change a risk behavior for which until now the double negative fallacy applied: because it could not be measured, its risks were ignored by enforcement officials. Fig I illustrates the operation of the system's peripheral monitor and back up Data Processing Unit (DPU).

The monitor's reliability and precision characteristics are keyed to the production of court-quality data, and its camera's optical specifications for reading the numbers on standard license plates. At the time of writing, other in-road sensor systems (pneumatic tubes, peizo-electric strips, induction loops and coxial microphone cables) or identification systems (transponder tags) were not able to meet these precision specifications.[1,5]

Table I summarizes, in general terms, the performance specifications of the system we have developed compared to alternative technical systems. Table II spells out the properties of the two types of data processing unit, one off line (central) and the other on-line. The central Data Processing Unit links up to a central vehicle registry; the on-line system prints out warning letters and photos on the spot. The power of this system resides in its data storage, linkage and analysis capacities. These offer opportunity for customized interventions based on cumulative vehicle violation profiles.

The system, as noted, is impervious to radar detectors, is operable at night, when high risk driver behaviors may be especially prevalent, and can be camouflaged and protected from vandalism and jamming. Its output, like other roadside detection systems, is population based. Detection levels are some 50-100 fold that of mobile individual police patrol cars. Even when the latter are equipped with radar or laser guns, their output is limited by the capacity for rapid repetitive movement and persistence of a human operator. Fig II presents the output of a video photo with date and time, location, vehicle length, speed and headway data.

Innovative Adaptations in Costa Rica:

One innovation came from the Costa Rican Consejo and Traffic Police, who opted to use the data output of the DPU directly rather than feed it into their central mainframe vehicle registry. The license numbers violating vehicles were published weekly in the newspapers, and the data attached to the annual registration form. This innovation may be pertinent to the use of the technology in other LDC's, where reliance on mainframe databases on vehicles is problematic.

Support of other organizations:

In Israel, the project received support from the Traffic Police, who ran pre-trials of the Marom on interurban roads, and fed the collected data via the DPU into the mainframe, which printed out warning letters and fines. In addition, one suburb, Rehovot, ran urban trials of the Marom, in conjunction with Metuna, a community based organization dedicated to fighting road carnage. One senior official of the Transport Ministry, Dr. Dan Link, also provided administrative contact with the government. Driver Safety Systems, the company set up to develop, operate and service the Marom Technological System, provided technical support at all stages of the project.

In Costa Rica, Dr. Ortiz, the PI, organized a consortium of organizations, including the Children's Hospital, the maintenance division of the Amusement Park, the Social Service Bureau of the National Insurance System, and other groups to oversee and interact with the project at all stages. These provided an array of indirect support, including manpower, computer time, vehicles, and administrative support.

III. Methods and Results:

Israel: The Rehovot Urban Driver Improvement Program: (G Ben-David)[23]

Methods:

We carried out an urban program of electronic monitoring and intervention to determine whether use if the Marom system in an urban setting would reduce speeds, and if so, would be followed by reduction in injuries and deaths.

The Rehovot Driver Improvement Program was carried out with the backing of the local municipality and the Israel Police Force, with partial funding by the Transport Ministry, Avner Insurance Company, (the national consortium) and the USAID CDR project. In July 1993, the operating team was trained, and baseline measurements of speeding and headway time gaps were made. Thereafter, from August 1993 to March 1994, one Marom unit and a downroad on-line DPU were used to trigger two types of interventions: a video printout of his vehicle and violation data and leaflets. Repeat violators received warning letters and invitations to an interview at the local police station. Interventions were triggered by travel speeds in excess of 10 kph of the posted speed limit and speedgating, which was defined as 50 kph and an interval of 0.8 sec. In Rehovot, the program was carried out at five sites considered to be high-risk for injury for pedestrians. Measurements without intervention were made on two roads in Raanana, which served as a "control" town in measurements of speeds and headways.

The program was accompanied by local public relations activities, and was augmented by the installation of new traffic signs with the posted limits, car stickers, and newspaper and television publicity.

Results: Output of the System:

During the period August 1993-March 1994, some 6500 drivers (~800 per month) were stopped. 4000 received verbal warnings for speeds exceeding the posted speed limit by 10 kph, 2500 received a first letter, fifty a second letter, and three a third letter. During the intervention period, no one was given a formal traffic ticket. Response was generally positive, except for some young drivers. In the case of the latter, their parents were contacted by the Rehovot Safety Department, which informed them of their children's violations. Parents generally welcomed this information; in one case, a family baked a cake for the program.

Results: Speed and headway trends:

In Rehovot, at the five sites, baseline mean travel speeds were in the range of 44 to 47.5 kph, and those exceeding 60 kph ranged from 3.8 to 9.0%. Serial speed measurements at the five observation sites monitored reductions in mean travel speeds ranging from 1.9% to 10.5%. The major finding was that there were 15% to 70% drops in fraction of drivers exceeding speed limit --50 kph-- by more than 10 kph. Figures IIIa, b, and c show trends for speed measurements at three sites in Rehovot. In Raanana, the control town, there were trivial differences in average speed, but there were drops in 8.5% and 11.7% in the percentage of vehicles exceeding 60 kph on two different roads (Fig IV a and b). Other data (see Appendix I) showed that headway trends were unchanged in Rehovot whereas gaps became shorter in Raanana. Clearly, the intervention program in Rehovot was associated with drops in average and 60 kph speed much greater than those seen in the one control town where there was monitoring, but no intervention. But we cannot exclude the possibility of some effect on higher travel speeds associated with monitoring alone.

The fact that the majority of the violating drivers in Rehovot were not Rehovot residents suggested that there was a local deterrent effect of the program. It was not possible to determine if there was a beneficial spillover effect to neighboring communities.

Injuries and deaths:

Table III presents data on fatal and all crashes and deaths and all casualties in Rehovot and nine comparison towns. During the eight month intervention period, injury producing crashes dropped from 151 to 132 (down some 15%), and there were no deaths, as compared to two deaths in the previous year (and three deaths two years previously.) In nine comparison towns combined, there was an increase in reported injuries overall (from 2402 to 2892, a 16% rise), and deaths went from 22 to 27, while Rehovot was one of three towns with a drop in crashes compared to the previous year. Figure V shows that the downward trend in all casualties in Rehovot was opposite to the expected 20% rise based on results from nine comparison towns combined.

Discussion:

The program, which was similar to a package operated in Graz Austria,[17] produced non-trivial drops in speeds and casualties opposite to the trend in nine comparison towns. It demonstrated the potential for a comprehensive mix of environmental, social and behavioral interventions directed at vehicles to protect pedestrians and cyclists the groups at special risk in urban settings. Roadside electronic monitoring and down-road intervention was the centerpiece of the behavioral package. Such a system could further be used to identify hot spots for subsequent environmental modifications, based on roundabouts, road humps, narrowing of streets, and pedestrianization. This package is suggested to be an environmentally friendly long-term strategy for protecting road users in urban settings.

COSTA RICA: Preliminary Projects

Marom License Plate Project: Impact on Law:

Prior to the enactment of the Transit Law, at least 30% of the vehicles in Costa Rica were without license plates. To determine whether drivers of unmarked vehicles were at greater risk for higher velocities, the Costa Rica traffic police compared velocity distributions for unmarked and marked vehicles on Route 1 during one morning. Fig VI (a and b) shows that the mean, median and 90 percentile velocities of unmarked vehicles were 92.6, 93 kph and 115 kph respectively, or some 10 kph higher than for marked vehicles, and the maximum velocity was 130 kph, or some 15 kph higher.

It is possible that newer vehicles, which were on the waiting list for new plates, could attain higher speeds, and that this was a factor which modified the relationship between lack of a license plate and higher speeds. But this extra factor did not change the basic problem: Not having a license plate, was, in the words of Mr. Ricardo De Leon, Director of the Consejo, "a license to kill." The above observations served to accelerate progress towards implementation of the provisions for importing and distributing license plates.

The Social Worker Project:
Professional Drivers

This study was carried out by a team of social workers supervised by Dr. Ortiz in 1992-1993.

A separate book,[1] attached in one copy, provides a study of the working conditions, knowledge, attitudes and practices of bus, truck and taxi drivers concerning road injury. (Appendix II contains top pages) This study is based on a sample of 223 drivers, all male, drawn from a total population of 1200-1500 professional drivers in the San Jose area. Of these, 161 (72.2%) were in the age range 22-43 (Table IV) 91 (41%) reported working between 8-12 hours per day, and 29 (13%) more than 12 hours per day. This finding itself is alarming, given the well known effects of long hours and fatigue in driver risk for crash involvement. Among all categories of drivers (taxis, busses, trucks), generally less than half received some form of training. Their attitudes towards the New Transportation Law, speed control, obeying street signs, and training were generally supportive.

Younger drivers also reported exceeding speed limits for heavy vehicles.

A Pre-test of the Marom for Downroad Intervention:

In February - March 1993, prior to the enactment of the Transit Law, the social workers pre-tested a small on-line intervention project modeled after the Rehovot Program in Israel. The program contained three stages--baseline readings (one month.) intervention (ten days.) and then a follow-up period. During the intervention period, they themselves stopped all drivers downroad from a Marom Unit, on a straight section of the road from Aserri to Desamparados, just outside San Jose. (See Figure VII) This is a heavily traveled road with a speed limit of 40 kph. Among drivers exceeding 40 kph, an unspecified number received verbal warnings and a pamphlet with a friendly warning message, including descriptive material on the Marom. The social workers worked from 8 am to noon.

Data from the three stage project (baseline observations, downroad stopping and warning, and return to baseline) showed a transient downward shift in speed distributions during the intervention period (from 13% to 10% exceeding 60 kph), and a return to higher baseline levels thereafter. (Fig. VIII) This project-- a "warm-up" for the use of the DPU, suggested that a combination of high-tech detection low-tech downroad intervention was followed by a transient effect, but that this effect was lost without subsequent intervention.

The Marom-DPU Interurban Intervention Project:

The new transit law was passed by the Legislature in May 1993. In December, the Police began feeding data from the Marom units fed into the Central Data Processing Unit. The data came from periodic monitoring of two roads, MD00 and RD00. From March 1994 onward, the Police began publishing data lists on vehicle identity, speed and headway violations, time and place each week in the newspapers and storing photographic printouts. Figure IX presents a photo printout stored in the vehicles file.

On route MD00, where vehicle speeds were much faster, four sitings were made prior to March, and nine sitings thereafter from March through August. On route RD00, the number of sitings prior to and after March were four and four respectively. Tables V and VI present the data on date and hours of observation, number of vehicles observed, speed (mean, max and 90 percentile), and headway (mean, minimum, and lowest 90 percentile) on roads MD00 and RD00. Additional tables in Appendix III give breakdowns stratified by vehicle length, speed and headway, so that trends for trucks and busses could be followed. Trucks, in particular, because of their heavy mass, are particularly at risk for involvement in injury producing crashes.

Daytime operation, usually in mornings, yielded outputs of more than 500 vehicle observations per hour. Figures X and XI present the above data on average, 90 percentile and maximum speeds from sequential sitings on Road MD00 and RD00. In these figures time data are grouped by month to simplify graphic presentation. Figures XII and XIII present similar data on headway trends.

Road MD00 was monitored zero to four times per month during the seven month intervention phase, and road RD00 up to twice per month. The graphs show that on Road MD00, following intervention, there appears to be a reversal of a prior upward trend in mean and 90% percentile speeds as the project progressed. Data from appendix III shows that on this road, the standard deviation of mean velocities also contracted. On RD00, where monitoring was much less frequent, the data were not sufficient to discern such a trend for mean velocities, although there is a suggestion of effect on the 90 percentile level.

Figs XII and XIII indicate that headway trends were inconclusive.

Was there an impact of the Marom-triggered interventions on percentage of drivers exceeding 90 kph? Figs XIV, XV and XVI and accompanying tables present grouped data for speed distributions on Roads MD00 and RD00. These graphs and tables, prepared by Otto Holst, make it possible to compare the pre-intervention and post-intervention periods for percentage of drivers exceeding 90 kph. The data show that on both MD00 and RD00, there were marked drops in percentage of drivers exceeding 90 kph as the project progressed. On MD00 this percentage dropped from 27.8% (830/2983) prior to interventions to 23.2% (585/2511) in August 1994, following a transient rise to 39.9% (1199/3002). Subsequently, this percentage dropped further: 15% (497/3301)* for a group of readings between 1.9.94-21.9.94, and 8.5% (769/9098)* between 3.1.95 and 9.3.95. On RD00, the percentage of drivers exceeding 90 kph dropped from 9.5% (420/4443) prior to interventions to 5.7% (198/3444) in August, and thereafter to 3.9% (113/2861)* between 6.9.94 and 13.9.94. (*Data received on May 18, 1995 - See Appendix IV and Table VII.)

Vehicle length, speed and headway:

The Tables in Appendix III present printouts from software we developed which read data taken from diskettes in the Marom field detectors. In these tables, data are presented in terms of vehicle length, speed and headway intervals. Such printouts, together with video camera data, enabled the system to detect speed-gating, i.e. speeding and tailgating combined in private vehicles, light trucks, and heavy trucks and busses. These data call attention to the potential for use of the Marom for screening and finding sub-groups with increasing gradients of risk, including fleets of drivers belonging to specific commercial companies. Thus, in the matrices, the cells on the lower right hand corner--i.e. high mass (e.g. trucks), high velocity and low headways, represent the sub-group at greatest risk for involvement in high-risk crashes in which large amounts of kinetic energy are released. These matrices offer the possibility of severity and swiftness of the intervention calibrated to the Newtonian equation for kinetic energy and represent a unique property of this system compared to other roadside monitoring technologies.

Discussion of results:

The data show an association between sustained monitoring and percentage of drivers not exceeding 90 kph over a sixteen month period. As the project progressed, the 90 percentile speed levels dropped on both MD00 and RD00. The fact that the drop in **percentage drivers exceeding 90 kph** was more marked than the drops in average velocity suggested that the program's impact was greater on "sick individuals" than on "sick populations". The greater drop in **average** velocity trends on MD00 compared to RD00 is suggested to reflect the truism that more frequent enforcement produces bigger and more sustained drops in speed, although we cannot rule out the influence of the fact that speeds on the first road were higher to begin with. In addition, the fall in SD of mean speed (see Appendix III) suggests that traffic flow may have become smoother and less turbulent. The data suggest the possibility that monitoring of a road no more frequently than 2-4 times per month may be sufficient to reduce illegal speeding and average and maximum velocity, but proof of this would require data based on hidden monitoring. Support for this suggestion comes from work in Finland, which showed persistence of a deterrence effect for periods up to 3 months[17] following either warning letters or fines.

It is not possible to say whether the relationship between intervention and drops in percentage of vehicles exceeding 90 kph was coincidental or cause-effect or the end-result of a mix of events associated with the new Transit Law, including our interventions. Data were not collected on a road which was monitored without interventions. However, the findings strongly suggest that sustained monitoring will produce sustained reductions of average and illegal speeds, and that the magnitude of the reduction will be related to the frequency of monitoring. This means that an impact of the intervention will be to shift the entire curve of speed distribution slightly to the left and, at the same time, to reduce the number of vehicle-drivers in the high-risk sub-group, e.g. speeders. In short, there are effects on both "sick populations" and "sick individuals."

IV. Impact, Relevance and Technology Transfer:

Epidemiologic theory suggests that prevention of health risk from a specified pathogen can be based either on small reductions in exposure to the agent in large numbers of individuals e.g. (shift of the entire distribution curve to the left) or big reductions in exposure in a small number of high risk individuals.[21,22] The first strategy is more effective and cost-effective for the entire population as a whole, and is directed at very large numbers of individuals with small increases in risk. The second, which is directed at the small number of high risk individuals at the tail of the distribution curve, is more cost-effective for these high-risk individuals alone. The data from the Rehovot Program in Israel and the interurban trials in Costa Rica show that the Marom Technology offers the potential for making use of both strategies simultaneously. In both countries there were drops in mean and illegal speeds where the systems were introduced, although only in the first was this drop shown to occur in a controlled study. In Costa Rica, there appears to have been a greater effect on higher speeds.

Based on data published by Joksch, each 10% increase in velocity of impact increases occupant case fatality by 43%.[11] Nillson has shown that frequency of crashes, serious injury and deaths increases with the square, third, and fourth po er of the average velocity respectively.[16] Similar relationships hold for speed of impact, serious injury and case fatality for pedestrians.[23] For all these outcomes, the same relationship holds true in the reverse direction for speed reduction. Therefore, our preliminary findings suggest the possibility for reductions in the interurban and urban death toll ranging anywhere from 15% to 50%, if there will be widespread use of the Marom system in Costa Rica. It is suggested that the use of at least 9-10 monitors on interurban roads could accomplish this.

Based on the findings and these risk assessments, the project gives Costa Rica the potential for achieving a *swift* large reduction in its road death toll to levels approaching those of Europear ountries, provided full use is made of the technology. The use of its back-up data processing software in tackling the problem of increased risks in companies which overwork and abuse their drivers is particularly important.

The technology which we transferred to Costa Rica was put to use for se mi-routine monitoring, detection and deterrence of speeding, tailgating, and speedgating on its highways by the Costa Rican Police. Costa Rica is now operating nearly all the elements of a system for detection and deterrence. The use of the detectors, together with the back-up data-processing unit, enables Costa Rica to leapfrog the obstacles associated with police patrol car enforcement: low levels of output, detection and deterrence, and little impact on reducing road death and injury.

The end-product of the system as it is now being used in Costa Rica are lists of violator vehicles published weekly in Costa Rica's newspapers. Fines are already being collected for the detected violations. Based on successful experience with the system, the Costa Rican Ministry of Public Work and Transport has opted to add two more Marom detector units to their traffic police program, and to participate in a joint project to add on-line down road print out systems for the four detectors which will be in use by the end of 1995. Connecting the DPU to the mainframe database also has to be carried out.

Activities of Investigators During Project:

To get to the project's end result, many hurdles had to be overcome in many sectors and institut ns. These are listed below.

(1) The Costa Rican Legislature ratified legislation pe. nitting roadside electronic monitoring and video-photo detection, but also providing safeguards against Orwellian abuse. This involved important legal precedents for Costa Rica, and required specifications for the reliability, accuracy and precision of all components of the Marom System. The law enables detection and fining for tailgating as well as speeding, and therefore serves as an important precedent in deterring this recognized predictor for vehicle crash involvement.

(2) We encouraged the Ministry to initiate the process of setting measurable goals for reduction of road deaths and injury, and to evaluate results in relation to anticipated benefits from specified countermeasures.

We prepared a position paper for reducing the death toll, over 400 in 1990, by 25% over a several year period and recommended that programs and operations be designed in terms of goals, objectives, anticipated results, methods, and evaluation. Evaluation should apply to long term operation of the Marom system. We also aimed to stimulate the beginnings of an epidemiologically oriented critical examination of the relative benefits and costs of other countermeasures, many of which may prove to be of dubious benefit.

(3) Marom data on increased speeds of unmarked vehicles spurred the Ministry of Public Transport to expedite the introduction of license plates for unmarked vehicles.

The Marom data on speed distributions documenting the added risks from this semi-anarchic situation provided evidence needed by the Minister to overcome delays in ratification of the law expediting the delivery of license plates.

(4) The Police acquired the skills for operation and maintenance of the detectors and data processing unit. They are ready to connect the latter to the mainframe of the Ministry as soon as the latter will be ready. The decision to bypass the mainframe in the interim and print lists of violating vehicles was an innovation of the Consejo.

(5) We prepared truck, bus and taxi companies employing professional drivers for use of the data output by the Marom system to monitor and detect speed and headway trends in their own drivers.

The report from the Social Worker Project underscored the point that detection and deterrence of professional drivers for high-risk driving behaviors needs to be part of a program for dealing with stresses and work conditions of this group. Many drivers were working too many hours without rest. Data from the monitoring program identified trucks traveling at higher speeds or failing to keep an adequate headway or both. However, work with the safety officers will be needed to help commercial fleets make use of monitoring data collected by the Marom to detect high risk situations and drivers.

Augmenting scientific capabilities in Costa Rica:

The scientific team in Costa Rica under Dr. Ortiz not only acquired new scientific capabilities, but brought their own insights concerning modifications and innovations. This happened through their direct role in facilitating the technology transfer from one country--Israel--to the traffic police force of their own country. Much of their time had to be devoted to "selling" the principle of electronic roadside monitoring to law-makers, ministers, policy-makers, safety officers of commercial fleets, administrators, computer scientists, maintenance personnel, traffic policemen and others. This formidable effort resulted in their acquiring an extremely sensitive grasp of the technology and its public health potential.

V. Project Activities and Outputs:

Meetings attended:

February 1987: Pre-proposal visit to Costa Rica:
ED Richter, Roberto Ortiz:
Some 14 meetings and work sessions with Ministers of Transportation, National Insurance Institute, Consejo De Seguridad Vial, Traffic Police, medical social workers, epidemiologists; field demonstration (day and night)

June 1991: 10 day orientation and training: Costa Rican Team in Israel: Roberto Ortiz MD, Jaime Cortes MD, Cdr Juanelque Gutierrez, Traffic Police; Oscar Bolanos, Ministry of Tran port and Public Works:

Seminars, field demonstrations, meetings, training sessions with Project Investigators, Israel Traffic Police, School of Public Health, Parliamentarians, Hospital Trauma Unit, Driver Safety Systems (DSS) maintenance team.

February 1992 Visit of Prof Gerald Ben-David, ED Richter MD, Joshua Maier, and Danny Suportas (DSS) to Costa Rica:
Two week training program in setting up, operation and maintenance of Marom Detectors: Selection of road sites for protocol: Meetings with Government Ministers and Consejo: Preparation of policy statement

August 1992: Visit of ED Richter MD and Dror Lenger (DSS) :
Review of overall progress, repair and replace equipment components, set up maintenance and service arrangements: revise protocol in light of license plate problems: review meetings with ministers and policy officials. Review of social worker project:
Meetings with epidemiologist

Jan-Feb 1993: Visit of Haim Xavier Linn (medical student)to work with CR PI, Consejo and Traffic Police on day-to-day operations of Marom field units. Collection of data on knowledge, attitudes and of drivers stopped downroad in relation to their monitored speed levels: Work with social worker team .

February 1993: Review visit: ED Richter MD to Costa Rica:
Meetings and negotiations re transfer of Marom units from Project to Consejo and preparation for shipment of DPU.

October-Nov 1993: Uri Richter to Costa Rica Traffic Police and Consejo: Work on day-to-day operation of equipment

December 1993 Dror Lenger (DSS) Visit to Costa Rica:
Setting up of Central DPU and merging of Marom field units with Consejo and Traffic Police: work with Otto Holst of project on supportive maintenance and use of software for database printouts.

February 1994: Visit of ED Richter MD to Project, Consejo and Minister:
Review of Progress with use of DPU for data printouts on violators in newspapers and expansion of Marom program in Consejo: review of social worker progress for commercial fleets

September 1994: Visit of Shmuel Kedmi, Director General DSS, to oversee progress in use of Maroms and explore transfer of additional Marom units and joint development of new on-line down road technology

VI. Project Productivity:

While the transfer of technology was successful, we did not have enough time or resources to implement the study design of the original protocol. (See Fig XVII)
The CR and Israeli investigators had intended to run a study design with internal and external controls. This study sought to evaluate the impact of the Marom technology and warning letters on reducing mean speeds and the percentage of drivers violating posted speed limits. An array of administrative and budgetary problems, some internal, others external, forced us to set more limited objectives. We were unable to recruit an epidemiologist in Costa Rica to oversee the setting up and operation of this protocol. The formidable problems which had to be overcome in introducing the technology and getting it on the road left us with no time or resources to do this.
As use of the Marom technology expands in Costa Rica, there will be a need to fund for, and build into the program, an ongoing study design, research and evaluation component as part of the Consejo's work. Doing this will involve a quantum jump in

program management and epidemiologic evaluation. This jump follows the quantum jump in technology resulting from the adoption of the Marom technology. There is a particular need to develop customized outputs of data packages and interventions for company-based program management based on a principle paraphrased from music about orchestras and conductors - there are no bad drivers, only bad managers.

The robustness of the project was demonstrated by its carrying on and thriving despite job changes involving one senior police official, three directors at the Consejo, three ministers of Transport, and two governments. The credit for this belongs to the firm, unwavering leadership of Commander Juanelque Gutierrez of the Traffic Police and the PI's Dr. Ortiz and Dr. Cortes. But delays produced by these changes meant that the longer term scientific goals in study design and project evaluation had to be deferred. The accumulating body of evidence from round the world on the relationship between higher speed limits, higher speeds, tailgating and injury risk, and the effectiveness of speed control measures in reducing these risks, means that data collected on the effectiveness of the Marom in achieving speed reduction is sufficient to demonstrate program success. Rediscovering the speed reduction--injury reduction relationship is no longer a question of whether but how to replicate in Costa Rica.

We have recommended that CR set up formal arrangements with University departments in transportation and epidemiology to carry out the necessary evaluation. The current in-house governmental resources need to be reinforced for this task.

The project leaves in Costa Rica, two Marom units and a DPU, a team of competent, well-trained, and motivated police officers operating this equipment, a back-up maintenance team, and a program of intervention based on the newspaper lists. Two more units will be added to the system and a down-road on-line system will be introduced. Costa Rica will become a partner in field testing newer more customized technologies now on the drawing boards. With the help of the company set up to develop the Marom--Driver Safety Systems, the joint Hebrew University - Jerusalem College of Technology Center for Injury Prevention at the Unit of Occupational and Environmental Medicine, study designs based on the Rehovot precedent can be introduced.

Conclusion:

In our original proposal, we wrote that at the end of the USAID project, Costa Rican road safety officials would be able to:

(1) select and prepare sites for operation of the monitoring system
(2) describe traffic flow in terms of date, location, and vehicle characteristics
(3) analyze driving behaviors
(4) provide profiles of the daily speed and tailgating characteristics of individual vehicles and vehicle fleets
(5) pinpoint high-risk locations for intervention
(6) use databases for intervention programs
(7) fully operate and maintain the system
(8) design and develop strategies to meet local needs
(9) evaluate the impact of these intervention programs

All but the last program objective were achieved within the time period of the USAID CDR project.

VII. Literature Cited:

1. Richter ED, Ben-David G. Ortiz R et al: A Traffic Monitoring and Driver Behavior Modification System (US AID CDR Project Number C8-043)

2. WHO Road Traffic Accidents in Developing Countries, WHO Technical Reports Series, Geneva 703: 1985

3. Jacobs: GD Road accidents in Developing Countries, Acc Anal Prev 1983: 15: 337-353. See also same author, Proc. Conf Transp. Safety in Developing Countries, AMalfi Italy 1985: 163-176

4. Ortiz R, Cortes J, Cortes AL, Montes MC, Vargas LM, Mora SM, Proyecto Modificacion Del Comportamiiento de los Conductores (Monograph), August 1993, 196 pp plus annexes

5. Richter ED, Ortiz R, Ben-David G et al: The Israel-Costa Rica Driver Improvement Program: A "Smart" Detection-Deterrence System: Proc Second Int'l Conference on New Ways for Improved Road Safety and Quality of Life: Oct 7-10 Tel Aviv Israel, 1991

6. Davis R, Mostolfi FK: Cluster of Testicular Cancer in Police Officers Exposed to Hand-Held Radar: Amer Journ Industrial Med: 1993: 24: 231-233

7. De Waard D, Rooijers T: An Experimental Study to Evaluate the Effectiveness of Different Methods and Interventions of Law Enforcement on Driving Speed on Motorways. Acc Anal Prev 1994: 26: 751-765

8. Teed N, Lund A: The effect of laser speed-measuring devices on speed limit law enforcement in Charlestown, South Carolina: Acc Anal Prev: 1993: 25: 4: 459-464

9. Makinen TE: Halo Effects of Automatic Speed Enforcement, Proc Third Intl Conference on Safety and Environment in 21st Century: NOv 7-10 Tel Aviv 341-345.

10. National Research Council: 44: A Decade of Experience. Washington DC National Academy Press 1984

11. Baum HM, LUnd AK, Wells JK: The Mortality Consequences of Raising the Speed Limit to 65 MPH on Rural Interstates: Amer Journ Publ Health: 1989: 79: 1392-1395

12. Insurance Institute of Highway Safety: Seven Straight Years: Deaths Higher After 65 MPH Speed Limits: Status Reports: 1994-5: 29: 10:3

13. Garber S, Graham JD: The Effect of the new 65 Miie per Hour Speed Limit on Rural Highway Fatalities: A State-by-State Analysis. Acc Anal Prev; 1990: 22: 2: 137-149

14. Joksch H: Velocity Change and Fatality Risk in a Crash: A rule of thumb: Acc Anal Prev: 1993: 25: 103-104

15. Evans L, Wasielewski P: Do accident-involved drivers exhibit riskier everyday driving behavior? Acc. Anal. Prev: 1982: 14: 57-64

16. Nilsson G: Reduction in the Speed Limit from 110 kph to 90 kph during Summer 1989: VTI Rapport 358A. Sweden 1990

17. Makinen T, Beilinson L, Salusjarvi M: Traffic Enforcement Strategy annd Tactics: Proc Second Int'lConference on New Ways for Improved Road Dafety and Quality of Life: Oct 7-10 1991 Tel Aviv Isr l, 1991

18. Sammer G General 30 KPH Speed Limit in the City: Results of a Model Project in the City of Graz: Proc 3rd Intl Conference: Safety and the Environment in 21st Century: Nov 7-10 1994, Tel Aviv

19. Lund A, Williams AF: A Review of the Literature Evaluating the Defensive Driving Course. Acc Anal Prev: 1985: 17:6: 449-460

20. Robertson L: Injury Epidemiology, Oxford University Press, 1992.

21. Rose G: Sick individuals and sick populations: Int'l Journ Epid: 1985: 14: 1: 32-38

22. Beaglehole R, Bonita R, Kjellstrom T: Basic Epidemiology: WHO Geneva, 1993

23. Ben-David G, Kedmi S, Lenger D, Bontchek A, Richter ED: Speed control, detection, and deterrence in a suburban area: Abstract: Proc Int'l Epi Association Conf: Jerusalem Feb 1993

VIII. Acknowledgements:

This final report is the end of a ten year journey which started with "let's give it a try" (1986) to the exchange of letters with Dr Ortiz, the pre-proposals, the proposal, the project, and ended, a bit behind schedule, at the finish line--this final report (1995). We went from air mail to fast mail, from telephone to telex to fax--and soon, email, and from Electric Typewriters through Apple 2e's to IBM DOS to Windows, and from large black floppies to hard disks. The project, with its many ups and downs, crises, and moments of elation, built a community of commitment and friendships in three countries forged by hard work of many fine people, just some of whom we cite below. We hope that our next report will describe the use of the technology as part of a regional strategy for road injury prevention in Central America. We predict that this strategy will be the showcase for developing countries on how to quickly produce big drops in the epidemic of death and injury from road crashes.

Costa Rica:

Jorge Alfaro, Bernardo Arte, Oscar Bolanos, Marcos Chinchilla Montes, Dr Guillermo Constenta Umana, Anna Cortes, Isabella and Carlos De Saenz, Mariano Duran, Mario Guardia Canas, Juanelque Gutierrez and the members of the Traffic Police Marom Project, Otto Holst, Francisco Jimenez, Manuel Lopez Trigo, Lilliana Mejias Vargas, Hector Monge Montero, Dr David Reuben, Lilliana Solano Mora, Yaakov Vishnia

Israel:

Joseph Apter, Mona Berdugo, Professor Joseph Bodenheimer, Dr Avigdor Bontchek, Sidney and Elizabeth Corob, Yehoshua Freedman, Professor Charles Greenblatt Shmuel Kedmi, Dr Dror Lenger and staff of Driver Safety Systems, Dan Link, Chaim Linn, Dan Liron, Josh Maier, Victoria Neuman, Itamar Nissim, Uri Richter, Simcha Rock, Naftali Schweitzer, Dr Paul Slater, Zvi Weinberger

USA:

David Mulenex and Boaz Ayalon of the Embassy, and Irwin Asher (formerly USAID), and the patient members of the USAID CDR office in Washington

Tables and Figures

Table I: **ROAD SIDE ENFORCEMENT SYSTEMS COMPARISON**

	RADAR SYSTEMS (based on Doppler Effect)	ELECTRO-MAGNETIC LOOPS	LASER GUNS	MAROM
1 ENFORCEMENT CAPABILITIES				
a) SPEED	YES	YES	YES	YES
b) HEADWAY (TAILGATING	NO	NO	NO	YES
2 TRAFFIC LANE STATISTICS	NO	YES	NO	YES
3 NO. OF DETECTED AND DOCUMENTED VEHICLES PER MINUTE (MAX)	20	40	CAMERA NOT INCL.	300
4 OUTPUT				
a) CENTRAL DATA PHOTOS PROCESSING UNIT	NO	YES	NO	YES
b) SAVES TIME OF FILM DEVELOPING	NO	NO	NO	YES
c) COMPUTERIZED VIDEO IMAGE PRODUCTION	FOLLOWING CUMBERSOME DEVELOPING	FOLLOWING CUMBERSOME DEVELOPING	NO	YES
d) TRAFFIC REPORT CONTAINS THE VEHICLE PICTURE	NO	NO	NO	YES
5 SAFETY	DANGER OF RADIATION	NO SAFETY PROBLEMS	DANGER OF LASER RADIATION	NO SAFETY PROBLEMS
6 ENVIRONMENTAL DISTURBANCE				
a) HUMIDITY	NORMAL OPERATION	NORMAL OPERATION	NORMAL OPERATION	NORMAL OPERATION
b) HEAVY RAINS, SNOW (LOW VISIBILITY)	NORMAL OPERATION	NORMAL OPERATION	MEASUREMENT ERRORS	STOPS OPERATION AUTO-MATICALLY
c) ELECTRO-MAGNETIC DISTURBANCE	CONSIDERABLE MEASUREMENT ERRORS	MEASUREMENT ERRORS	NO PROBLEMS	NO PROBLEMS
7 DETECTIBILITY BY THE DRIVER	*RADAR DETECTORS	NOT DETECTABLE	*LASER DETECTORS	NOT DETECTABLE

Table II:

DPU Options: USAID Costa Rica Program:

	On-line Packages		Off-line Package
	A. Basic	B. Expanded	C. Giant
I. Output			
a. Warning letters	manual	automatic	automatic
b. Tickets	manual	automatic	automatic
c. Fines	manual	automatic	automatic
d. Data storage-vehicle	no	yes	yes
e. Data storage-location	yes	yes	yes
f. Data storage-driver	no	yes	available
g. Prints pictures	yes	no* (see below)	yes
h. Back-up capacity	--	--	5-6 Maroms
II. Interfaces to Other Peripheral Detection Systems			
a. Backs up other detection systems	no	yes	no
b. Stores Data Prints Letters, Tickets, Fines	no	yes	yes
III. Interfaces to Central IBM CR Mainframe (MF)			
a. Takes addresses from CR IBM MF	no	No, but option available	yes
b. Feeds violation data into CR IBM MF	no	yes	yes
c. Searches for violation records	no	yes	yes
IV. System components			
a. Hardware	On-line Picture Printer & TV Monitor	Ink-jet printer Rugged lap top PC	Laser printer Large PC Videorecorder & Backup tape Unit
b. Software	No	Yes	Yes
c. Manpower	1	1	1

Table III:

Crashes and Casualties on 8 Months Rehovot Project

	CRASHES			CASUALTIES		
	TOTAL	FATAL	(Fatal/All*100)	TOTAL	FATAL	(Fatal/All*100)
NINE TOWNS						
92/93	1685	21	1.25	2402	22	0.92
93/94	1876	27	1.44	2892	27	0.93
REHOVOT						
92/93	151	2	1.32	208	2	0.96
93/94*	132	0	0.00	206	0	0.00

* intervention

Rehovot Chi ^{2} for O/E trend
Crashes: (3.71): 0.05 p 0.10
Casualties: (3.88): p 0.05

Table IV:

Social Worker Project: Age Distribution for Professional Drivers

Age	Absolute	Relative(%)
0-21	7	3.1
22-32	73	32.7
33-43	88	39.5
44-54	43	19.2
55+	12	5.3
Total	**223**	**100**

*from *Modificacion Del Comportamiento de los Conductores*

Table V:
Road MD00: Marom Readings on Speed and Gap: December through August

date	22/12/93	11/01/94	04/02/94	08/02/94	08/03/94	11/05/94	06/06/94	09/06/94	21/06/94	30/06/94	15/07/94	28/07/94	04/08/94
time	9 50-12 19	9 15-10 46	8 30-10 31	8 17-10 19	8 36-10 09	9 00 11 00	7 04 9 14	7 05-9 21	7 10-9 21	7 23-9 18	7 41-9 16	9 10-9 44	9 09-10 56
n	1196	397	704	719	364	524	1044	1026	932	808	527	140	1012
avg speed	69	82 2	84 5	87 1	88	84 3	85 9	86 9	84 1	85 6	81 7	86 4	70 1
max speed	108 1	155 5	127	134 7	135 1	124 2	123 1	124	131 8	126 7	127 5	116 1	108 9
90 percentile	91 1	104 1	104 3	109 2	109 4	105 4	104 8	106 3	104 1	103 1	102 3	106 7	93 5
avg gap	6 07	6 99	6 38	6 33	7 33	7	5 35	5 59	5 23	5 64	5 92	7 17	7 39
min gap	0 12	0 25	0 2	0 19	0 48	0 25	0 14	0 23	0 18	0 23	0 27	0 34	0.15
lowest 10%	0 6	0 8	0 7	0 7	1 1	0 9	0 6	0 6	0 6	0 6	0 6	0 7	1 4

Table VI:
Road RL00: Marom Readings on Speed and Gap: December through August

date	28/12/93	10/01/94	16/01/94	13/02/94	20/05/94	05/07/94	05/08/94	08/08/94
time	8 16-10 15	9 01-10 31	13 52-18 1	7 10-9 09	6 47-7 56	7 59 9 13	9 03 10 09	8 30-9 49
n	1121	862	1273	1179	520	851	620	794
avg speed	72	66 6	69	72 5	72 9	70 4	69 6	70 1
max speed	98	117 3	116 6	115	108 2	112 1	130 3	103 2
90 percentile	88 4	85 3	92	95 2	92 2	88 8	89 4	88 5
avg gap	4 98	5 05	5 72	6 21	4 74	4 68	4 95	4 71
min gap	0 23	0 25	0 14	0 14	0 51	0 29	0 29	0 21
lowest 10%	0 7	0 7	0 7	0 7	0 8	0 7	0 8	0 7

First published interventions March 3, 1994

Table VII:

Costa Rica: Interurban Marom Project
Percentage of Drivers Exceeding 90 kph
Jan 1994 - Mar 1995

Road MD00

	Jan-Mar'94*		June '94		June-Aug'94		Aug-Sept'94		Jan-Mar '95		Total	
Speed	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
> 90 kph	830	(27.8)	1199	(39.9)	585	(23.3)	497	(15.0)	769	(8.5)	3880	(17.8)
< 90 kph	2153	(72.2)	2803	(60.1)	1926	(76.7)	2804	(85.0)	8229	(91.5)	17915	(82.2)
All	2983		4002		2511		3301		8998		21795	

* Baseline and first intervention

Chi² for trend: $p < 0.0005$

Road RD00

	Jan-Mar'94*						Aug-Sept'94		Jan-Mar '95		Total	
Speed	No.	(%)					No.	(%)	No.	(%)	No.	(%)
> 90 kph	420	(9.5)					198	(5.7)	113	(3.9)	831	(7.7)
< 90 kph	4023	(90.5)					3246	(94.3)	2748	(96.1)	9917	(92.3)
All	4443						3444		2861		10748	

* Baseline and first intervention

Chi² for trend: $p < 0.005$

Table VII - Graph:

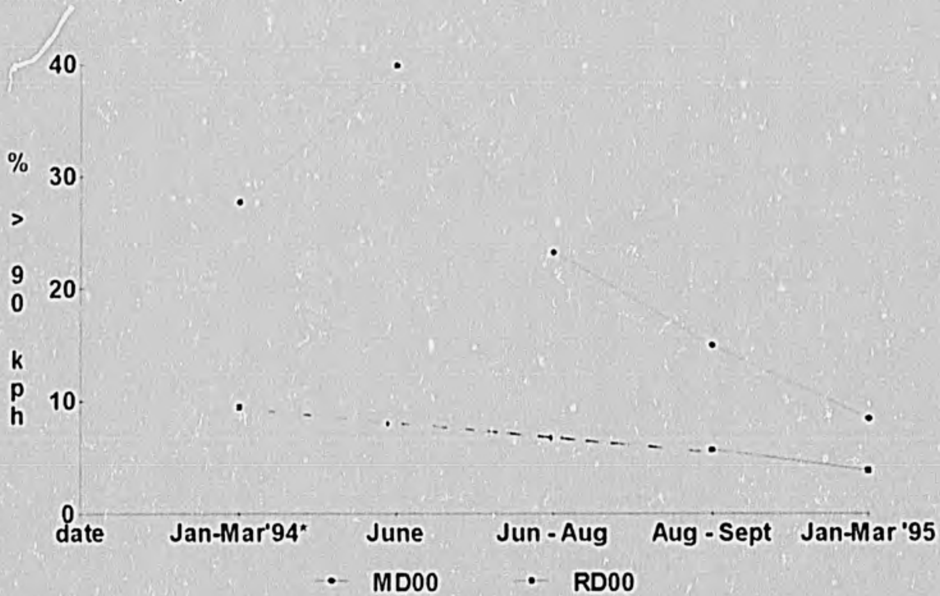
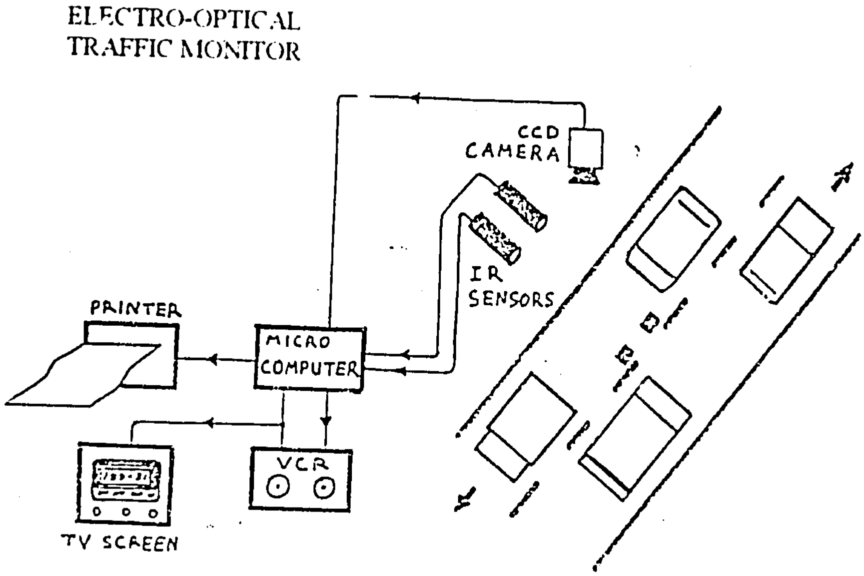


Figure 1:
Operation of the Marom electronic Roadside Monitoring System



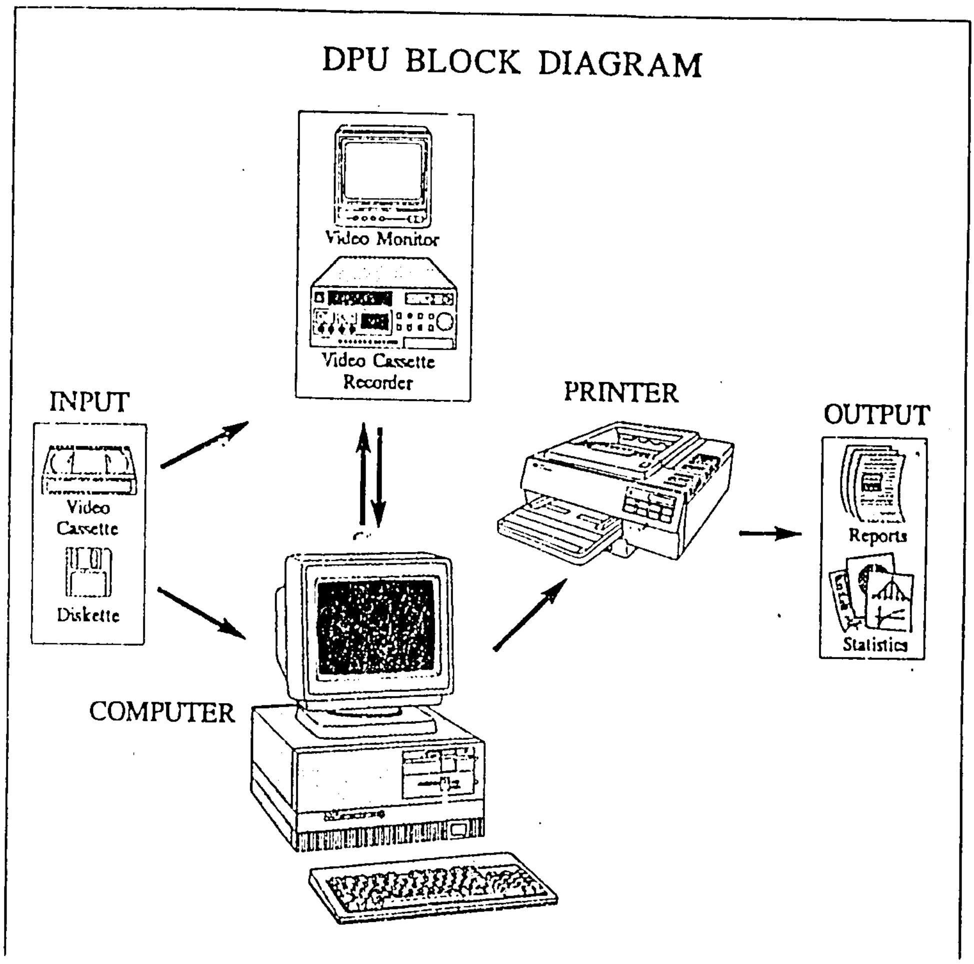


Figure II: Marom Video Photo Output

MAROM

Police Report

Safetown
Police Dept.

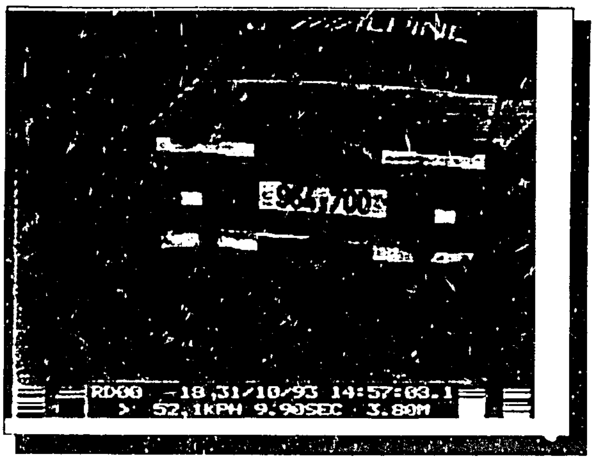
Notice to Registered Owner/ Keeper/ Hirer of a Vehicle

Fixed Penalty Notice No. 45

Name: Davis Jonathan

Address: 345th Aluph

Date of Issue 04-nov-1993



DETAILS OF OFFENSE

Date 31-oct-1993

Time 14:57:08.1

Place RD00

Vehicle Reg. No. 964700

Offense: Speeding at 52.1 KPH

Tailgating at 9.90 Sec.

It is believed you were the Owner/ Keeper/ Hirer of the Vehicle seen in the attached photograph. The Law requires that, within 28 days after receiving this notice, you arrange for full payment of the fixed penalty, using the attached slip:

LACK OF RESPONSE MAY RESULT IN A FINE OF & 133.76 PLUS AN ADDITIONAL SUM OF FOR ENFORCEMENT BY A LOCAL COURT, AS IF IT WERE A FINE.

If the fine has already been paid, please list time, place and sum.

For Payment of Standard Fine, please tear the attached slip on the perforation and send to: 1800 Penalton St.
Safetown 90555

Payment Slip: Enclosed is the sum of:
as stated in notice no.: Dated

Name (in block letters):
Full address

1. This fine is payable in person or by post.
2. Payment must be for the exact amount. Checks and Money orders are to be made out to "the Clerk of the Justices".
3. Cash is to be sent by registered mail.
4. Payments made out to a different Justices Clerk will not be accepted.

Figure IIIa:

Variation of Average Speed with Time

Location TC1W: 04/07/93 - 20/12/93

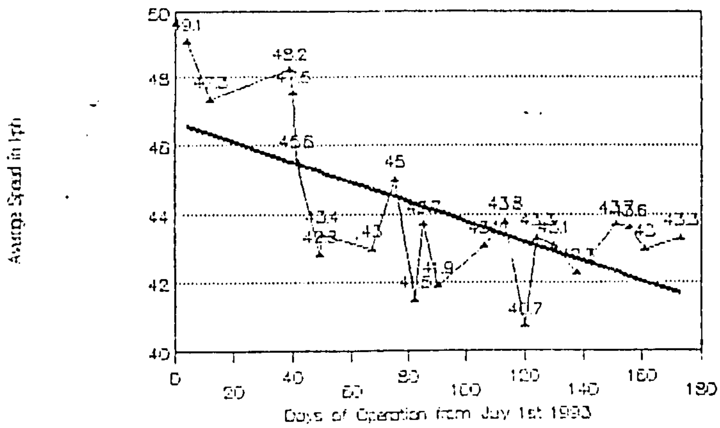


Figure IIIb:

Location YV1S: 05/07/93 - 23/11/93

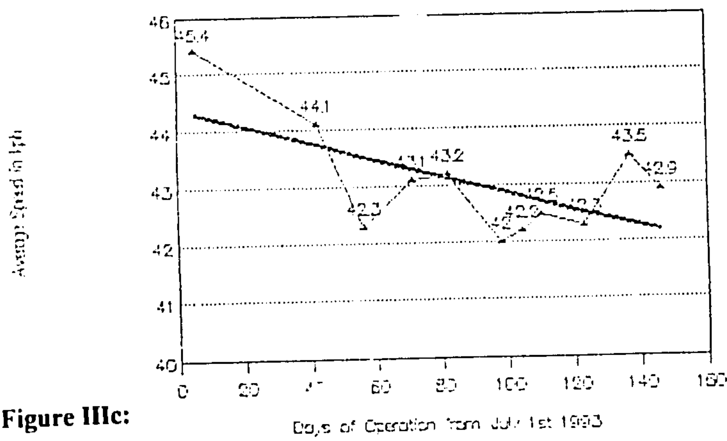


Figure IIIc:

Location YV1N: 05/07/93 - 16/12/93

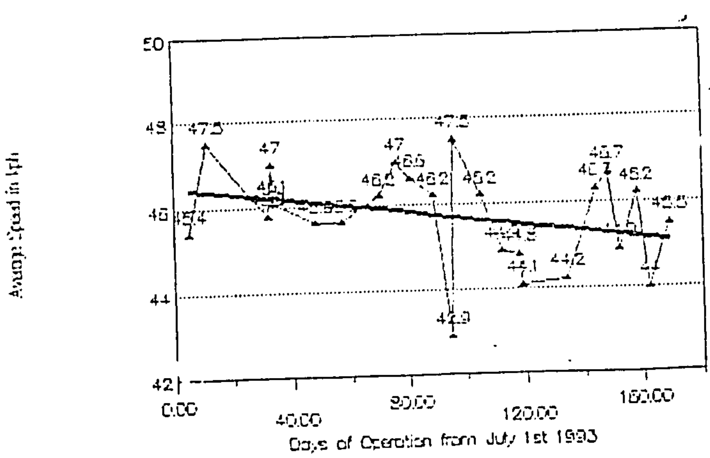


Figure IVa:

Variation of Average Speed with Time

Location RA2N: 15/07/93 - 09/11/93

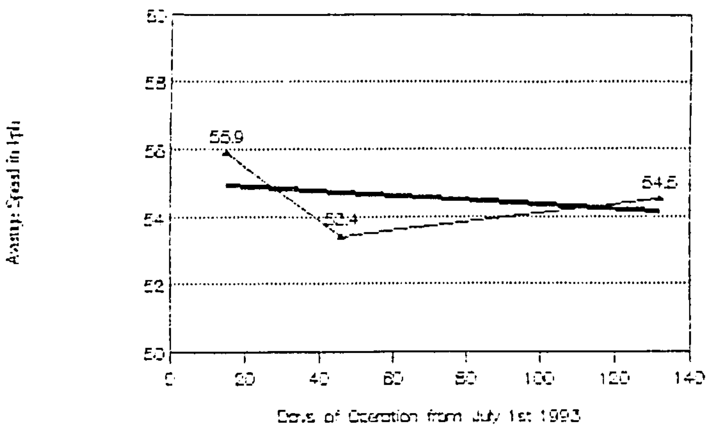


Figure IVb:

Variation of Average Speed with Time

Location RA1S: 15/07/93 - 09/11/93

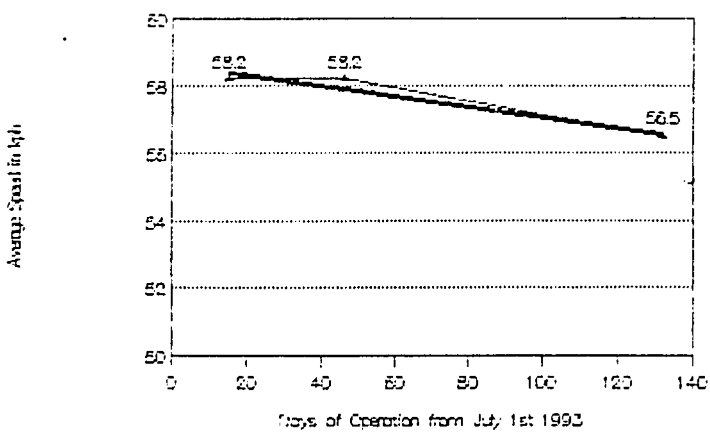
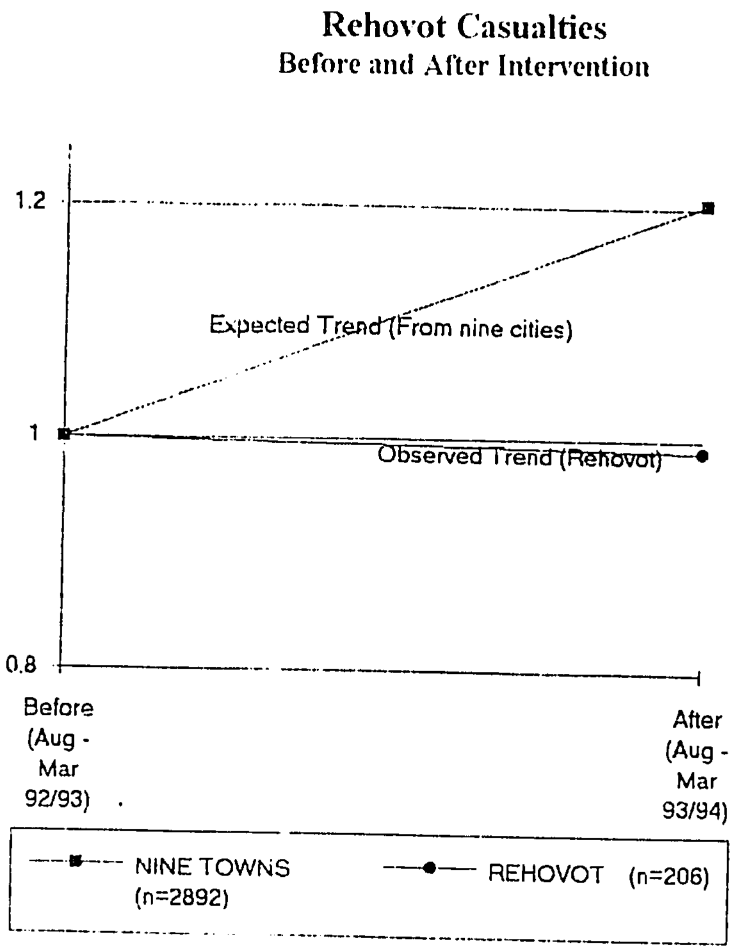


Figure V:


Rehovot Casualties
Before and After Intervention
1.2
1
0.8
Expected Trend (From nine cities)
Observed Trend (Rehovot)
Before (Aug - Mar 92/93)
After (Aug - Mar 93/94)
NINE TOWNS (n=2892)
REHOVOT (n=206)

Costa Rica Pre-test 1992

Figure VIa:

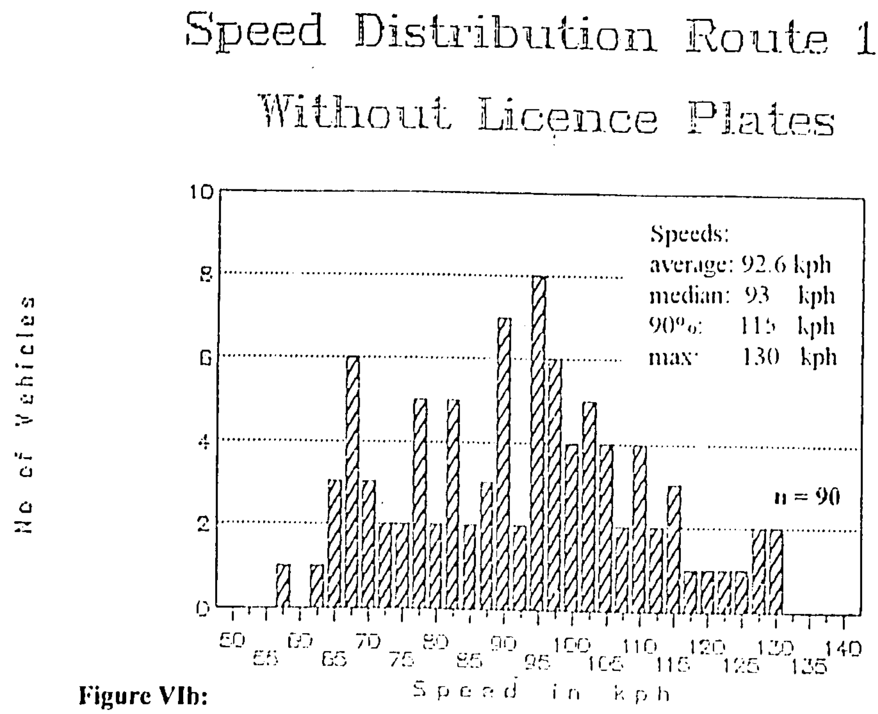


Figure VIb:

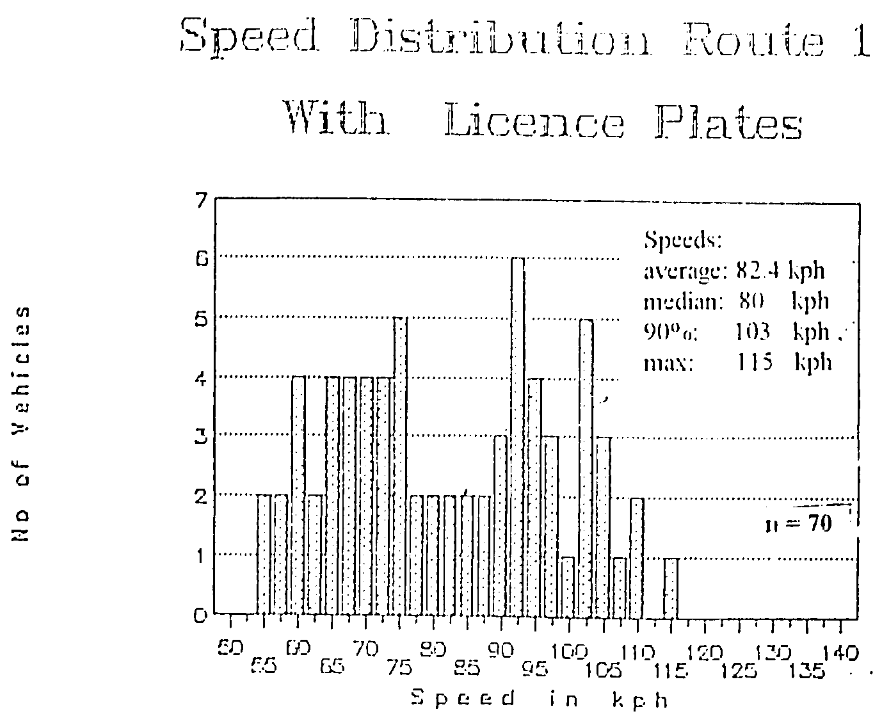


Figure VII:
EL MAROM Y SU COLOCACIÓN EN DOS PUNTOS

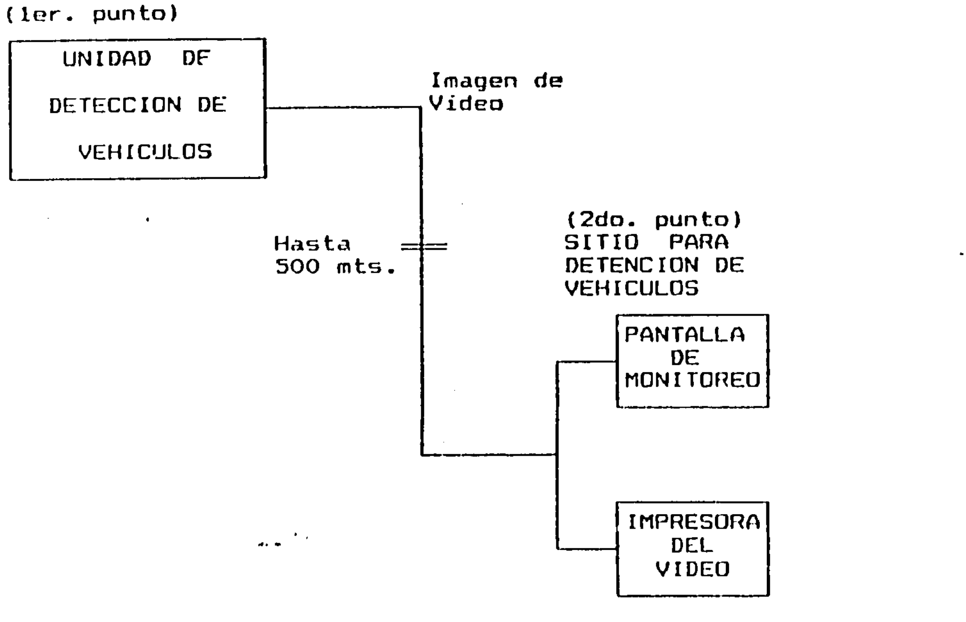
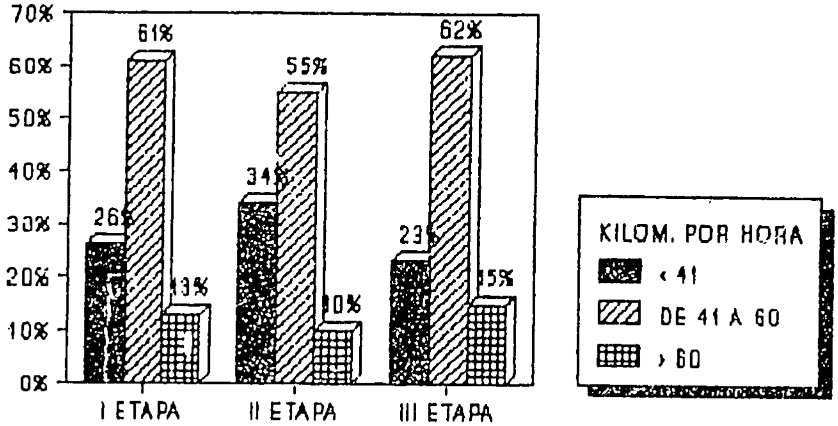


Figura VIII:

DISTRIBUCION DE CONDUCTORES VELOCISTAS
SEGUN VELOCIDAD A LA QUE VIAJABAN



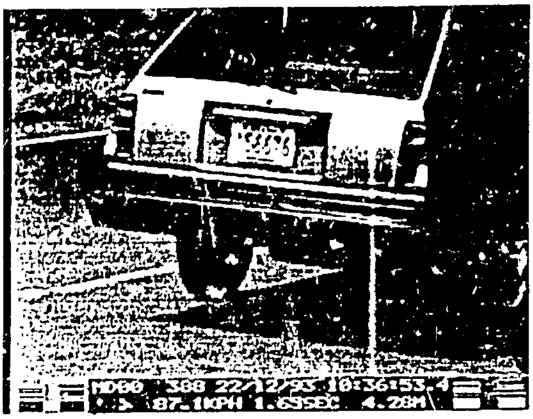
FUENTE: ELABORACION PROPIA A PARTIR DE
LOS DATOS DE LA INVESTIGACION

Figure IX:

MINISTERIO DE OBRAS PUBLICAS Y TRANSPORTES
DIRECCION GENERAL DE TRANSITO

39

22-dec-1993



22-dec-1993

10:36:53.4

MD00

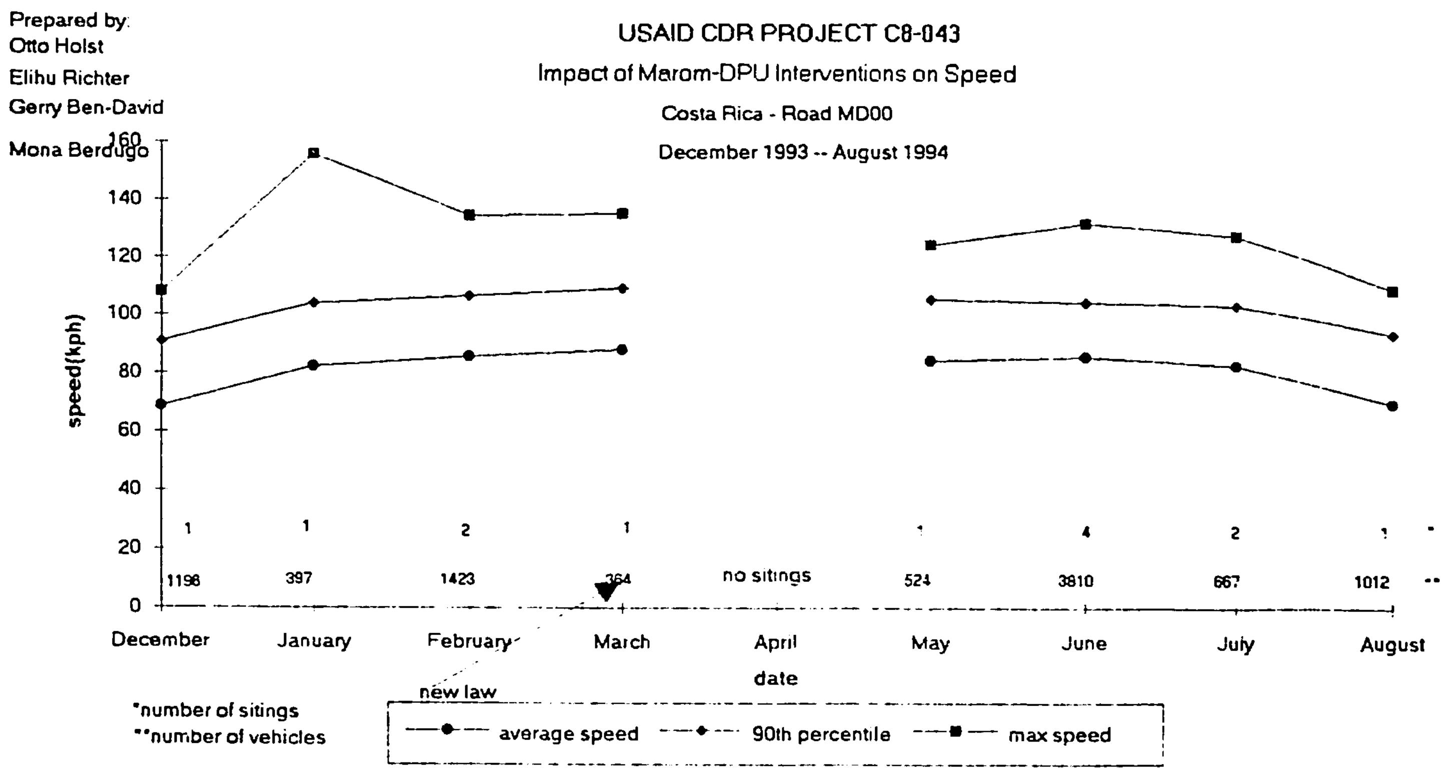
156676

87.1

1.65

5000.00

Figure X:



Prepared by:
Otto Holst
Elihu Richter
Gerry Ben-David
Mona Berdugo
USAID CDR PROJECT C8-043
Impact of Marom-DPU Interventions on Speed
Costa Rica - Road MD00
December 1993 -- August 1994
speed(kph)
160
140
120
100
80
60
40
20
0
1
1
2
1
4
2
*
1198
397
1423
364
no sitings
524
3810
667
1012
**
December
January
February
March
April
May
June
July
August
date
new law
*number of sitings
**number of vehicles
average speed
90th percentile
max speed

Figure XI:

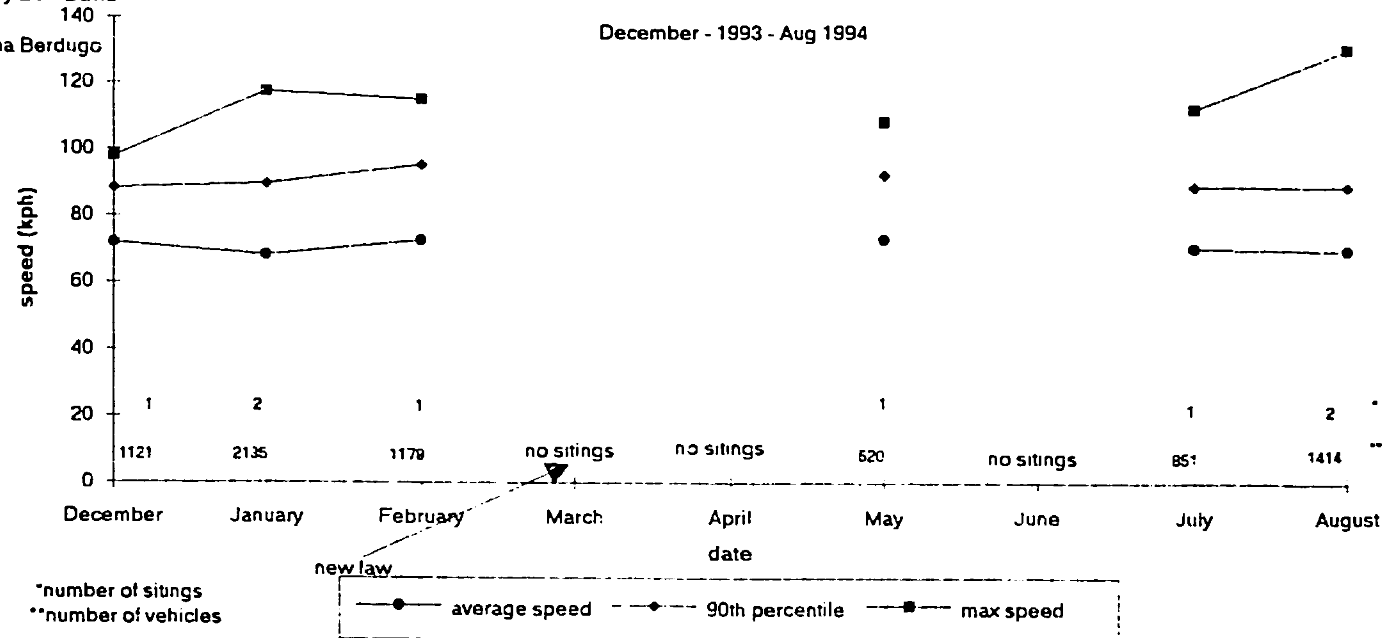
Prepared by:
Otto Holst
Elihu Richter
Gerry Ben-David
Mona Berdugo

USAID CDR PROJECT C8-043

Impact of Marom-DPU Interventions on Speed:

Costa Rica - Road RD00

December - 1993 - Aug 1994



*number of sitings
**number of vehicles

12

Figure XII:

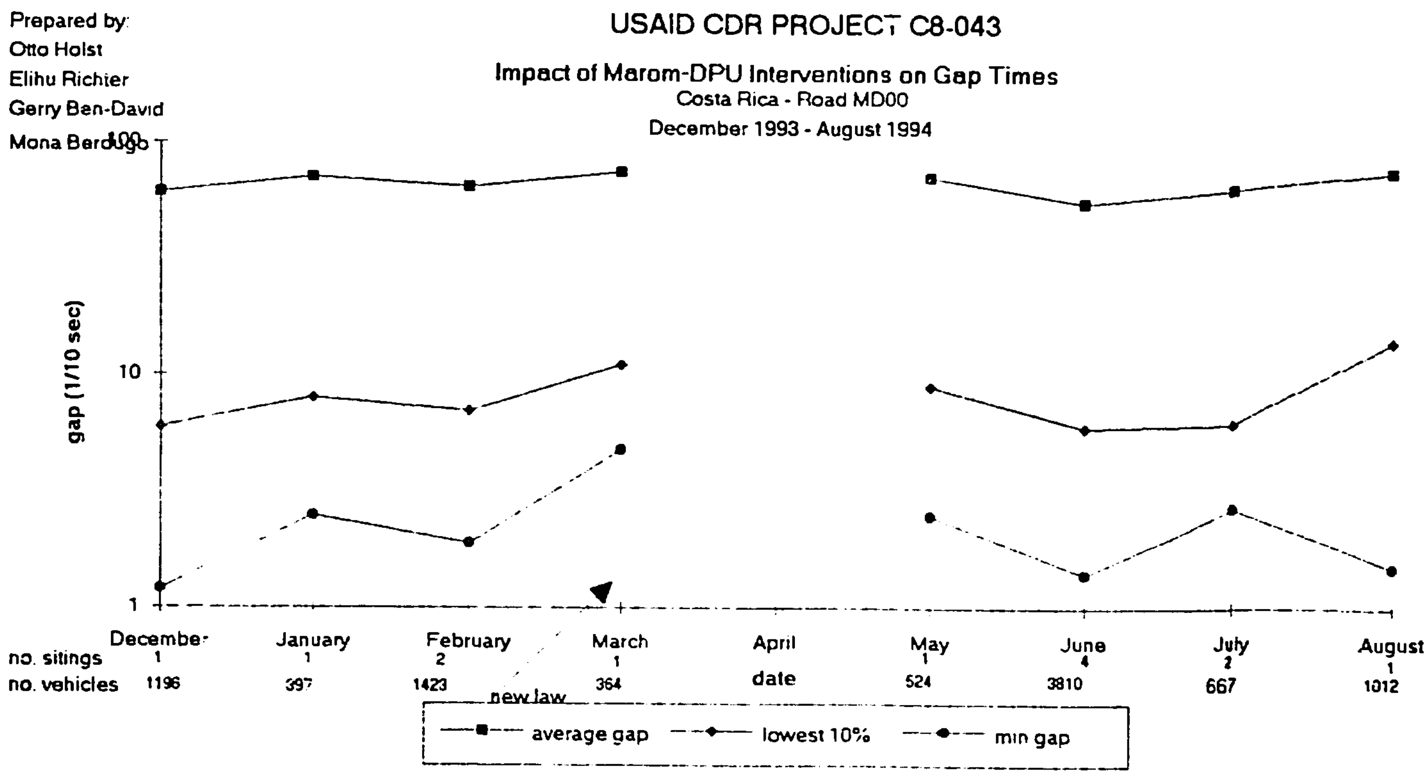


Figure XIII:

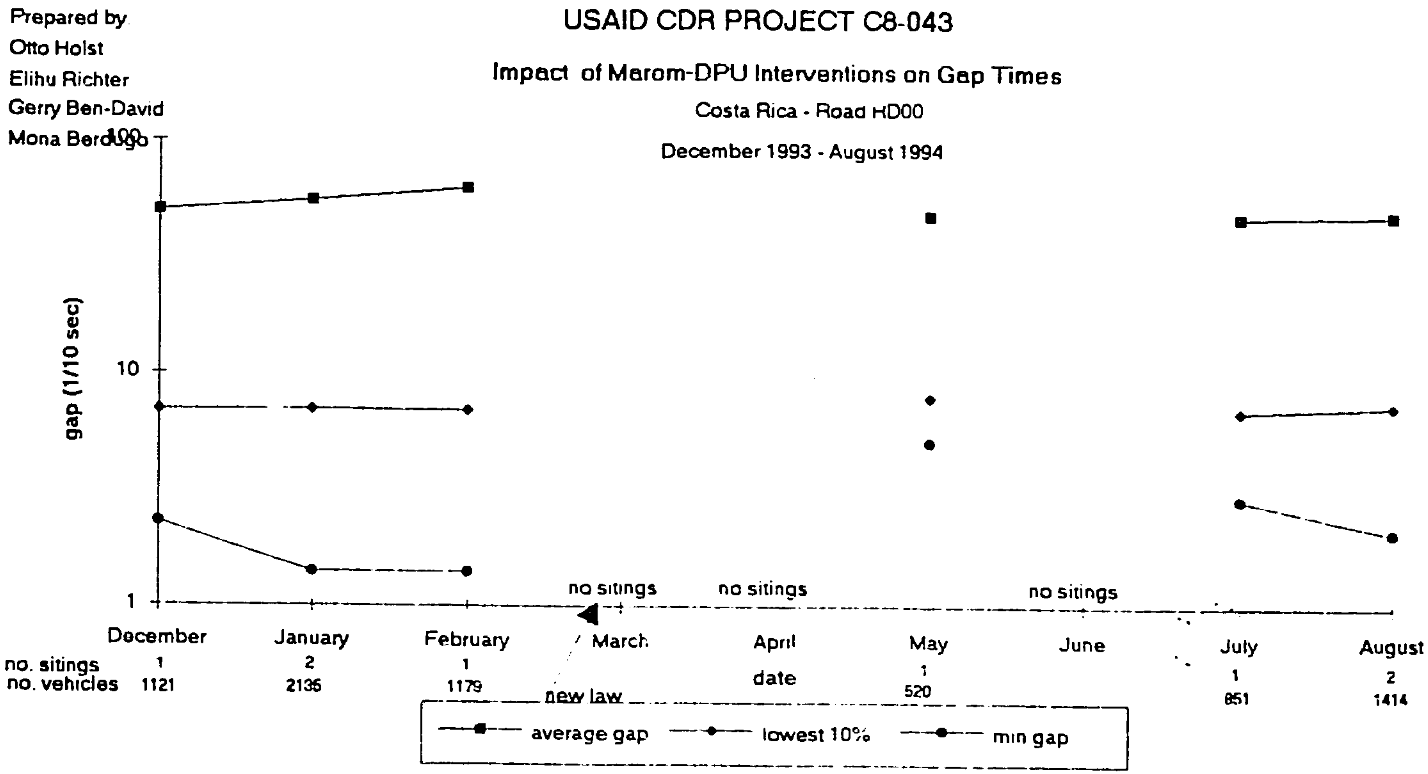
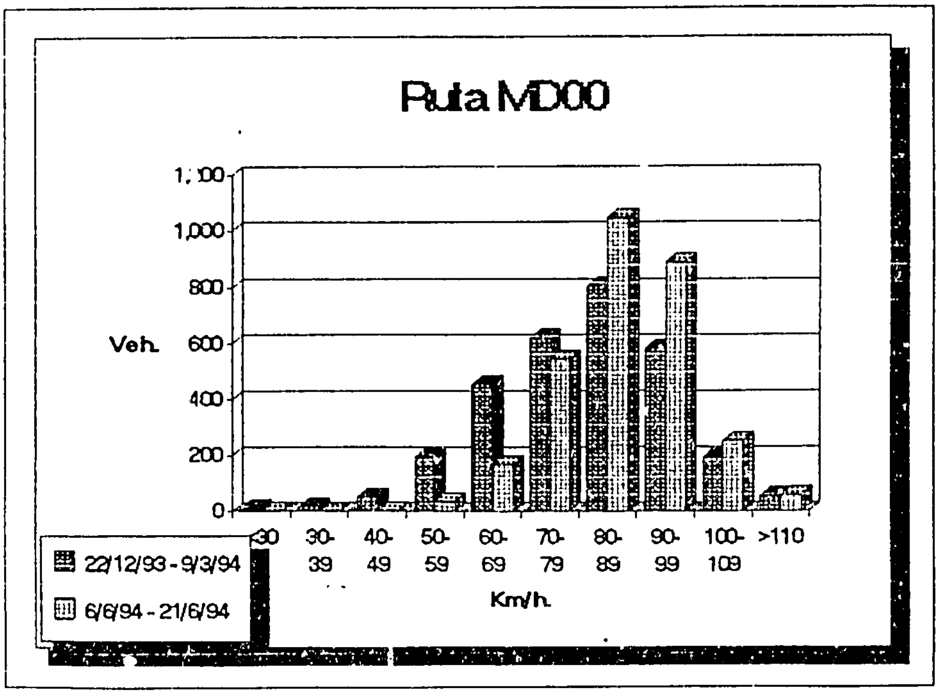

Prepared by
Otto Holst
Elihu Richter
Gerry Ben-David
Mona Berdugo
USAID CDR PROJECT C8-043
Impact of Marom-DPU Interventions on Gap Times
Costa Rica - Road HD00
December 1993 - August 1994
gap (1/10 sec)
100
10
1
no sitings
no sitings
no sitings
December
January
February
March
April
May
June
July
August
no. sitings
no. vehicles
1
1121
2
2135
1
1179
new law
date
1
520
1
851
2
1414
average gap
lowest 10%
min gap

Figure XIV:

25/8/94

Gráfico Estadístico del Marom Ruta MD00 22/12/93 - 9/3/94	
Velocidad en Km/h	***Vehículos***
<30	11
30-39	16
40-49	52
50-59	196
60-69	456
70-79	621
80-89	801
90-99	580
100-109	830 194
>110	56
Total	2,983

% > 90 kph 27.8%



Nota 1: 22/4/93 Nueva Ley de Tránsito
Nota 2: 2/3/94 Primera Notificación

Figure XV:

25/8/94

Gráfico Estadístico del Marom Ruta MD00

6/6/94 - 21/6/94

Velocidad en Km/h		*Vehículos*
<30		0
30-39		1
40-49		4
50-59		35
60-69		169
70-79		548
80-89		1,046
90-99		888
100-109	1199	253
>110		58
Total		3,002

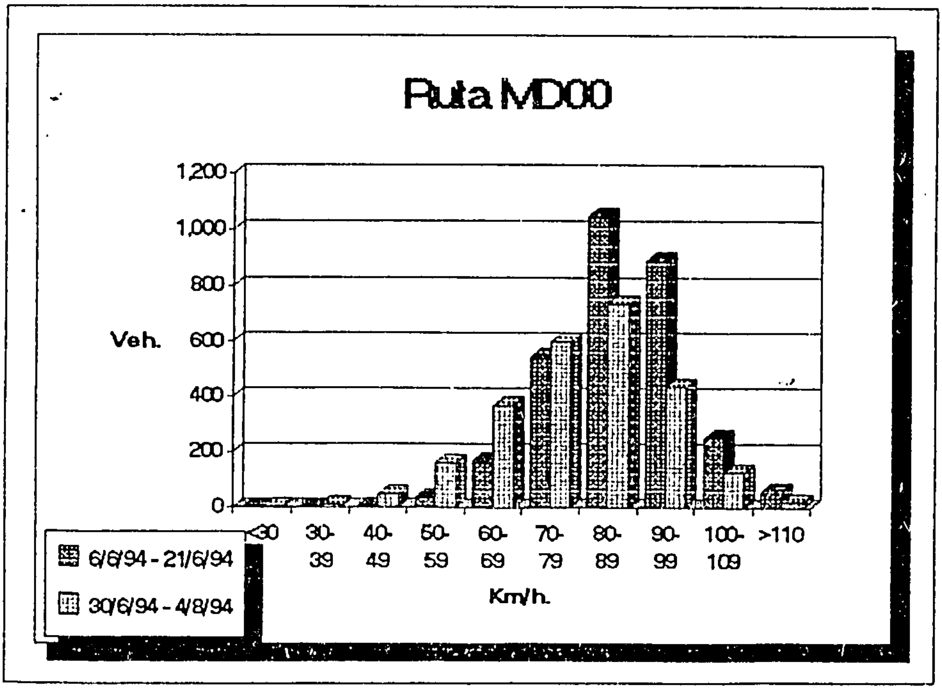
% > 90 kph 39.9%

Gráfico Estadístico del Marom Ruta MD00

30/6/94 - 4/8/94

Velocidad en Km/h		*Vehículos*
<30		4
30-39		11
40-49		47
50-59		159
60-69		368
70-79		602
80-89		735
90-99		438
100-109	585	126
>110		21
Total		2,511

% > 90 kph 23.2%



Nota 1:	22/4/93	Nueva Ley de Tránsito
Nota 2:	2/3/94	Primera Notificación

Figure XVI:

25/8/94

Gráfico Estadístico del Marom Ruta RD00 1/7/93 - 1/2/94		
Velocidad en Km/h		***Vehículos***
<30		15
30-39		23
40-49		137
50-59		486
60-69		1,210
70-79		1,402
80-89		750
90-99		319
100-109	420	80
>110		21
Total		**4,443**

% > 90 kph 9.5%

Gráfico Estadístico del Marom Ruta RD00 13/2/94 - 8/8/94		
Velocidad en Km/h		***Vehículos***
<30		6
30-39		19
40-49		74
50-59		361
60-69		969
70-79		1,271
80-89		552
90-99		160
100-109	198	29
>110		9
Total		**3,444**

% > 90 kph 5.7%

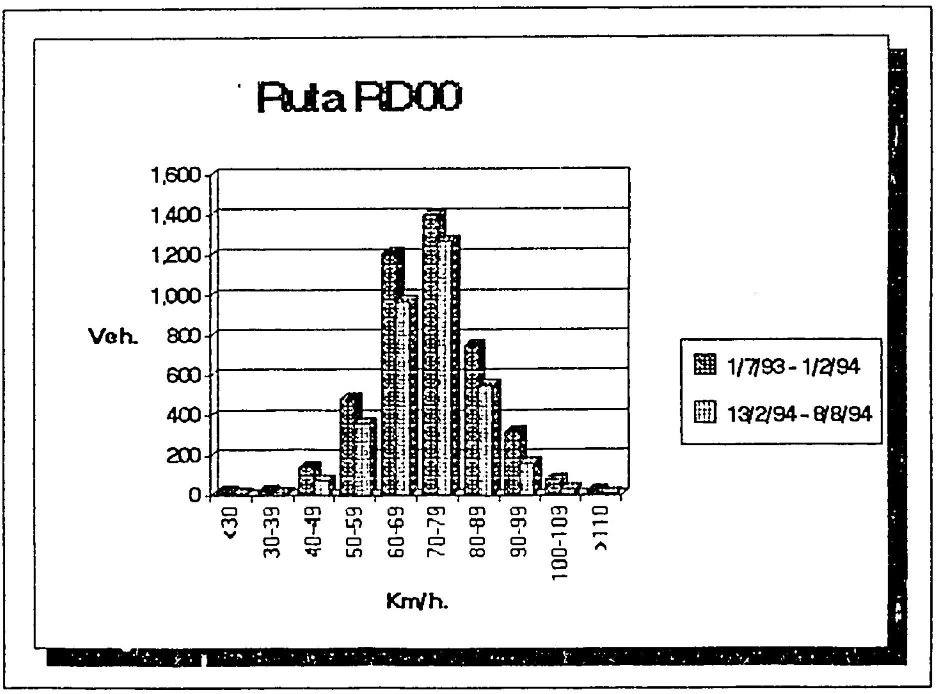


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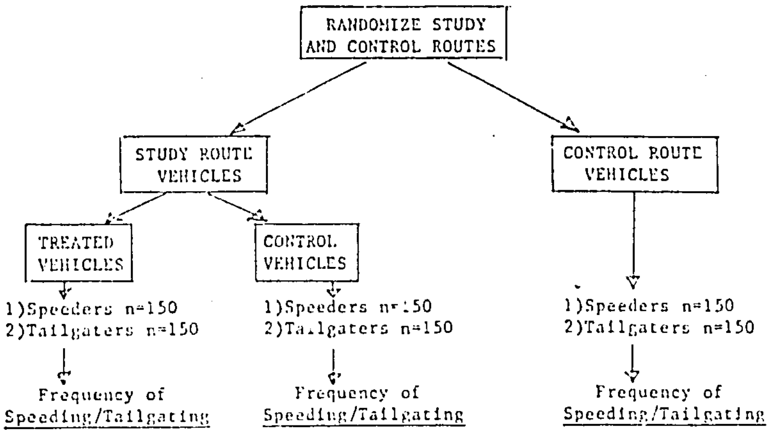
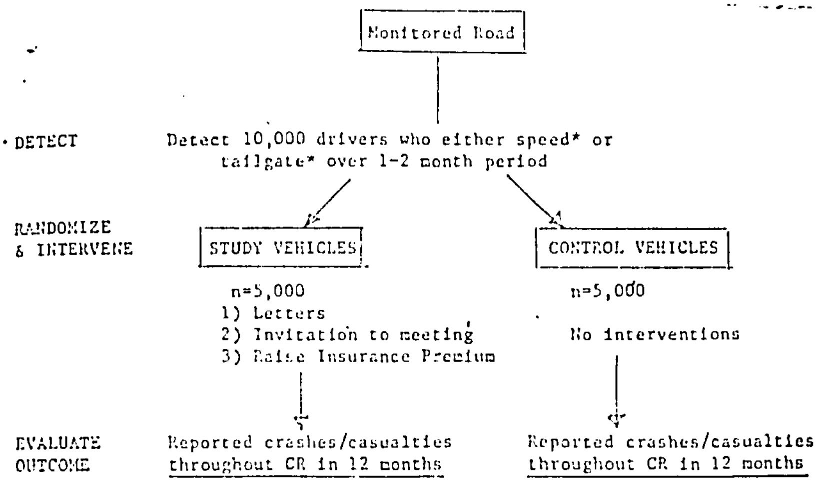
Figure XVII:

Hypothesis I: Impact of monitoring and interventions on negligent driver behaviors



Definition of eligibility for intervention	Definition of successful outcome of interventions
150 Speeders>100 kph in more than 1/2 of their trips	1/2 of those treated exceed 100 kph <50% of their previous frequency (e.g.60% → 30
150 Tailgaters Headways <1.0 sec. in more than 25% of trips	1/4 of those treated have headways <1.0 sec. at 1/2 their previous frequency (e.g. 20 → 15%)

Hypothesis II: Impact of monitoring and interventions on crash/casualty outcome



Definition of Successful Outcome: Significant reduction in crash & casualty frequency by 20% in study compared to control groups.

*per definition of Hypothesis I.

Appendix I

Data from Rehovot Urban Driver Improvement Program

	DATE	DAY	NUMBER	HOURS	VAV	%V60	%V65	%V70	%GV8
1	40793	4	1747	3.7	49.1	10.2	3.3	1.3	2
2	120793	12	2162	3.7	47.3	7.4	2.1	0.6	2
3	80893	39	2978	5.1	48.2	12.4	4.6	1.9	2
4	90893	40	3385	6.1	47.5	10.8	4.3	1.4	1.6
5	100893	41	3236	5.6	45.6	7.7	2.7	0.9	1.2
6	180893	45	3147	5.7	42.8	5.3	2	0.8	0.9
7	190893	50	3186	5.9	43.4	5.2	1.9	0.5	0.8
8	50993	67	2997	4.8	43	4.4	1.5	0.4	0.6
9	130993	75	2688	6.1	45	8.4	3.2	0.7	0.7
10	200993	82	1134	2.1	41.5	3.7	1.5	0.3	0.4
11	230993	85	2756	5.1	43.7	5.7	2.4	1	0.9
12	280993	90	3196	5.4	41.9	3.3	1.3	0.3	0.7
13	141093	106	3835	6.5	43.1	4.5	1.7	0.6	0.7
14	211093	113	2599	4.7	43.8	5.6	2.2	0.8	0.8
15	281093	120	3668	6.3	40.7	2.9	0.8	0.3	0.6
16	11193	124	428	1.8	43.3	3.5	2.6	0.9	0.2
17	71193	130	3285	5.8	43.1	4.4	1.4	0.3	0.9
18	151193	138	2096	3.6	42.3	3	1.1	0.2	0.5
19	281193	151	2688	4.9	43.7	4.2	1.5	0.6	0.8
20	31293	156	1317	2	43.6	3.8	1.4	0.5	0.7
21	81293	161	2778	6.2	43	4.3	1.6	0.5	0.9
22	201293	173	3330	6	43.3	4.8	1.5	0.2	0.6
23	50194	189	3783	6.1	41.2	3	1.2	0.4	0.5
24	110194	195	3464	5.8	41.1	3.1	1	0.3	0.4
25	170194	201	2866	5.3	42.6	3.5	1.3	0.3	0.6
26	180194	202	3548	6.6	41.1	3.5	1.3	0.4	0.6
27	70294	222	3256	5.7	40.8	2	0.6	0.2	0.2
28	160294	231	2109	3.8	42.9	3.7	1.6	0.4	0.6
29	20394	248	2058	3.6	42.2	3.4	1	0.3	0.6
30	100394	256	2694	4.7	41.5	3.2	1	0.3	0.7
31	200394	266	2686	4.5	41.7	2.9	0.9	0.1	0.3

	DATE	DAY	NUMBER	HOURS	VAV	%V60	%V65	%V70	%GV8
1	50793	5	2008	5.4	45.4	4.8	1.7	0.6	0.5
2	110793	11	1917	4.2	47.5	6.4	1.8	0.7	0.3
3	10893	32	1688	4.4	45.8	7.3	2.4	0.9	0.4
4	20893	33	544	2.3	47	6.8	2.4	0.7	0.2
5	30893	34	147	3.3	46.1	4.1	1.4	0.7	0
6	170893	48	2095	5.6	45.6	5.4	1.7	0.5	0.4
7	260893	57	999	2.7	45.6	4.2	0.9	0.1	0.6
8	80993	70	2108	6	46.2	4.6	1.3	0.4	0.5
9	140993	76	2014	6	47	6.4	1.9	0.8	0.5
10	190993	81	2303	6.5	46.6	5.5	2	0.5	0.4
11	270993	89	1985	5.8	46.2	5.1	1.8	0.4	0.4
12	31093	95	194	0.6	42.9	3.6	1	0	0.5
13	41093	96	1329	3.8	47.5	5.9	1.7	0.7	0.7
14	131093	105	2181	6.3	46.2	5.5	1.5	0.6	0.5
15	201093	112	1560	5.9	44.9	3.5	1	0.2	0.4
16	261093	118	1007	2.6	44.8	3.7	1.1	0.7	0.3
17	271093	119	2330	6.3	44.1	3	0.8	0.1	0.2
18	111193	134	1761	6.3	44.2	4.5	1.7	0.4	0.1
19	211193	144	1863	5.6	46.3	4.3	1.2	0.2	0.5
20	251193	148	543	1.5	46.7	3.1	0.6	0.4	0.7
21	291193	152	1919	5.8	44.9	3	1.3	0.6	0.2
22	51293	158	1513	5	46.2	4.4	1.7	0.8	0.1
23	91293	162	1817	5	44	2.5	0.8	0.2	0
24	161293	169	1775	5.1	45.5	4.1	1.1	0.1	0.3
25	20194	186	1988	5.6	45.1	3.5	0.8	0.4	0.2
26	120194	196	2017	5.8	45.4	3.6	1	0.2	0.1
27	230194	207	1603	4.4	45.4	3.3	1.2	0.5	0.1
28	100294	225	1754	5.1	46	3.6	1.3	0.4	0.2

LOCATION IV15

	DATE	DAY	NUMBER	HOURS	VAV	%V60	%V65	%V70	%GV8
1	50793	5	1144	2.9	45.4	4.3	0.7	0	0.3
2	110893	42	2230	5.5	44.1	4	1.4	0.6	0.1
3	250893	56	2536	6.1	42.3	1.2	0.2	0	0.3
4	90993	71	2658	6.3	43.1	2.7	1	0.3	0
5	200993	82	1367	3.4	43.2	2.4	0.8	0.3	0.1
6	61093	98	1174	2.7	42	2.1	0.5	0.1	0
7	121093	104	2867	6.6	42.2	2.2	0.4	0.1	0.2
8	181093	110	1890	5.2	42.5	2.6	0.7	0.2	0.3
9	311093	123	2704	6.4	42.3	1.9	0.6	0.1	0.1
10	141193	137	2487	6.2	43.5	2.1	0.6	0	0.1
11	231193	146	2512	6.4	42.9	1.5	0.4	0.2	0.2
12	231293	176	1906	5	43.2	2.5	1.1	0.6	0.1
13	90194	193	1701	4.3	43.1	2.6	0.9	0.4	0.2
14	270194	211	2078	5.4	42.5	1.4	0.5	0.1	0.1
15	30294	218	1764	4.8	43.3	2.1	0.6	0.1	0.1
16	140294	229	2338	5.8	43.4	2.5	0.6	0.1	0.3
17	80394	251	1176	2.9	43.1	2.2	0.9	0.2	0.3

LOCATION [illegible]

	DATE	DAY	NUMBER	HOUR	VAV.	%V60	%V65	%V70	%GV8
1	150793	15	905	2.2	58.2	43.4	24	10.6	3.4
2	150893	46	976	1.8	58.2	42.5	23.9	11.7	4.2
3	91193	132	838	1.6	56.5	37.2	17.5	6.4	3.5
4	30194	187	1339	2.2	58	39.7	19.3	8.4	5.3
		LOCATION		RA2N					
1	150793	15	787	1.6	55.9	38.5	19.6	8.3	6.5
2	150893	46	983	1.7	53.4	26.6	14.2	4.9	7.4
3	91193	132	1096	1.9	54.5	29.5	15.1	5.8	7.1
4	30194	187	1260	2	55.3	34	15.2	6.4	8.5

	DATE	DAY	NUM	HRS	VAV	%V60	%V65	%V70	%GV8
1	200793	20	1207	4.6	49.9	13	4.7	1.8	0.3
2	40893	35	1769	5.6	45.7	6.6	2.7	1	0.2
3	160893	47	1612	5.7	47.1	7.7	3.2	1.2	0.4
4	60993	68	1593	5.3	46.1	6.3	1.9	0.8	0.6
5	120993	74	1247	3.3	41.5	2.2	0.8	0.2	0.2
6	260993	88	1440	5.2	44.6	4.3	1	0.3	0.1
7	51093	97	1115	3.4	43.9	3.9	1.1	0.3	0.5
8	111093	103	1921	6.1	45.7	4.8	1.7	0.6	0.4
9	171093	109	1089	6.1	44.6	6.2	1.7	0.1	0
10	41[illegible]	127	1763	6.2	45	4.3	1.1	0.2	0.1
11	10[illegible]3	133	1859	6	45.4	4.7	1.2	0.4	0.3
12	181193	139	1429	4.7	45.6	4.9	1.6	0.6	0.1
13	241193	145	2069	6.4	42.8	2.8	1.2	0.5	0
14	21293	153	1256	4.5	46	5.6	2.1	0.6	0.2
15	61293	157	1584	5.5	45.6	5.3	2.1	0.5	0.1
16	121293	163	1808	5	44.9	3.9	1.4	0.3	0.1
17	211293	172	1933	5.6	44.7	3.5	1.3	0.6	0.3
18	261293	177	1087	5.2	45	3.1	1	0.3	0.3
19	271293	178	1926	6.1	44.8	4.2	1.2	0.3	0.1
20	281293	179	1757	5.8	44.7	4.6	1.5	0.6	0
21	291293	180	2029	6.1	44	2.7	0.8	0.2	0.1
22	301293	181	1560	5.2	44.2	2.6	0.7	0.3	0.4
23	190194	201	1874	6	44.3	4.3	1.8	0.6	0.1
24	20294	215	1311	4.5	45.6	4.7	1.7	0.5	0.2
25	150294	228	1720	5.4	45.3	4.2	1.3	0.3	0.1
26	10394	242	1095	3.9	44.5	3.5	1	0.4	0.1

LOCATION MN1W

	DATE	DAY	NUMBER	HOURS	VAV	%V60	%V65	%V70	%GV8
1	220893	53	2440	5.8	46.5	5.5	1.3	0.2	0.8
2	70993	69	2324	5.6	47.5	5.8	1.7	0.2	0.5
3	150993	77	1062	2.1	48	7.1	2.4	0.8	0.8
4	220993	84	2605	6.3	47.1	5.7	1.6	0.2	0.7
5	290993	91	1498	3.1	46.6	5.1	1.1	0.2	0.5
6	101093	102	1647	4.3	48.1	7	2.1	0.4	1.3
7	191093	111	914	4.8	46.9	5.6	2	0.7	0.4
8	261093	118	1204	3	47	4.7	0.7	0.3	1.1
9	31193	124	1275	4	46.9	5.3	1.5	0.5	0.9
10	81193	129	2163	5.9	46	3.7	1.1	0.3	0.7
11	171193	138	2310	6	46.2	5.5	1.5	0.6	0.5
12	221193	143	2421	6.3	46.2	4.8	1.3	0.3	0.5
13	11293	152	1041	3.4	47.1	6.3	1.2	0	0.5
14	191293	170	1597	4.5	46.8	4.6	1.7	0.7	0.9
15	60194	188	2170	5.5	45.2	2.8	1	0.4	0.7
16	100194	192	2184	5.9	45.1	3	0.7	0.1	0.6
17	200194	202	2070	5.3	45.6	3.8	1	0.1	0.7
18	310194	213	2336	5.6	45.4	3.4	0.7	0.1	0.3
19	280294	241	1618	4.4	46.3	3.2	0.7	0.2	1.4
20	90394	250	2168	5.3	45	3.4	0.9	0.4	0.4
21	150394	256	2536	5.9	46.1	4.5	1.2	0.5	0.7

Appendix II

Conclusions: Costa Rica Social Worker Project

\\|b

CONCLUSIONES

Los accidentes de tránsito son una problemática multicausal, en la que intervienen y se entremezclan una serie de factores que precipitan la posibilidad de que ocurra cierto hallazgo.

Se logró identificar cómo intervienen los tres factores presentes en la ocurrencia de los accidentes (el factor vehicular, la infraestructura vial y el factor humano). En algunos accidentes la causa se centra en uno de los factores, en otros se entremezclan varios para ocasionar accidentes.

En cuanto al factor vehicular, es el que menor cantidad de accidentes ocasiona. Este se refiere al mantenimiento del vehículo y a la posesión de dispositivos de seguridad como son los triángulos de prevención, estinguidores y el cinturón de seguridad.

La infraestructura vial se refiere al estado de las carreteras, a la existencia de señales de tránsito, disponibilidad de aceras, semáforos y otros dispositivos de seguridad que alerten al conductor y al peatón.

Finalmente, el factor humano se ha considerado como el elemento más importante en la ocurrencia de accidentes. El cual se refiere tanto a la conducta del peatón como a la del conductor en las vías públicas.

Con base en la experiencia de los conductores, se logró dilucidar que este factor es el que incide con mayor importancia en la generación de accidentes.

Cabe mencionar que los conductores estudiados (los velocistas y los que laboran como conductores) coincidieron con las estadísticas nacionales al afirmar que la imprudencia del conductor y la del peatón son las causas principales en la generación de accidentes, con porcentajes del 62% y del 23% respectivamente.

La conducta de ambos actores se ve influenciada por una serie de estímulos existentes en las vías públicas, por lo que se afirma que la conducta es cambiante en el individuo y por lo tanto de difícil estudio. Estos estímulos son de carácter interno y externo.

Los estímulos internos se caracterizaron por ser problemas o carencias en el sub-sistema individual y familiar de los afectados como la muerte de un familiar, problemas económicos, despidos y otros. Los externos se refieren a situaciones independientes a los afectados, como el ruido en las carreteras, las presas, los otros conductores y las presiones laborales.

Todas estas situaciones producen cambios negativos en la conducta vial de los usuarios de las vías y los impulsan a actuar de manera transgresora de la seguridad vial en general.

Cabe mencionar que los conductores pueden ubicarse en cualquier punto del continuo comportamental cuyos polos son el comportamiento o conducta responsable y el irresponsablemente vial. La ubicación de los individuos varía de acuerdo con la capacidad de autocontrol que éstos tengan con respecto a los estímulos que enfrentan.

La investigación permitió diagnosticar la influencia de la conducta del usuario de las vías en la generación de accidentes y algunos estímulos que la afectan, lo cual facilita la posibilidad de actuar preventivamente en el campo de los accidentes.

El equipo investigador, conciente de las capacidades de los individuos para originar cambios en su comportamiento, evaluó conjuntamente con los conductores, la factibilidad de incursionar en el campo de la modificación conductual para disminuir o aplacar aquellas situaciones que aumentan la probabilidad de que un individuo se enfrente a un accidente de tránsito.

El proyecto en general, desarrolló dos mecanismos para la prevención de accidentes, ambos se caracterizaron por su orientación educativa como complemento de la gestión estatal, que tradicionalmente se ha caracterizado por utilizar la sanción como orientación general de las políticas.

El primer mecanismo se refirió a la capacitación, entendida esta como un proceso de retroalimentación entre los individuos que la reciben y los instructores de la actividad: tenía como objetivo fundamental fortalecer el comportamiento responsablemente vial de los conductores, con la finalidad de disminuir el riesgo de sufrir accidentes de tránsito.

Tanto la selección de dicho mecanismo de prevención, como los temas que se impartieron tuvieron importante acogida de los participantes por dos razones:

i) Se tomaron en cuenta las opiniones de los conductores entrevistados con respecto a las carencias sentidas en el campo de la seguridad vial, y

ii) Se tomaron en cuenta los resultados de un proceso de retroalimentación desarrollado entre los encargados de las organizaciones seleccionadas para la capacitación y el equipo investigador.

Mediante la capacitación se obtuvieron alcances importantes, entre los más sobresalientes están:

i) Los conductores lograron identificar situaciones estresantes en su labor y la importancia de tener un mayor control frente a estas, tanto en las carreteras como en la vida cotidiana.

ii) Al impartir temas sobre relaciones humanas y estrés, los conductores interiorizaron que la problemática vial no solo está compuesta por aspectos sobre destrezas y habilidades para conducir y legislación, sino que integran elementos de indole comportamental tales como: los rasgos de la personalidad, la conducta y las relaciones con compañeros y usuarios de las vias, también son determinantes para mantener un comportamiento vial responsable.

iii) Con el desarrollo de los temas sobre seguridad vial. se planteó la necesidad de que se brinde continuidad para el refrescamiento de conocimientos.

Con respecto a las mediciones realizadas por el **MAROM** se presentó una modificación en la velocidad de circulación durante las diferentes etapas de las mediciones, conforme fueron avanzando las etapas se presentó una disminución del número de personas que conducían dentro del límite de velocidad establecido y a su vez disminuyó la cantidad de vehículos que circulaban por encima del límite. En la tercera etapa, al final de la intervención, no existe un descenso porcentual en comparación a las otras etapas, por el contrario hay un ligero incremento, pero si es muy llamativo que el número de vehiculos circulantes por esa carretera haya disminuido a la mitad con respecto a las mediciones iniciales. Podríamos pensar que si bien porcentualmente siempre se mantuvo la mayor parte de los vehiculos circulando por encima del límite permitido, la mitad de los conductores prefirieron buscar otras vías de acceso ante la posibilidad de ser detectados conduciendo a exceso de velocidad y ser multados.

Creemos que con la nueva Ley de Tránsito y sistemas de detección de alta tecnología como el que usamos, capaz de detectar hasta 2000 infractores por hora, lograremos modificar el comportamiento de nuestros conductores en lo que se refiere a exceso de velocidad y distancia de seguimiento apropiada.

LIMITACIONES DEL PROYECTO

A) EN EL AREA INVESTIGATIVA:

1. No se contó con datos estadísticos recientes sobre la problemática vial, lo que imposibilitó al grupo investigador disponer de información reciente (últimos dos años) que permitiera establecer tendencias actuales de la problemática vial.

2. La carencia casi total de apoyo por parte del Ministerio de Obras Públicas y Transportes, quien es en nuestro país el rector de la seguridad vial, por lo que el equipo investigador tuvo que laborar con recursos limitados durante el desarrollo total del proyecto.

3. El momento coyuntural relacionado con la aprobación de la nueva Ley de Tránsito, involucró a todos los personeros del campo de la seguridad vial en el estudio y divulgación de esta, restándole importancia a los resultados de la investigacion para atacar la problemática en nuestro país.

4. La presencia de una serie de conflictos y choques de intereses, tanto al interior de las empresas involucradas en la investigacion como en la institucion rectora de la seguridad vial en Costa Rica, y los propios de los países en vías de desarrollo, limitaron el desarrollo del proyecto.

RECOMENDACIONES

1. Que en Costa Rica se estudie y se tomen acciones preventivas en los accidentes de tránsito, tomando en cuenta todos los factores que intervienen en esta problemática, con el fin de que la gestión del gobierno tenga un caracter integral.

2. Que las instituciones nacionales afines con esta problemática tengan mayor apertura en la ejecución de proyectos de este caracter, ya que se convierten en importantes insumos para la gestión gubernamental.

3. Establecimiento de prioridades para la intervención: los datos presentados en este proyecto se constituyen en un insumo importante para que las diferentes instituciones que intervienen en esta materia, orienten parte de sus acciones y recursos a la atención preventiva en areas de prioridad.

4. Establecimiento de una estructura interdisciplinaria y permanente que se encargue de la investigación en este campo, fundamentalmente en los siguientes aspectos.

- Mejoramiento de los sistemas de registro de información, los que se constituirán en un medio que suministre información para la toma de decisiones.

- Profundizar en la caracterización de los grupos de mayor vulnerabilidad para fortalecer la capacitación.

- Fortalecer los sistemas educativos y de capacitación sobre la seguridad vial tanto en centros educativos como en empresas o instituciones con flotas numerosas de vehículos.

- Fortalecer las campañas de prevención desarrolladas en los medios de comunicación masivos.

- Utilización de una metodología pedagógica que facilite e incremente la asimilación de la conducta vial responsable para los programas educativos en las diferentes instancias donde se desarrollarán.

5. Dado los altos costos económicos tanto para el Estado como para las familias afectadas y las consecuencias sociales permanentes que sufren los accidentados, es obligación para las instituciones rectoras de nuestro país incluir el tema de **"seguridad vial"** como una materia calificada y obligatoria dentro del currículum de primaria y secundaria de nuestra educación nacional.

6. Dada la ineficiencia del Consejo de Seguridad Vial como dependencia del Ministerio de Obras Públicas y Transportes, se recomienda su independencia con sus propias entradas económicas, así como mejorar la integración de este Consejo cuyos miembros deben poseer alto nivel de poder de decisión y a la vez pertenecer a las siguientes instituciones nacionales: Caja Costarricense de Seguro Social, Ministerio de Obras Públicas y Transportes, Instituto Nacional de Seguros, Ministerio de Salud y Ministerio de Educación

7. Que las recaudaciones de las multas por infracciones y el cobro de peajes sea invertido sin desviaciones en el mantenimiento y señalización de las carreteras, en lugar de la construcción de la mismas.

8. Implantar la obligatoriedad del buen mantenimiento de los vehículos, tanto para las empresas e instituciones con numerosas flotas como para los conductores particulares; así como la revisión constante del estado de los vehículos por parte de los inspectores de tránsito.

9. Procurar la profesionalización de los policías de tránsito, con la finalidad de contar con personal más capacitado y dirigido por una ética laboral.

10. El exceso de velocidad y al no mantener una apropiada distancia de seguimiento constituyen junto con el falso adelantar y el irrespeto a las señales de tránsito, las principales causas de los accidentes. Por tal motivo, la vigilancia en las carreteras debe ser rápida, eficiente y con un costo-beneficio rentable, por lo que los sistemas de detección en carretera deben funcionar a un nivel tal que realmente tengan impacto y modifiquen los hábitos del conductor. Creemos que con la nueva Ley de Tránsito y sistemas de detección de alta tecnología como el que usamos, capaz de detectar hasta 2000 infractores por hora, lograremos modificar el comportamiento de nuestros conductores en lo que se refiere a exceso de velocidad

Appendix III

Data from Marom-DPU Interurban Intervention Project
Sept 1993 - Sept 1994

Summary of Costa Rica Data for Sites MD00 and RD00

Site MD00

Date	22/12/93	11/01/94	04/02/94	08/02/94	08/03/94
Time	9:50-12:19	9:15-10:46	8:30-10:31	8:17-10:19	8:36-10:09
hours	2:28	1:31	2:01	2:02	1:33
n	1196	397	704	719	364
avspeed	69.0	82.2	84.5	87.1	88.0
sdspeed	13.3	11.9	11.4	12.9	12.7
upper 90pcl	91.1	104.1	104.3	109.2	109.4
n> 100	9	26	51	98	55
maxspeed	108.1	155.5	127.0	134.7	135.1
avgap	6.07	6.99	6.38	6.33	7.33
sdgap	3.5	3.5	3.6	3.6	3.3
lowest10%	0.6	0.8	0.7	0.7	1.1
n < 1sec	99	31	58	60	17
mingap	0.12	0.25	0.20	0.19	0.48

Date	11/05/94	06/06/94	09/06/94	21/06/94	30/06/94
Time	9:00-11:00	7:04-9:14	7:05-9:21	7:10-9:21	7:23-9:18
hours	2.00	2.10	2:16	2:11	1:55
n	524	1044	1026	932	808
avspeed	84.3	85.9	86.9	84.1	85.6
sdspeed	12.3	10.8	10.9	11.7	10.4
upper 90pcl	105.4	104.8	106.3	104.1	103.1
n> 100	43	92	107	67	52
maxspeed	124.2	123.1	124.0	131.8	126.7
avgap	7.0	5.35	5.59	5.23	5.64
sdgap	3.5	3.6	3.6	3.7	3.7
lowest10%	0.9	0.6	0.6	0.6	0.6
n < 1sec	32	129	128	132	90
mingap	0.25	0.14	0.23	0.18	0.23

Date	15/07/94	28/07/94	04/08/94
Time	7:71-9:16	9:10-9:44	9:09-10:56
hours	1:25	0:34	1:47
n	527	140	1012
avspeed	81.7	86.4	70.1
sdspeed	12.2	12.6	13.2
upper 90	102.3	106.7	93.5
n> 100	30	20	17
maxspeed	127.5	116.1	108.9
avgap	5.92	7.17	7.39
sdgap	3.6	3.5	3.1
lowest10%	0.6	0.7	1.4
n < 1sec	62	13	28
mingap	0.27	0.34	0.15

Site RD00

Date	28/12/93	10/01/94	16/01/94	13/02/94
Time	8:16-10:15	9:01-10:31	13:52-18:15	7:10-9:09
hours	2:00	1:31	4:23	2:00
n	1121	862	1273	1179
avspeed	72.0	66.6	69.0	72.5
sdspeed	9.3	11.3	13.2	13.2
upper 90	88.4	85.3	92.0	95.2
n> 100	0	2	14	21
maxspeed	98.0	117.3	111.6	115.0
avgap	4.98	5.05	5.72	6.21
sdgap	3.5	3.46	3.8	3.9
lowest10%	0.7	0.7	0.7	0.7
n < 1sec	105	71	122	117
mingap	0.23	0.25	0.14	0.14

Date	20/05/94	05/07/94	05/08/94	08/08/94
Time	6:47-7:56	7:59-9:13	9:03-10:05	8:30-9:49
hours	1:09	1:14	1:00	1:19
n	520	851	620	794
avspeed	72.9	70.4	69.6	70.1
sdspeed	11.2	10.2	10.7	10.3
upper 90	92.2	88.8	89.4	88.5
n> 100	4	5	4	2
maxspeed	108.2	112.1	130.3	103.2
avgap	4.74	4.68	4.95	4.71
sdgap	3.4	3.4	3.4	3.4
lowest10%	0.8	0.7	0.8	0.7
n < 1sec	57	85	49	85
mingap	0.51	0.29	0.29	0.21

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vspeed = 81.6 sigspeed= 12.1 midspeed= 82.5 maxspeed= 127.5 minspeed= 30.3
percentile speed = 102.2. RMS ten-percentile speed = 6.2
of vehicles with speed above 60 kph : 530 (96.2 %)
of vehicles with speed above 70 kph : 466 (84.6 %)
of vehicles with speed above 75 kph : 390 (70.8 %)
of vehicles with speed above 80 kph : 318 (57.7 %)

vgap = 5.91 siggap = 3.59 midgap = 6.00 maxgap = 9.90 mingap = 0.27
percentile gap = 0.6. RMS ten-percentile gap = 0.2
of vehicles with gap below 2 second : 116 (21.1 %)
of vehicles with gap below 1 second : 66 (12.0 %)
of vehicles with gap below 0.8 second : 42 (7.6 %)
of vehicles with gap below 0.5 second : 17 (3.1 %)

vlen = 5.01 siglen = 2.42 midlen = 4.30 maxlen = 17.49 minlen = 2.34

Speed, Gap, Length, Histogram for 551 Vehicles

Speed		Frequency	Gap		Frequency	Gap %	Gap Fine		Frequency	Length		Frequency	Length Fine		
2.5	k/hr	0	0.5	sec	35	6.4 %	0.1	fsec	0	0.5	m	0	10.1	m	0
5.0	k/hr	0	1.0	sec	43	7.8 %	0.2	fsec	0	1.0	m	0	10.2	m	0
7.5	k/hr	0	1.5	sec	25	4.5 %	0.3	fsec	2	1.5	m	0	10.3	m	0
10.0	k/hr	0	2.0	sec	30	5.4 %	0.4	fsec	6	2.0	m	0	10.4	m	1
12.5	k/hr	0	2.5	sec	23	4.2 %	0.5	fsec	14	2.5	m	1	10.5	m	4
15.0	k/hr	0	3.0	sec	22	4.0 %	0.6	fsec	6	3.0	m	1	10.6	m	0
17.5	k/hr	0	3.5	sec	13	2.4 %	0.7	fsec	7	3.5	m	29	10.7	m	0
20.0	k/hr	0	4.0	sec	26	4.7 %	0.8	fsec	15	4.0	m	190	10.8	m	0
22.5	k/hr	0	4.5	sec	17	3.1 %	0.9	fsec	12	4.5	m	202	10.9	m	0
25.0	k/hr	0	5.0	sec	21	3.8 %	1.0	fsec	5	5.0	m	72	11.0	m	0
27.5	k/hr	0	5.5	sec	12	2.2 %	1.1	fsec	5	5.5	m	6	11.1	m	1
30.0	k/hr	2	6.0	sec	14	2.5 %	1.2	fsec	6	6.0	m	5	11.2	m	0
32.5	k/hr	0	6.5	sec	17	3.1 %	1.3	fsec	7	6.5	m	1	11.3	m	1
35.0	k/hr	0	7.0	sec	22	4.0 %	1.4	fsec	5	7.0	m	2	11.4	m	1
37.5	k/hr	0	7.5	sec	10	1.8 %	1.5	fsec	5	7.5	m	2	11.5	m	4
40.0	k/hr	0	8.0	sec	4	0.7 %	1.6	fsec	3	8.0	m	1	11.6	m	0
42.5	k/hr	0	8.5	sec	6	1.1 %	1.7	fsec	5	8.5	m	3	11.7	m	0
45.0	k/hr	1	9.0	sec	9	1.6 %	1.8	fsec	4	9.0	m	0	11.8	m	0
47.5	k/hr	1	9.5	sec	7	1.3 %	1.9	fsec	6	9.5	m	1	11.9	m	0
50.0	k/hr	1	10.0	sec	195	35.4 %	2.0	fsec	3	10.0	m	0	12.0	m	2
52.5	k/hr	2	10.5	sec	0	0.0 %	2.1	fsec	11	10.5	m	5	12.1	m	0
55.0	k/hr	6	11.0	sec	0	0.0 %	2.2	fsec	6	11.0	m	1	12.2	m	2
57.5	k/hr	5	11.5	sec	0	0.0 %	2.3	fsec	1	11.5	m	6	12.3	m	3
60.0	k/hr	7	12.0	sec	0	0.0 %	2.4	fsec	8	12.0	m	4	12.4	m	0
62.5	k/hr	11	12.5	sec	0	0.0 %	2.5	fsec	8	12.5	m	3	12.5	m	0
65.0	k/hr	19	13.0	sec	0	0.0 %	2.6	fsec	2	13.0	m	0	12.6	m	0
67.5	k/hr	18	13.5	sec	0	0.0 %	2.7	fsec	4	13.5	m	0	12.7	m	0
70.0	k/hr	29	14.0	sec	0	0.0 %	2.8	fsec	4	14.0	m	0	12.8	m	0
72.5	k/hr	43	14.5	sec	0	0.0 %	2.9	fsec	6	14.5	m	1	12.9	m	0
75.0	k/hr	30	15.0	sec	0	0.0 %	3.0	fsec	3	15.0	m	0	13.0	m	0
77.5	k/hr	41	15.5	sec	0	0.0 %	3.1	fsec	4	15.5	m	2	13.1	m	0
80.0	k/hr	38	16.0	sec	0	0.0 %	3.2	fsec	5	16.0	m	4	13.2	m	0
82.5	k/hr	49	16.5	sec	0	0.0 %	3.3	fsec	5	16.5	m	7	13.3	m	0
85.0	k/hr	50	17.0	sec	0	0.0 %	3.4	fsec	3	17.0	m	0	13.4	m	0

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7.5	k/hr	42	17.5	sec	0	0.0 %	3.5	fsec	1	17.5	m	2	13.5	m	0
0.0	k/hr	49	18.0	sec	0	0.0 %	3.6	fsec	3	18.0	m	0	13.6	m	0
2.5	k/hr	31	18.5	sec	0	0.0 %	3.7	fsec	1	18.5	m	0	13.7	m	0
5.0	k/hr	24	19.0	sec	0	0.0 %	3.8	fsec	7	19.0	m	0	13.8	m	0
7.5	k/hr	14	19.5	sec	0	0.0 %	3.9	fsec	6	19.5	m	0	13.9	m	0
0.0	k/hr	16	20.0	sec	0	0.0 %	4.0	fsec	8	20.0	m	0	14.0	m	0
2.5	k/hr	8	20.5	sec	0	0.0 %	4.1	fsec	2	20.5	m	0	14.1	m	0
5.0	k/hr	2	21.0	sec	0	0.0 %	4.2	fsec	3	21.0	m	0	14.2	m	0
7.5	k/hr	7	21.5	sec	0	0.0 %	4.3	fsec	7	21.5	m	0	14.3	m	0
0.0	k/hr	1	22.0	sec	0	0.0 %	4.4	fsec	2	22.0	m	0	14.4	m	0
2.5	k/hr	1	22.5	sec	0	0.0 %	4.5	fsec	4	22.5	m	0	14.5	m	1
5.0	k/hr	1	23.0	sec	0	0.0 %	4.6	fsec	2	23.0	m	0	14.6	m	0
7.5	k/hr	0	23.5	sec	0	0.0 %	4.7	fsec	2	23.5	m	0	14.7	m	0
0.0	k/hr	1	24.0	sec	0	0.0 %	4.8	fsec	5	24.0	m	0	14.8	m	0
2.5	k/hr	0	24.5	sec	0	0.0 %	4.9	fsec	2	24.5	m	0	14.9	m	0
5.0	k/hr	0	25.0	sec	0	0.0 %	5.0	fsec	3	25.0	m	0	15.0	m	0
7.5	k/hr	1	25.5	sec	0	0.0 %	5.1	fsec	4	25.5	m	0	15.1	m	0
0.0	k/hr	0	26.0	sec	0	0.0 %	5.2	fsec	7	26.0	m	0	15.2	m	0
2.5	k/hr	0	26.5	sec	0	0.0 %	5.3	fsec	1	26.5	m	0	15.3	m	0
5.0	k/hr	0	27.0	sec	0	0.0 %	5.4	fsec	4	27.0	m	0	15.4	m	0
7.5	k/hr	0	27.5	sec	0	0.0 %	5.5	fsec	3	27.5	m	0	15.5	m	0
0.0	k/hr	0	28.0	sec	0	0.0 %	5.6	fsec	2	28.0	m	0	15.6	m	1
2.5	k/hr	0	28.5	sec	0	0.0 %	5.7	fsec	2	28.5	m	0	15.7	m	1
5.0	k/hr	0	29.0	sec	0	0.0 %	5.8	fsec	6	29.0	m	0	15.8	m	1
7.5	k/hr	0	29.5	sec	0	0.0 %	5.9	fsec	1	29.5	m	0	15.9	m	2
0.0	k/hr	0	30.0	sec	0	0.0 %	6.0	fsec	4	30.0	m	0	16.0	m	1

iolation Matrix 1

	L < 6m		6m < L < 11m		L > 11m	
	V<60	V>60	V<60	V>60	V<60	V>60
GAP > 2	12	377	0	17	1	28
GAP < 2	8	107	0	0	0	1

olation Matrix 2

	L < 6m		6m < L < 11m		L > 11m	
	V<60	V>60	V<60	V>60	V<60	V>60
GAP > 2	12	377	0	17	1	28
1.5<GAP<2.0	0	23	0	0	0	0
1.0<GAP<1.5	[illegible]	[illegible]	0	0	0	1
.5<GAP<1.0	5	44	0	0	0	0
.0<GAP<0.5	3	14	0	0	0	0

olation Matrix/Three Speed/Three Length/Five Gap

L < 6m 6m < L < 11m L > 11m

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	V<60	60<V<70	V>70	V<60	60<V<70	V>70	V<60	60<V<70	V>70
GAP > 2	12	42	335	0	4	13	1	4	24
1.5<GAP<2.0	0	0	23	0	0	0	0	0	0
1.0<GAP<1.5	0	6	20	0	0	0	0	1	0
0.5<GAP<1.0	5	5	39	0	0	0	0	0	0
0.0<GAP<0.5	3	2	12	0	0	0	0	0	0

Platoon Statistics

	Total	Gap		Speed		Length		Leader Gap		Leader Speed		Leader Length	
Size	Cars	Mean	Sigma	Mean	Sigma	Mean	Sigma	Mean	Sigma	Mean	Sigma	Mean	Sigma
1	349	7.20	2.86	83.33	12.10	5.08	2.49	7.20	2.86	83.33	12.10	5.08	2.49
2	130	1.09	0.50	78.87	12.13	4.88	2.25	7.38	2.81	78.74	11.62	5.22	2.73
3	36	1.00	0.36	78.49	7.83	5.15	3.07	6.91	3.23	75.62	7.48	6.85	4.86
4	24	1.00	0.45	32.97	7.53	4.37	0.43	6.94	3.10	80.10	5.20	4.73	0.48
5	5	0.60	0.16	52.22	2.99	4.35	0.27	2.19	0.00	55.20	0.00	4.80	0.00
6	6	1.12	0.42	75.57	4.87	5.79	2.88	9.90	0.00	75.40	0.00	12.19	0.00
7	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix IV

Data from Marom-DPU Interurban Intervention Project
Sept 1994 - March 1995

THE FACULTY OF MEDICINE הפקולטה לרפואה

THE JOSEPH H. AND BELLE. R. BRAUN
HEBREW UNIVERSITY-HADASSAH
SCHOOL OF PUBLIC HEALTH
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P O B 1172, JERUSALEM 91010, ISRAEL.

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בית הספר לבריאות הציבור ורפואה קהילתית
של האוניברסיטה העברית והדסה
ע"ש יוסף ובלה בראון
ת.ד. 1172 ירושלים 91010

May 18 1995

To: Roberto Ortiz MD
Children's Hospital
San Jose Costa Rica

Dear Roberto:

We just received Otto Holst's latest printouts and graphics. They are very impressive, and they appear to indicate a sustained impact of the Marom Units on reduction of percentage of vehicles exceeding 90 kph. If the measurements are being made at the same or roughly same points at the same time of day under roughly similar traffic conditions, this is a startling and important finding.

Here are the data:

	Route MD00			RD00		
	>90	All	%>90	>90	All	%>90
Jan-Mar 1994	830	2983	27.8	420	4443	9.5
Aug-Sept 1994	497	3301	15.0	198	3444	5.7
				113	2861	3.9
Jan -Mar 1995	769	9098	8.5			

It would be interesting to know whether there has been a drop in crashes and casualties during this period.

Congratulations to Otto, Juanelque and everyone else.

Sincerely,

Elihu D Richter MD, MPH

cc Daniel Segre

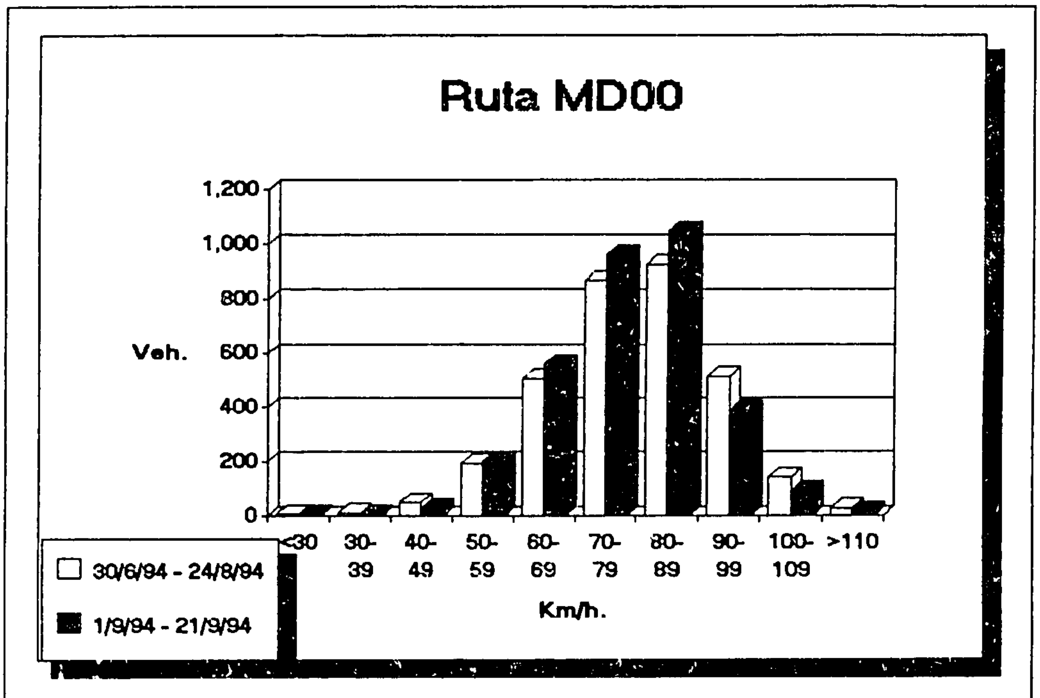
13/4/95

Gráfico Estadístico del Marom Ruta MD00 30/6/94 - 24/8/94	
Velocidad en Km/h	***Vehículos***
<30	8
30-39	11
40-49	49
50-59	182
60-69	507
70-79	867
80-89	925
90-99	516
100-109	685 < 142
>110	28
Total	3,242

% 90 kph 21.1%

Gráfico Estadístico del Marom Ruta MD00 1/9/94 - 21/9/94	
Velocidad en Km/h	***Vehículos***
<30	4
30-39	3
40-49	27
50-59	202
60-69	581
70-79	981
80-89	1,045
90-99	389
100-109	497 90
>110	18
Total	3,301

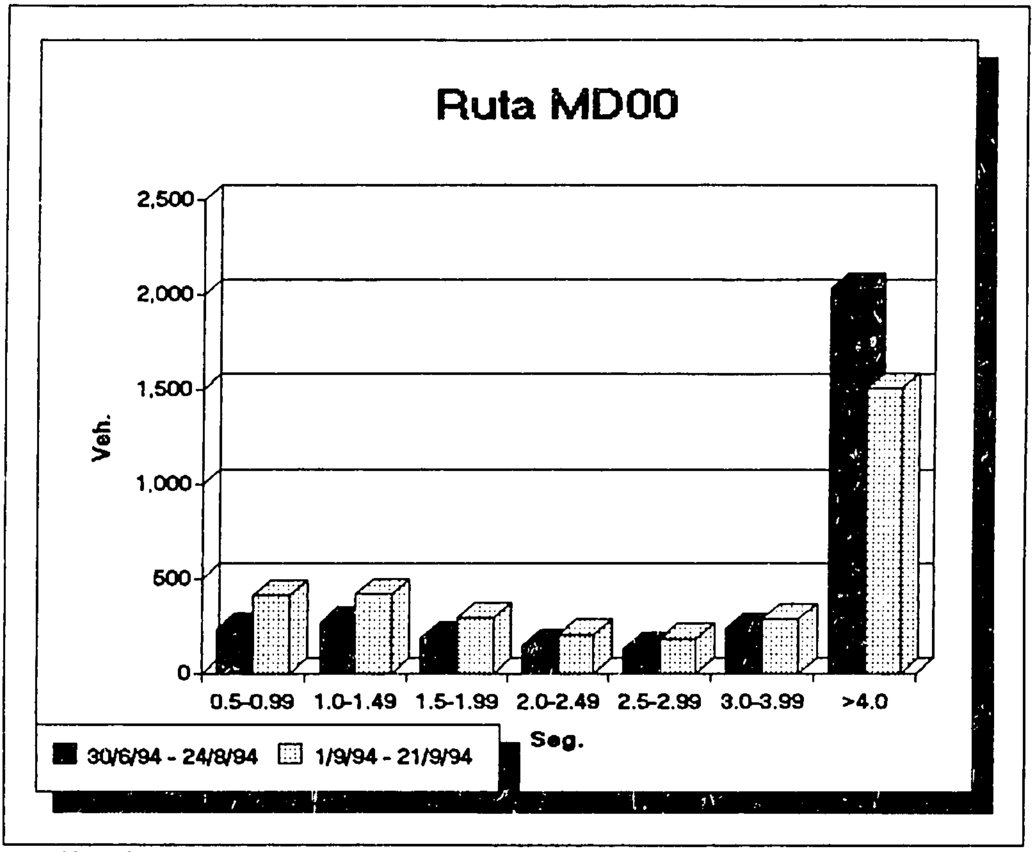
% > 90 kph 15.1%



Nota 1: 22/4/93 Nueva Ley de Tránsito
Nota 2: 2/3/94 Primera Notificación

Gráfico Estadístico del Marom Ruta MD00 30/6/94 - 24/8/94	
Distancia en seg.	***Vehículos***
0.5-0.99	233
1.0-1.49	268
1.5-1.99	169
2.0-2.49	149
2.5-2.99	131
3.0-3.99	237
>4.0	2,095
Total	3,242

Gráfico Estadístico del Marom Ruta MD00 1/9/94 - 21/9/94	
Distancia en seg.	***Vehículos***
0.5-0.99	410
1.0-1.49	416
1.5-1.99	291
2.0-2.49	205
2.5-2.99	183
3.0-3.99	298
>4.0	1,608
Total	3,301



Nota 1:	22/4/93	Nueva Ley de Tránsito
Nota 2:	2/3/94	Primera Notificación

Gráfico Estadístico del Marom Ruta MD00

30/6/94 - 21/9/94

Velocidad en Km/h	*Vehículos*
<30	10
30-39	14
40-49	76
50-59	394
60-69	1,068
70-79	1,828
80-89	1,971
90-99	904
100-109	1182 232
>110	46
Total	**6,543**

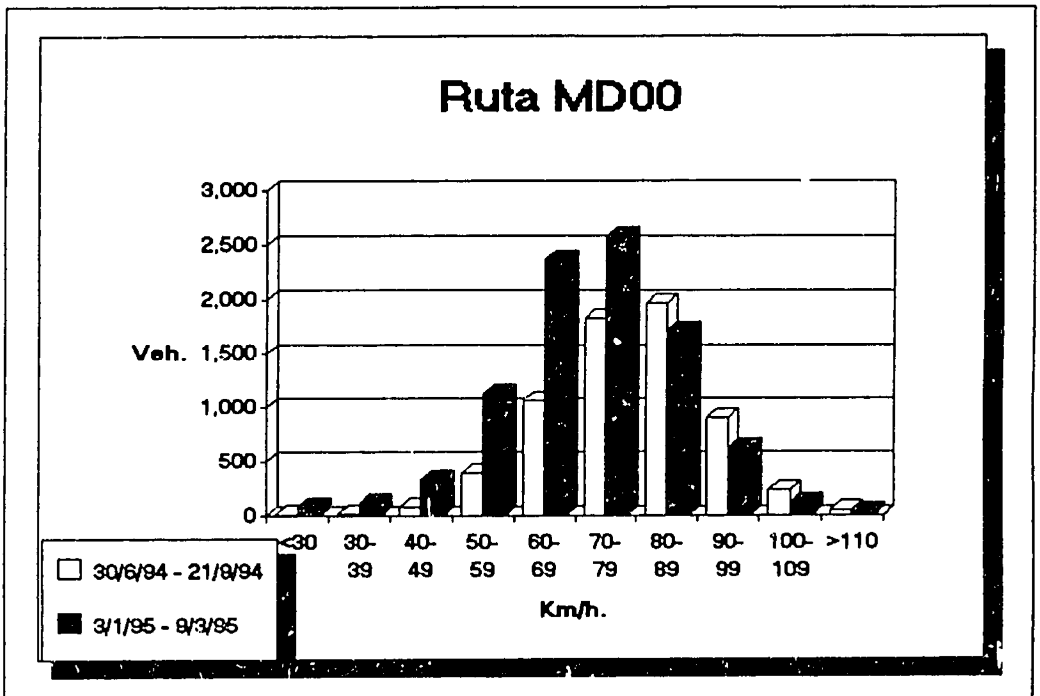
% > 90 kph 18.1%

Gráfico Estadístico del Marom Ruta MD00

3/1/95 - 9/3/95

Velocidad en Km/h	*Vehículos*
<30	83
30-39	117
40-49	338
50-59	1,190
60-69	2,387
70-79	2,577
80-89	1,717
90-99	622
100-109	769 121
>110	26
Total	**9,098**

% > 90 kph 8.5



Nota 1: 22/4/93 Nueva Ley de Tránsito

Nota 2: 2/3/94 Primera Notificación

Gráfico Estadístico del Marom Ruta RD00 13/2/94 - 8/8/94	
Velocidad en Km/h	***Vehículos***
<30	6
30-39	18
40-49	74
50-59	361
60-69	969
70-79	1,271
80-89	552
90-99	160
100-109	198 29
>110	9
Total	**3,444**

% > 90 kph 5.7 %

Gráfico Estadístico del Marom Ruta RD00 6/9/94 - 13/3/94	
Velocidad en Km/h	***Vehículos***
<30	4
30-39	9
40-49	64
50-59	300
60-69	908
70-79	1,012
80-89	451
90-99	96
100-109	113 15
>110	2
Total	**2,861**

% > 90 kph 3.9%

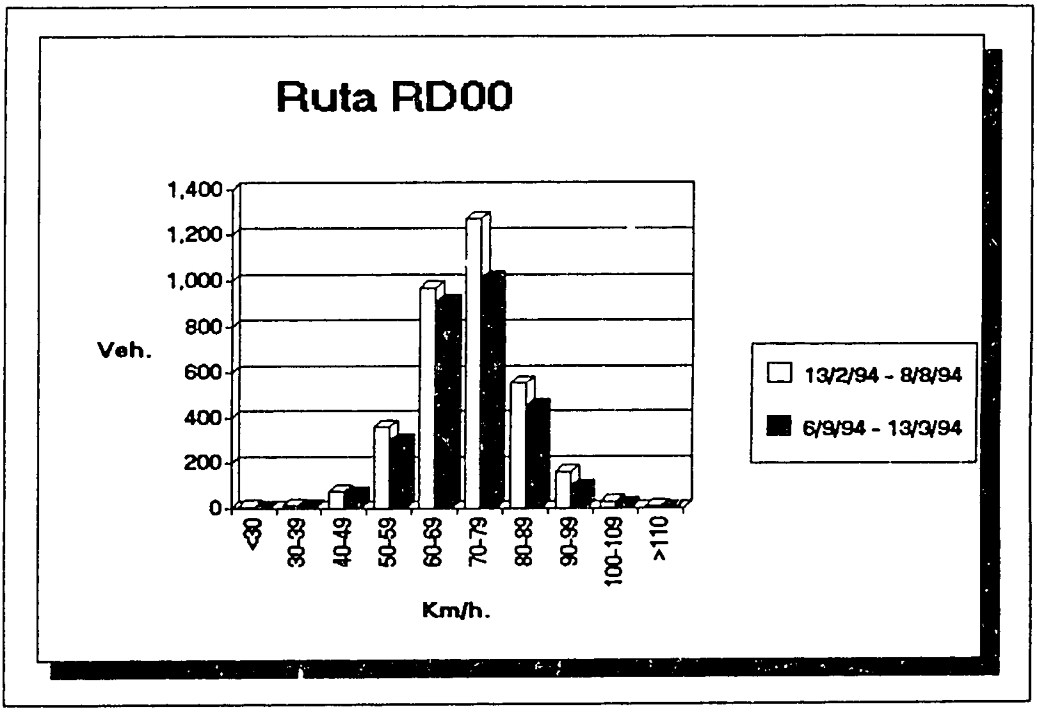
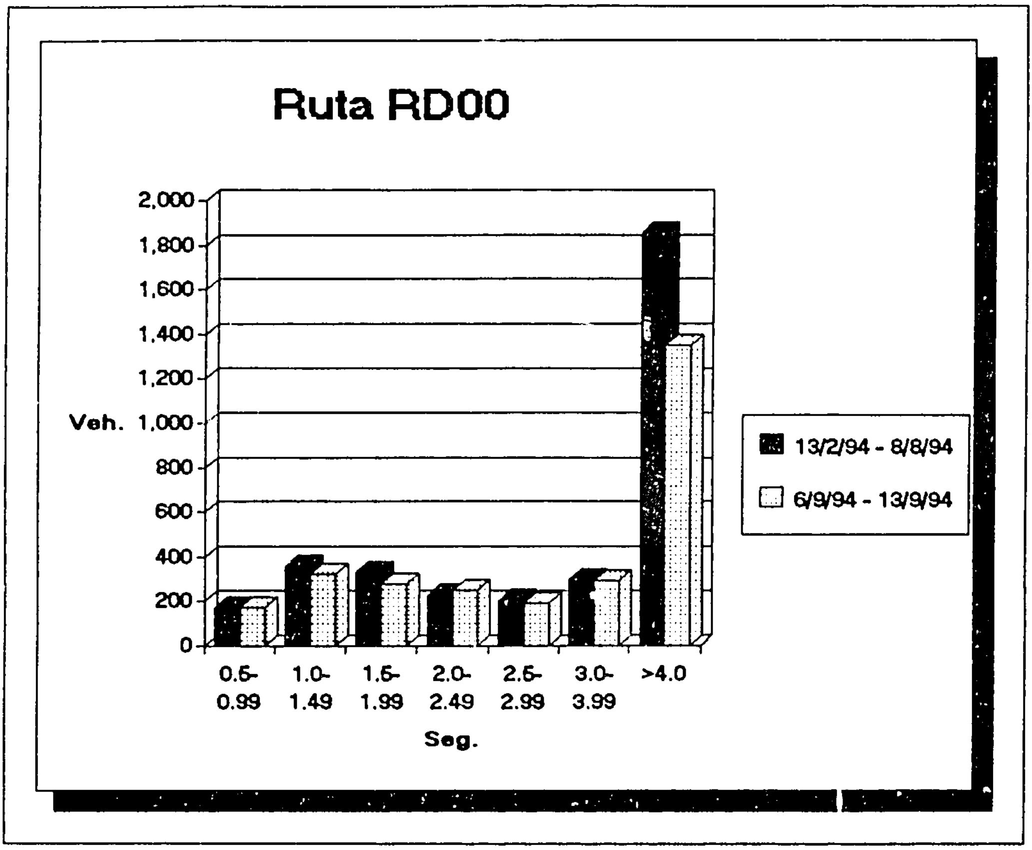


Gráfico Estadístico del Marom Ruta RD00 13/2/94 - 8/8/94	
Distancia en seg.	***Vehículos***
0.5-0.99	171
1.0-1.49	359
1.5-1.99	339
2.0-2.49	228
2.5-2.99	204
3.0-3.99	296
>4.0	1,854
Total	3,444

Gráfico Estadístico del Marom Ruta RD00 6/9/94 - 13/9/94	
Distancia en seg.	***Vehículos***
0.5-0.99	173
1.0-1.49	321
1.5-1.99	280
2.0-2.49	250
2.5-2.99	191
3.0-3.99	295
>4.0	1,351
Total	2,861



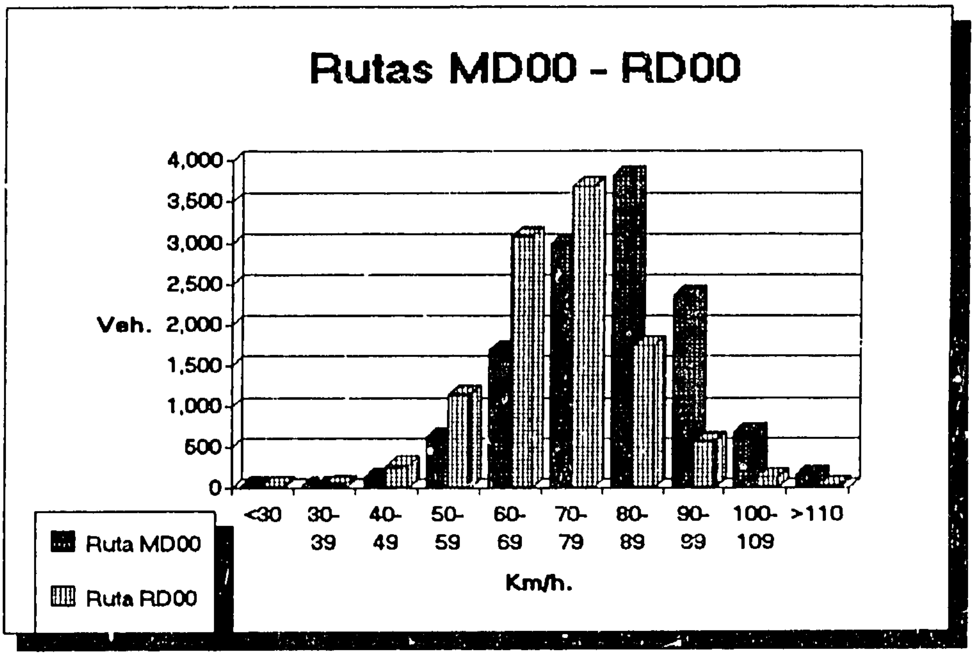
13/4/95

Gráfico Estadístico del Marom Ruta MD00	
Ruta MD00	
22/12/93 -21/9/94	
Velocidad en Km/h	***Vehículos***
<30	21
30-39	31
40-49	132
50-59	625
60-69	1,693
70-79	2,997
80-89	3,818
90-99	2,372
100-109 3211	679
>110	160
Total	12,528

% > 90 kph 25.6%

Gráfico Estadístico del Marom Ruta RD00	
Ruta RD00	
1/7/93 - 13/9/94	
Velocidad en Km/h	***Vehículos***
<30	26
30-39	45
40-49	276
50-59	1,147
60-69	3,087
70-79	3,685
80-89	1,759
90-99	575
100-109 731	[illegible]
>110	[illegible]
Total	10,748

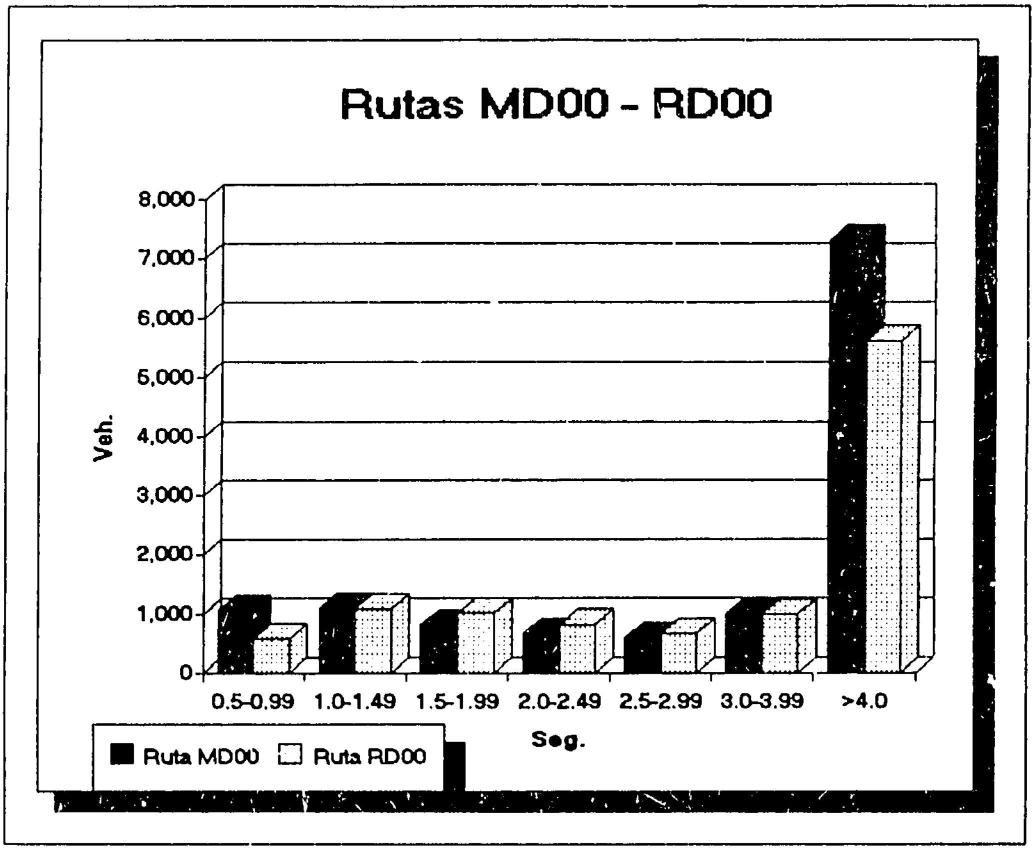
% > 90 kph 6.8 %



Nota 1: 22/4/93 Nueva Ley de Tránsito
Nota 2: 2/3/94 Primera Notificación

Gráfico Estadístico del Marom Ruta MD00 Ruta MD00 22/12/93 -21/9/94	
Distancia en seg.	*Vehículos*
0.5-0.99	1,085
1.0-1.49	1,100
1.5-1.99	818
2.0-2.49	667
2.5-2.99	590
3.0-3.99	988
>4.0	7,304
Total	12,528

Gráfico Estadístico del Marom Ruta RD00 Ruta RD00 1/7/93 - 13/3/94	
Distancia en seg.	*Vehículos*
0.5-0.99	576
1.0-1.49	1,082
1.5-1.99	1,004
2.0-2.49	821
2.5-2.99	661
3.0-3.99	990
>4.0	5,614
Total	10,748



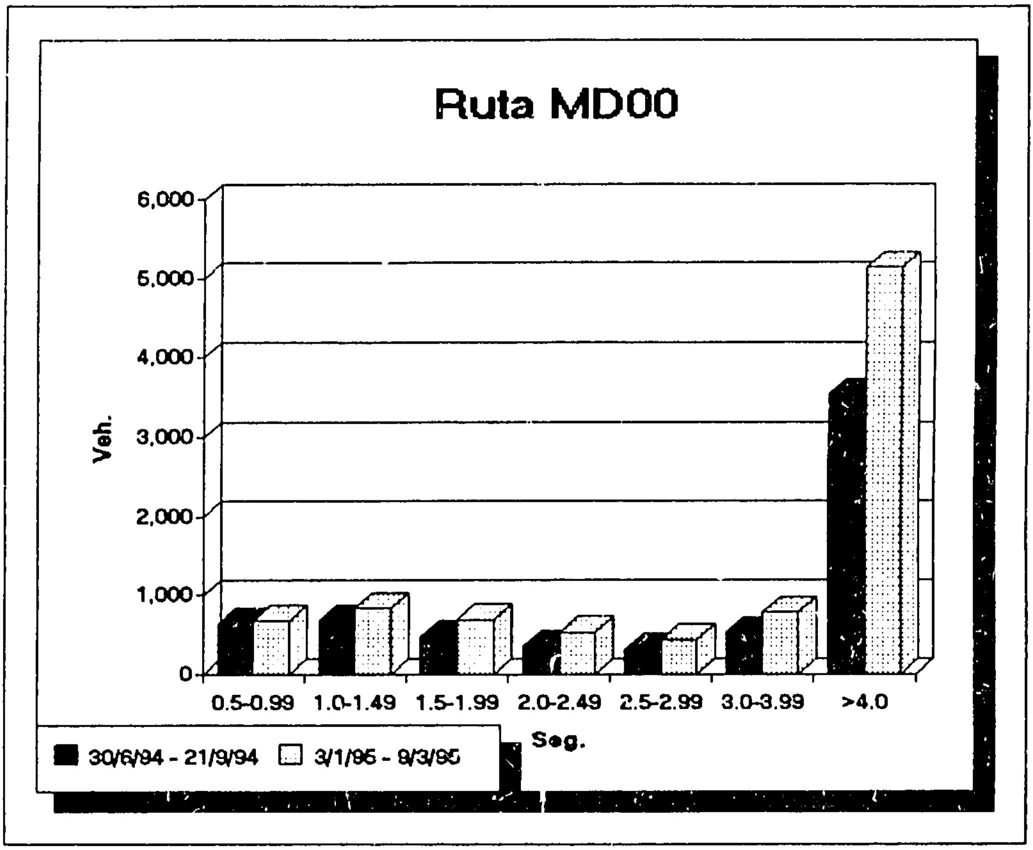
Nota 1: 22/4/93 Nueva Ley de Tránsito
Nota 2: 2/3/94 Primera Notificación

10

13/4/95

Gráfico Estadístico del Marom Ruta MD00 30/6/94 - 21/9/94	
Distancia en seg.	***Vehículos***
0.5-0.99	643
1.0-1.49	684
1.5-1.99	460
2.0-2.49	354
2.5-2.99	314
3.0-3.99	625
>4.0	3,543
Total	6,543

Gráfico Estadístico del Marom Ruta MD00 3/1/95 - 9/3/95	
Distancia en seg.	***Vehículos***
0.5-0.99	684
1.0-1.49	839
1.5-1.99	698
2.0-2.49	582
2.5-2.99	437
3.0-3.99	795
>4.0	5,128
Total	9,098

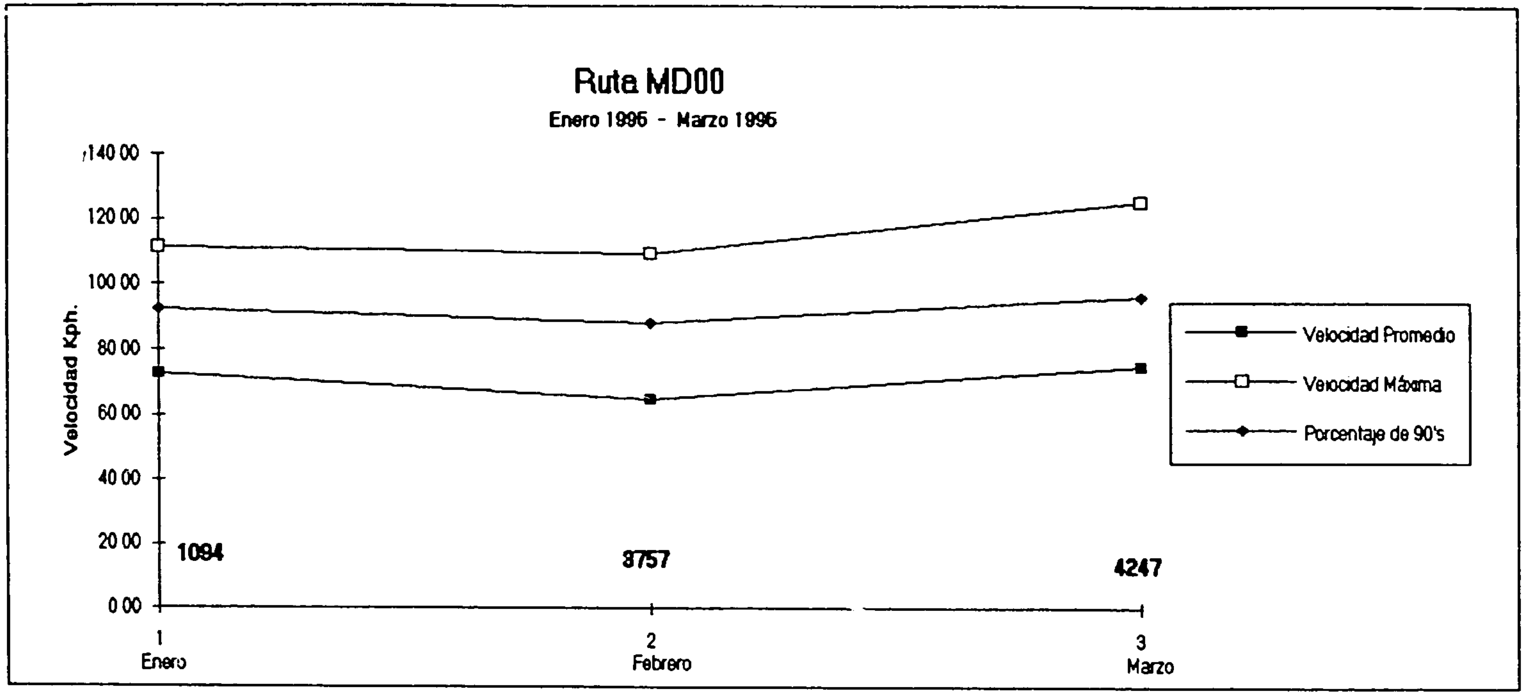


Nota 1: 22/4/93 Nueva Ley de Tránsito

Nota 2: 2/3/94 Primera Notificación

Zona MD00																								
Mes	Enero				Febrero				Marzo				Abril				Mayo				Junio			
Fecha	3/1/95	10/1/95	12/1/95		15/2/95	15/2/95	28/2/95		2/3/95	3/3/95	7/3/95	9/3/95												
Hora	7:42-12:57	8:14-9:43	15:13-15:33		6:42-8:58	15:46-18:48	6:51-9:59		7:30-9:00	15:23-16:50	6:19-7:47	6:11-7:31												
Vehículos	411	557	126		1158	1225	1374		897	515	1567	12[illegible]1												
Velocidad Prom.	68.50	67.40	82.00		61.30	67.10	66.00		79.40	71.60	73.50	75.70												
Velocidad Máxima	110.80	111.60	102.10		99.20	108.70	103.30		115.30	125.20	116.20	122.70												
Porcentaje de 90's	91.00	88.70	97.70		86.30	89.60	88.60		98.60	96.00	94.10	96.80												
Distancia Prom.	7.48	6.78	6.19		5.69	5.41	6.35		4.82	7.06	3.33	3.58												
10 % Distancia	1.70	1.00	0.70		0.80	1.00	1.10		0.50	1.30	0.50	0.50												
Distancia Mínima	0.15	0.15	0.29		0.16	0.15	0.13		0.18	0.16	0.19	0.18												

Zona MD00						
Fecha	Enero	Febrero	Marzo	Abril	Mayo	Junio
Hora	7:42 - 15:33	6:42 - 18:48	6:11 - 16:50			
Vehículos	1094	3757	4247			
Velocidad Prom.	72.63	64.80	76.06			
Velocidad Máxima	111.60	109.30	125.20			
Porcentaje de 90's	92.47	88.17	96.38			
Distancia Prom.1/10	68.17	61.50	46.98			
10 % Distancia 1/10	11.33	9.67	7.00			
Distancia Mín. 1/10	1.50	1.30	1.60			


Ruta MD00
Enero 1995 - Marzo 1995
Velocidad Kph.
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
1094
3757
4247
1
Enero
2
Febrero
3
Marzo
Velocidad Promedio
Velocidad Máxima
Porcentaje de 90's