TRANSPORT RESEARCH LABORATORY

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Reprint

TITLE **The improvement of accident data quality in Malaysia**

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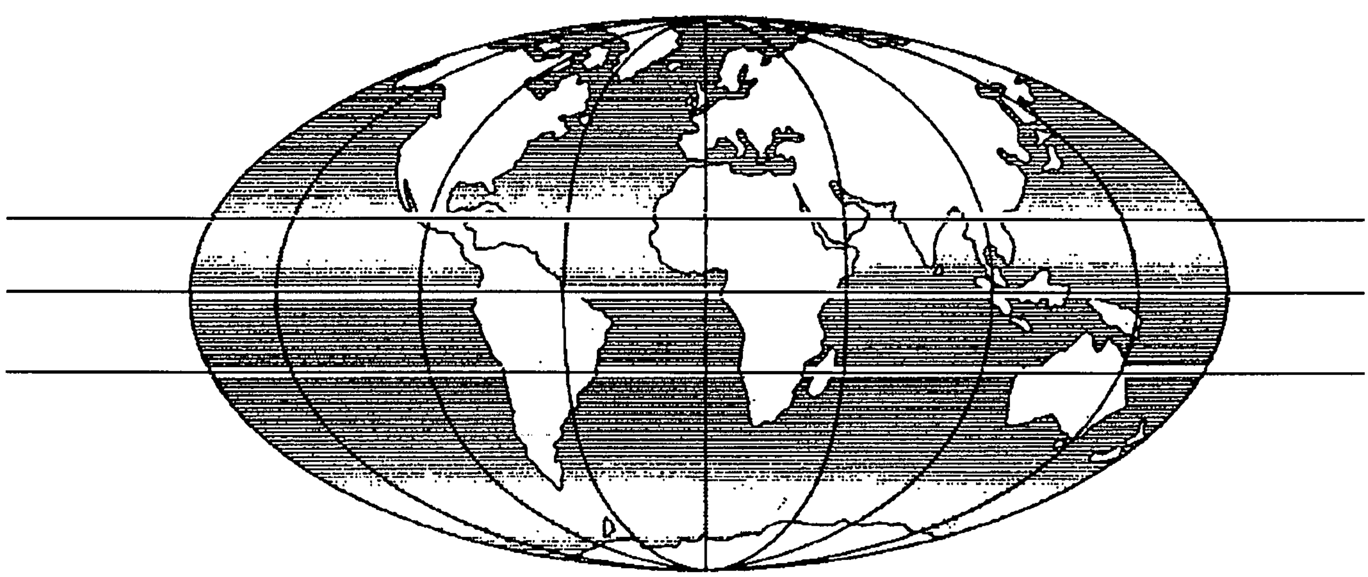

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THE IMPROVEMENT OF ACCIDENT DATA QUALITY IN MALAYSIA

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Chris Baguley graduated from the University of Wales, Aberystwyth with a BSc in Physics and was subsequently awarded an MSc in 'Physics of the Upper Atmosphere' in 1975.
Following a brief period in the food technology industry with Unilever Research, he has, for the past 18 years, been working in the road safety field at TRL, where he has been involved in a range of research projects related to driver behaviour and safety engineering measures.
He joined the Overseas Centre at TRL in 1989, initially having UK-based responsibility for the Centre's Microcomputer Accident Analysis Package, and also for the final production of a major road safety engineering guide. He has worked in eight different countries and, for the past year, has been based in Malaysia to initiate a road safety research programme at IKRAM

Ir. Radin Omar Radin Sohadi graduated from University of Sheffield in Civil and Structure Engineering (Hons) in 1984. In 1985 he obtained his M.Eng. degree in Transport and Traffic Engineering (Sheffield) and served as a lecturer in the Department of Civil and Environmental Engineering UPM. He is a member of the Institution of Engineers Malaysia and Institution of Highway and Transportation Engineers (UK).
His involvement in road safety started in 1986 as a member of Research Committee National Road Safety Council . He was responsible in designing the new police accident reporting system and responsible in the computerisation accident data in Malaysia. His research has helped many authorities in

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He is now the Head of the Infrastructural Technology Research Programme at the Faculty of Engineering UPM, the Coordinator of the Accident Research Unit, Faculty of Engineering and an Associate Professor in the Civil and Environmental Engineering, Faculty of Engineering, Universiti Pertanian Malaysia.

THE IMPROVEMENT OF ACCIDENT DATA QUALITY IN MALAYSIA

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ABSTRACT

One of the factors affecting the efficiency of a nation's transport system is the safety of its road network. In order that as high a level of safety as possible is achieved an important prerequisite is that an accurate and comprehensive accident database is maintained. This should be readily accessible and easy-to-use at both the national and local levels. Only with this can safety be monitored, the specific nature and location of safety problems investigated, appropriate remedial action designed and implemented, and the effect of that action evaluated.

This paper describes the steps already taken, as well as on-going research, to help improve the database of Malaysia. The long-term aim is to equip all rural and municipal highway authorities with a standard software package and relevant database to enable them to investigate their particular safety problems. A new system was developed and pilot tested in two areas and the results from these were encouraging and, indeed, prompted the national introduction of a new report form by the Royal Malaysia Police in 1992. However, there have been problems associated with the rapid expansion to the national level (primarily related to the recording of accident locations), and new trials by IKRAM are addressing some of these.

1. INTRODUCTION

The details of road accidents in Malaysia have been recorded in some form by the Royal Malaysia Police, as they have by police authorities all over the world, probably from the time that they were first called upon to deal with a road traffic accident. However, the recording of details in a standard format which facilitated aggregated analysis really only began in 1974 when a mainframe computer system was installed at Police Headquarters, Bukit Aman. This computer is used to store all police statistics, and the function of the road accident database has been primarily to monitor general accident trends across the country. The Police produce an annual publication, Statistical Report Road Accidents Malaysia, which is a good general source of information at the macro level.

However, the database was not easily accessible or useable by highway engineers chiefly because no recording of accident location had been included. In 1989 a redesigned accident coding form was introduced which at least required the recording of the nearest kilometre post for accidents occurring on state or federal roads. The database still contained only limited information as the coding sheet was restricted to a single page. Despite its small size this form tended to require considerable police time to complete owing to the need to look up codes in separate coding books.

Since 1990 the Universiti Pertanian Malaysia (UPM) sponsored by the National Road Safety Council (MKJR) has been carrying out a research programme aimed at improving the accident data collection and analysis system in Malaysia (Radin & Aminuddin, 1992). It was decided that in order to facilitate wider usage of the accident data, particularly by highway authority engineers, the database needed to be available on a microcomputer system. The microcomputer accident analysis package, MAAP, produced by the Transport Research Laboratory, UK (TRL) was chosen as the most appropriate software available for both management and analysis of the data (see Hills and Elliott, 1986). In cooperation with the Royal Malaysia Police (PDRM), a new report form was designed which was intended to be easier to complete and provide more comprehensive data for use by engineers.

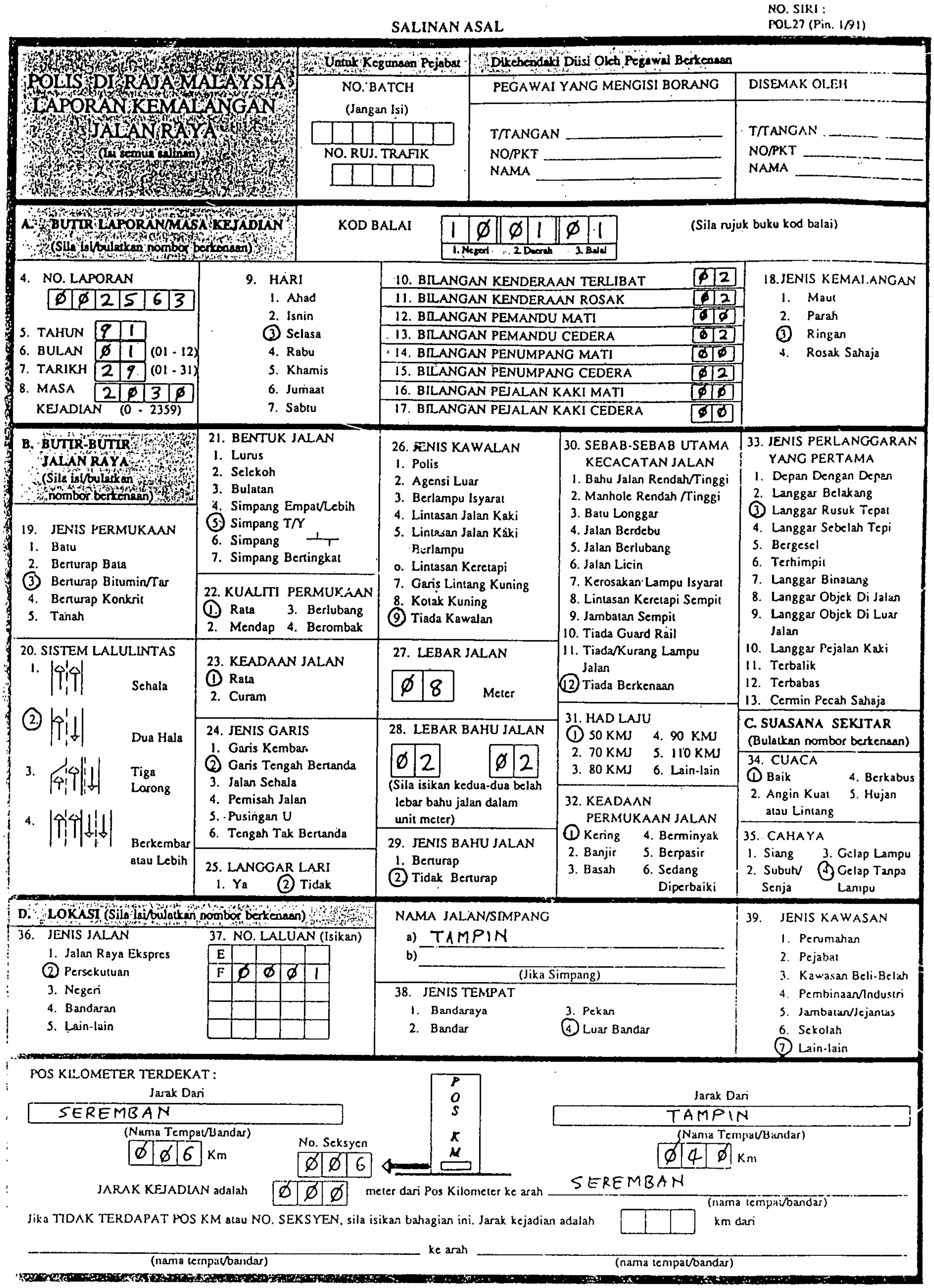
2. THE PILOT PROJECT

The Police accident coding form is referred to as POL27 (Pin 1/91) and an example of the first page of the new version is given in Fig. 1. It can be seen that most of the information required by the Police reporter is contained on the form itself without the need to look up codes in a separate document. The person filling in the form simply needs to encircle the relevant value for each accident parameter or, in a few cases, to fill in a box. The form also contains provision for more comprehensive location data including space for a location sketch as well as a collision diagram.

The two districts of Shah Alam and Seremban were selected as trial areas where the Police agreed to cooperate in using the new POL27 form in addition to their current version of the form. Training in the completion of the new form was given to relevant police officers and its use in these two districts began fully in 1991. The specification files used by MAAP were modified to be compatible with the new POL27 form, and data is entered onto microcomputer at the police station. Assistance by a UPM staff member in the checking and coding of the data was given on a regular basis to the police stations involved in the pilot project, and this assistance is still continuing.

2.1 Location systems

For the improvement of safety by engineering measures, one of the most important items of information recorded about an accident is its precise location because analyses need to be chiefly focused on accident histories at individual sites. These are examined in detail to find common patterns which, by some



NO. SIRI :
POL27 (Pin. 1/91)

SALINAN ASAL

POLIS DI RAJA MALAYSIA
LAPORAN KEMALANGAN JALAN RAYA
(Isi semua salinan)

Untuk Kegunaan Pejabat — NO. BATCH (Jangan Isi) — NO. RUJ. TRAFIK

Dikehendaki Diisi Oleh Pegawai Berkenaan — PEGAWAI YANG MENGISI BORANG: T/TANGAN, NO/PKT, NAMA — DISEMAK OLEH: T/TANGAN, NO/PKT, NAMA

A. BUTIR LAPORAN/MASA KEJADIAN (Sila isi/bulatkan nombor berkenaan)

KOD BALAI 1 Ø | Ø 1 | Ø 1 (1. Negeri 2. Daerah 3. Balai) (Sila rujuk buku kod balai)

4. NO. LAPORAN ØØ2563
5. TAHUN 91
6. BULAN Ø1 (01 - 12)
7. TARIKH 29 (01 - 31)
8. MASA KEJADIAN 2Ø3Ø (0 - 2359)

9. HARI: 1. Ahad 2. Isnin (3) Selasa 4. Rabu 5. Khamis 6. Jumaat 7. Sabtu

10. BILANGAN KENDERAAN TERLIBAT Ø2
11. BILANGAN KENDERAAN ROSAK Ø2
12. BILANGAN PEMANDU MATI ØØ
13. BILANGAN PEMANDU CEDERA Ø2
14. BILANGAN PENUMPANG MATI ØØ
15. BILANGAN PENUMPANG CEDERA Ø2
16. BILANGAN PEJALAN KAKI MATI ØØ
17. BILANGAN PEJALAN KAKI CEDERA ØØ

18. JENIS KEMALANGAN: 1. Maut 2. Parah (3) Ringan 4. Rosak Sahaja

B. BUTIR-BUTIR JALAN RAYA (Sila isi/bulatkan nombor berkenaan)

19. JENIS PERMUKAAN: 1. Batu 2. Berturap Bata (3) Berturap Bitumin/Tar 4. Berturap Konkrit 5. Tanah

20. SISTEM LALULINTAS: 1. Sehala (2) Dua Hala 3. Tiga Lorong 4. Berkembar atau Lebih

21. BENTUK JALAN: 1. Lurus 2. Selekoh 3. Bulatan 4. Simpang Empat/Lebih (5) Simpang T/Y 6. Simpang 7. Simpang Bertingkat

22. KUALITI PERMUKAAN: (1) Rata 2. Mendap 3. Berlubang 4. Berombak

23. KEADAAN JALAN: (1) Rata 2. Curam

24. JENIS GARIS: 1. Garis Kembar (2) Garis Tengah Bertanda 3. Jalan Sehala 4. Pemisah Jalan 5. Pusingan U 6. Tengah Tak Bertanda

25. LANGGAR LARI: 1. Ya (2) Tidak

26. JENIS KAWALAN: 1. Polis 2. Agensi Luar 3. Berlampu Isyarat 4. Lintasan Jalan Kaki 5. Lintasan Jalan Kaki Berlampu 6. Lintasan Keretapi 7. Garis Lintang Kuning 8. Kotak Kuning (9) Tiada Kawalan

27. LEBAR JALAN Ø8 Meter

28. LEBAR BAHU JALAN Ø2 Ø2 (Sila isikan kedua-dua belah lebar bahu jalan dalam unit meter)

29. JENIS BAHU JALAN: 1. Berturap (2) Tidak Berturap

30. SEBAB-SEBAB UTAMA KECACATAN JALAN: 1. Bahu Jalan Rendah/Tinggi 2. Manhole Rendah /Tinggi 3. Batu Longgar 4. Jalan Berdebu 5. Jalan Berlubang 6. Jalan Licin 7. Kerosakan Lampu Isyarat 8. Lintasan Keretapi Sempit 9. Jambatan Sempit 10. Tiada Guard Rail 11. Tiada/Kurang Lampu Jalan (12) Tiada Berkenaan

31. HAD LAJU: (1) 50 KMJ 2. 70 KMJ 3. 80 KMJ 4. 90 KMJ 5. 110 KMJ 6. Lain-lain

32. KEADAAN PERMUKAAN JALAN: (1) Kering 2. Banjir 3. Basah 4. Berminyak 5. Berpasir 6. Sedang Diperbaiki

33. JENIS PERLANGGARAN YANG PERTAMA: 1. Depan Dengan Depan 2. Langgar Belakang (3) Langgar Rusuk Tepat 4. Langgar Sebelah Tepi 5. Bergesel 6. Terhimpit 7. Langgar Binatang 8. Langgar Objek Di Jalan 9. Langgar Objek Di Luar Jalan 10. Langgar Pejalan Kaki 11. Terbalik 12. Terbabas 13. Cermin Pecah Sahaja

C. SUASANA SEKITAR (Bulatkan nombor berkenaan)

34. CUACA: (1) Baik 2. Angin Kuat atau Lintang 4. Berkabus 5. Hujan

35. CAHAYA: 1. Siang 2. Subuh/ Senja 3. Gelap Lampu (4) Gelap Tanpa Lampu

D. LOKASI (Sila isi/bulatkan nombor berkenaan)

36. JENIS JALAN: 1. Jalan Raya Ekspres (2) Persekutuan 3. Negeri 4. Bandaran 5. Lain-lain

37. NO. LALUAN (Isikan): E; F ØØØ1

NAMA JALAN/SIMPANG: a) TAMPIN b) (Jika Simpang)

38. JENIS TEMPAT: 1. Bandaraya 2. Bandar 3. Pekan (4) Luar Bandar

39. JENIS KAWASAN: 1. Perumahan 2. Pejabat 3. Kawasan Beli-Belah 4. Pembinaan/Industri 5. Jambatan/Jejantas 6. Sekolah (7) Lain-lain

POS KILOMETER TERDEKAT :
Jarak Dari SEREMBAN (Nama Tempat/Bandar) ØØ6 Km
No. Seksyen ØØ6
POS KM
Jarak Dari TAMPIN (Nama Tempat/Bandar) Ø4Ø Km
JARAK KEJADIAN adalah ØØØ meter dari Pos Kilometer ke arah SEREMBAN (nama tempat/bandar)
Jika TIDAK TERDAPAT POS KM atau NO. SEKSYEN, sila isikan bahagian ini. Jarak kejadian adalah ___ km dari ___ (nama tempat/bandar) ke arah ___ (nama tempat/bandar)

Fig. 1 Example page from POL27 accident report form

appropriate remedial treatment to a site, the engineer may be able to prevent in the future. Unfortunately, adequate attention to detail in the recording of accident location is often neglected.

MAAP users are encouraged to use more than one system of location coding, and to record normally two types for each accident (one to serve as a cross-check on the other). For accidents in cities or towns, ie. Shah Alam and Seremban, two separate location items are recorded for each accident, namely:-

i) map grid coordinates (X, Y or eastings and northings of the national grid system); and

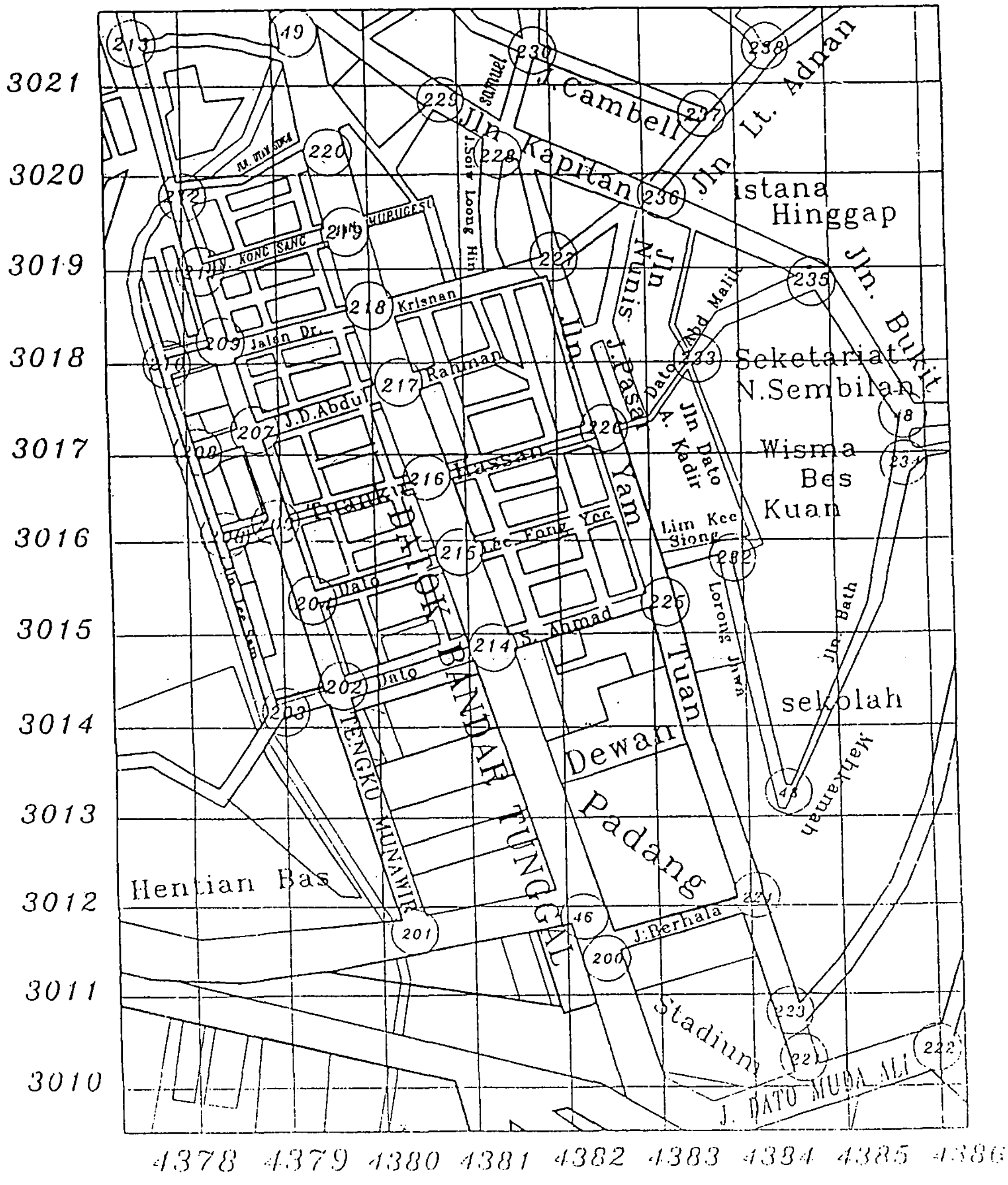


Fig.2 Node and grid coordinate system in centre of Seremban

ii) a Node or Link number. For this system it is necessary to assign unique numbers (Nodes) to all main intersections on a town map . The Links are sections of road between these junctions and are simply referenced by the two nearest Node numbers on each side of the accident location.

The maps used for coding accident location had both the national grid coordinates and the Node-Link system superimposed; an example of part of such a map for Seremban is shown in Fig. 2.

For the rural routes where intersections are much more widely spaced, it has been decided that accident location should be recorded to the nearest 100m from a kilometre post; or rather, the post's unique Section Number from the beginning of the road. For accurate recording by the Police this will mean that kilometre posts do need to exist along each highway. Although installation of kilometre posts can be a relatively costly exercise they are invaluable for highway maintenance purposes as well as accident recording, and are also beneficial to motorists in providing distance information of their destinations or their position in the event of a breakdown.

Thus on rural roads the two location items recorded on computer are:-

i) map grid coordinates as above, and

ii) estimate of nearest 100m from previous Section number post.

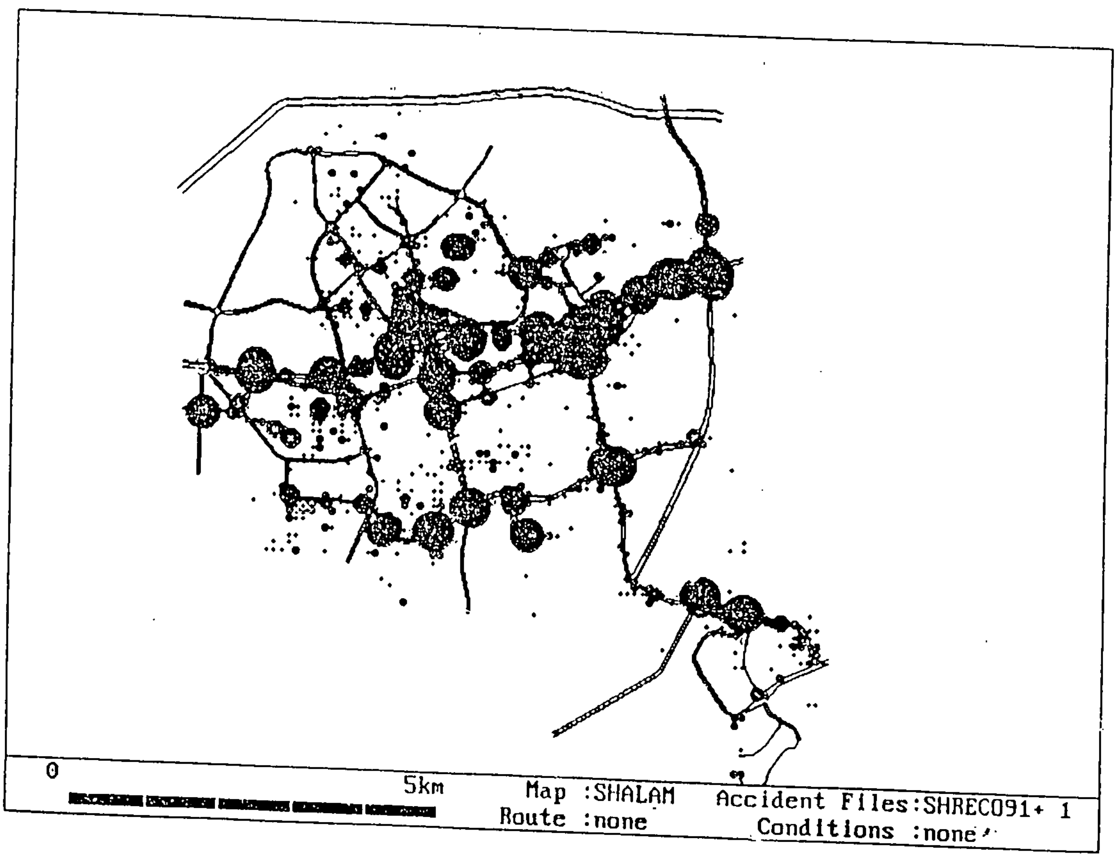


Fig. 3 Accident clusters in Shah Alam using grid coordinates

2.2 Site prioritising

The above location data are used by the computer package to inform the user of sites with the worst accident histories. If accurate digitised or scanned maps of an area are available, the software can use the X-Y coordinate information of the accident database to produce accident maps. These simply provide a quick visual indication of where accidents are clustered, as shown in Fig. 3.

For rural roads, histograms of accident frequencies can be produced along a complete or part of a particular route. The intervals of each bar can be specified by the user and the program can list the worst kilometre lengths in terms of accident numbers (of types the user may specify), or even the worst 100m sections if required (as shown in the example in Fig. 4).

```
-----------------------------------------------------------------------

 KILOMETRES        accidents

  0    - .9        7   xxxxxxx
  1    - 1.9       13  *xxxxxxxxxxxx
  2    - 2.9       106 *xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                       xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
  3    - 3.9       128 ******xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                       xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                       xxxxxxxxxxxxxxxxxx
  4    - 4.9       54  *xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
  5    - 5.9       24  *xxxxxxxxxxxxxxxxxxxxxxx
  6    - 6.9       28  *xxxxxxxxxxxxxxxxxxxxxxxxxxx
  7    - 7.9       18  **xxxxxxxxxxxxxxxx
  8    - 8.9       24  *xxxxxxxxxxxxxxxxxxxxxxx
  9    - 9.9       31  **xxxxxxxxxxxxxxxxxxxxxxxxxxxxx
  10   - 10.9      20  xxxxxxxxxxxxxxxxxxxx
  11   - 11.9      22  *xxxxxxxxxxxxxxxxxxxxx
  12   - 12.9      15  *xxxxxxxxxxxxxx
  13   - 13        2   xx
-----------------------------------------------------------------------
       Total=      492
-----------------------------------------------------------------------
                       * Fatal      x Injury or Damage


Listing of worst 100m sections

  Kilometre Post 3.0       51  accidents
  Kilometre Post 2.1       50  accidents
  Kilometre Post 2.0       46  accidents
  Kilometre Post 3.1       41  accidents
  Kilometre Post 4.8       23  accidents
  Kilometre Post 11.2      19  accidents
  Kilometre Post 3.2       17  accidents
  Kilometre Post 8.0       17  accidents
  Kilometre Post 9.6       16  accidents
  Kilometre Post 6.4       14  accidents
```

Fig. 4 Histogram of accidents along a Federal road in Seremban

In urban areas, MAAP can list the worst nodes or links in an area and can plot histograms along a route specified by node number, similar to the above kilometre analysis. These priority listings are simply by frequency of accidents but they can be restricted to different accident types (eg. injury accidents only, pedestrians only, etc). From the listed accident severity details it is possible to use an accident points weighting system such as that adopted by the Highway Planning Unit of Malaysia (HPU), ie. accidents involving fatality=6, serious injury=3, slight injury=0.8 and damage-only=0.2, to give an initial priority listing: the top five sites in Seremban are given as an example in Table 1. This Table also shows an alternative method of obtaining the priority listing by ranking by the total cost of accidents (ESCAP, 1985) at the locations. In this case the three ways (accident totals, points and costs) all give the same ranking but often they yield different orders of priority for the sites.

Table 1 Priority Listing of worst nodes in Seremban

Node No.	Junction Name Jalan:	Accidents 1991 & 92					Accident	
		Fatal	Serious	Minor	Damage	**Total Accs.**	Points	Cost RM
225	Yam Tuan/Sh. Ahmad	2	-	11	55	**67**	31.8	547,500
214	D.B. Tunggal/Sh. Ahmad	1	3	8	48	**60**	31.0	387,000
215	D.B. Tunggal/Lee F. Yee	-	4	12	27	**43**	27.0	280,500
313	Zaaba/Dato Ling	-	4	9	22	**35**	23.6	228,000
224	Yam Tuan/Berhala	1	1	3	14	**19**	20.2	231,000
.	.							
.	.							

It should, of course, be noted that after investigation of the accident types at each junction and site visits/studies the above priority listing for actual remedial work is likely to change, dependent upon the estimated cost effectiveness of appropriate treatments and available budget.

2.3 Demonstration study

As a demonstration application of the pilot project database, some in-depth studies of blackspots have been carried out (Baguley, 1992; Radin, 1993). Taking the worst site in Seremban as an example (see Table 1), this is an uncontrolled T-junction, Jalan Sheikh Ahmad with the major road F0001 (Jalan Yam Tuan) located within the main town area. Both roads are one-way only and permit two lanes of traffic. The accident data for this junction were extracted from the available data of 1991 and 1992. Using the 'stick diagram' option of MAAP (Fig. 5) and producing a separate collision diagram, as in Fig.6, it was found that the majority of accidents were side swipes or side impacts that occurred chiefly on the main road with vehicles merging from the side road. A total of six side impact accidents in two years resulted in injury (including one fatality) and all involved motorcyclists. The other main type of

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STICK DIAGRAM ANALYSIS

ACCIDENT RECORD FILES: NOD225
CONDITIONS SET: Node 1 = 225
Node 2 = 000

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
BLN	09	09	09	12	08	08	08	10	10	10	01	11	11	11	11	11	03	03
TRH	07	19	30	02	01	10	16	13	20	23	03	07	11	15	29	30	04	09
HRI	7	5	2	2	5	7	6	1	1	4	5	5	1	6	6	7	2	7
MSA	16	10	12	20	15	09	15	09	18	09	09	21	17	01	20	11	13	12
PEJ																		
PRH	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	D
BK	BK	BK	BK	BK		BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK
>*<											>*<							
>*>															>*>	>*>		>*>
>*|																	>*|	
ANI																		
OT					OT													
SS	SS		SS	SS		SS			SS	SS			SS					
D&D																		
DRK																		

	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
BLN	02	03	03	03	03	03	04	04	04	05	05	06	06	06	07	08	08	08
TRH	29	10	14	15	19	26	01	06	20	02	08	14	27	29	24	05	23	30
HRI	7	3	7	1	5	5	4	2	2	7	6	1	2	4	6	4	1	1
MSA	12	08	00	15	21	18	17	16	13	10	07	16	10	17	12	11	11	14
PEJ														PEJ				
PRH	D	D	D	I	D	D	D	D	D	D	D	I	D	I	D	D	D	I
BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK
>*<																	>*<	
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>*|									>*|								
ANI																		
OT					OT	OT												
SS				SS			SS	SS		SS	SS	SS	SS		SS	SS		
D&D						D&D												
DRK																		

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
BLN	03	04	04	04	04	06	06	05	05	05	07	07	01	01	02	02	02	02
TRH	27	05	05	12	30	03	09	03	10	30	03	11	05	14	03	06	10	12
HRI	4	6	6	6	3	2	1	6	6	5	4	5	1	3	2	5	2	4
MSA	15	20	10	21	17	12	16	13	16	13	20	20	13	16	01	18	15	19
PEJ			PEJ					PEJ										
PRH	D	D	I	D	D	D	D	I	D	D	D	I	D	D	D	D	I	F
BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK
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>*>	>*>					>*>								>*>		>*>		
>*|															>*|			>*|
ANI																		
OT									OT									
SS				SS	SS		SS			SS		SS	SS				SS	
D&D																D&D		
DRK																		

	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
BLN	09	09	10	10	10	10	10	11	11	11	11	11	12	12				
TRH	06	06	06	08	13	13	23	15	16	09	22	14	22	11				
HRI	1	1	3	4	3	3	6	1	2	2	1	7	3	6				
MSA	23	13	13	14	11	11	14	08	06	11	14	20	17	22				
PEJ								PEJ						PEJ				
PRH	D	D	I	D	D	D	D	I	D	D	D	D	D	F				
BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK	BK				
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ANI																		
OT																		
SS		SS		SS		SS			SS		SS							
D&D									D&D									
DRK																		

BLN= BULAN TRH= TARIKH HRI= HARI MSA= MASA
PEJ= PEJ.KAKI PRH= KEPARAHAN BK = BAIK >*<= HEADON
>*>= REAR END >*|= SIDE ANI= ANIMAL OT = OVERTURN
SS = SIDESWIPE D&D= SUBUHSENJA DRK= DARK

Stick Number = Accident Code Number:-

1 =021139 2 =022084 3 =023430 4 =030387 5 =019100 6 =019730 7 =020055 8 =025006
9 =025632 10=025898 11=000253 12=027504 13=027706 14=028153 15=029898 16=030053
17=005640 18=006068 19=007627 20=008423 21=008420 22=009096 23=010276 24=012604
25=013542 26=010386 27=010793 28=012139 29=015955 30=016991 31=000659 32=001813
33=004612 34=005113 35=005466 36=005626 37=007209 38=008200 39=008617 40=008743
41=009150 42=009674 43=010265 44=010452 45=011281 46=012372 47=012970 48=016538
49=017877 50=018113 51=021177 52=023359 53=026505 54=027712 55=028721 56=028797
57=033104 58=033357 59=034229 60=034232 61=035419 62=037828 63=037829 64=037219
65=038520 66=037699 67=041581 68=040492

Fig. 5 Stick diagram for Node 225, Seremban

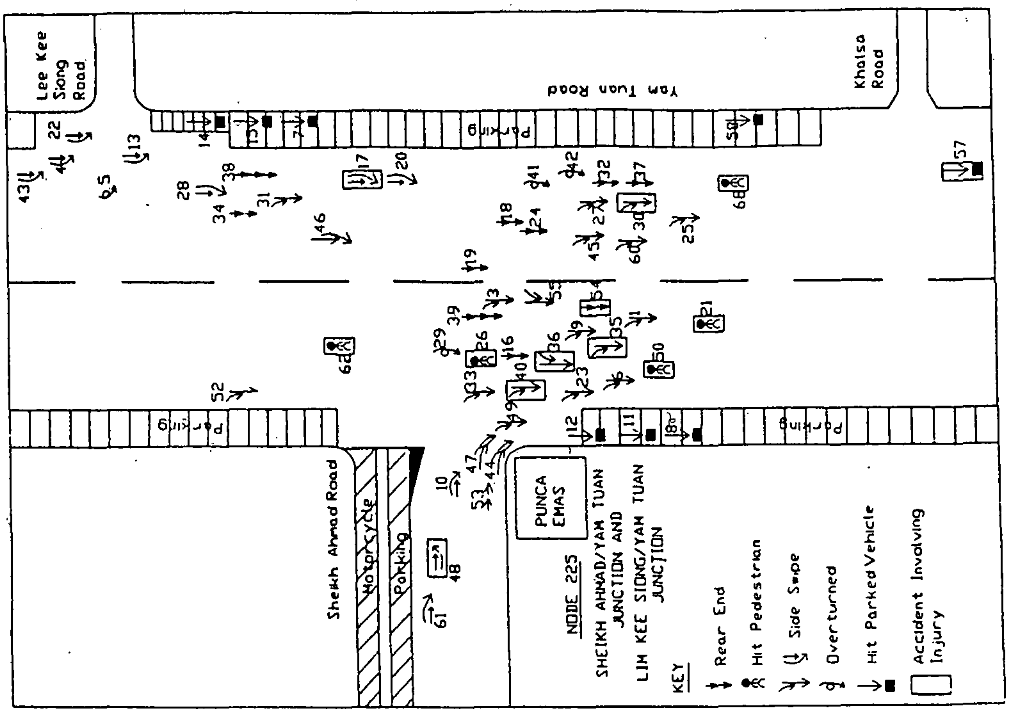

Fig. 6 Collision diagram for Node 225, Seremban

serious accidents, comprising one fatal and four injury, that occurred at or near this junction involved pedestrians. In addition rear-end collisions were common with 12 accidents occurring in the two-year period.

2.3.1 On-site study results

To supplement the accident data, a one-day site study was made in which vehicle manoeuvre and pedestrian flow counts, traffic conflicts (or near-misses - see Baguley, 1984; TRRL, 1987), and vehicle approach speeds were monitored. The pedestrian and vehicle counts are given in Fig. 7 and it can be seen that there are a relatively large number of pedestrians crossing the busy Jalan Yam Tuan, reaching a maximum of 890 during the lunchtime period. In comparison, the number of motorcyclists passing through the junction reached a peak of over 1100 during the late afternoon period (1600hrs), and motorcycles comprised about 32 percent of all motor traffic.

The traffic conflicts recorded over the six-hour observation period are given in Table 2.

These tend to confirm the accident history for the junction. The most frequent type of conflict is the merge, where vehicles from Jalan Sheikh Ahmad tend not to give way to vehicles on the major road. Many drivers were also observed to force their way as quickly as possible over to the left-hand side in order to turn left into Lorong Khalsa or an adjoining petrol station. Approach speeds were

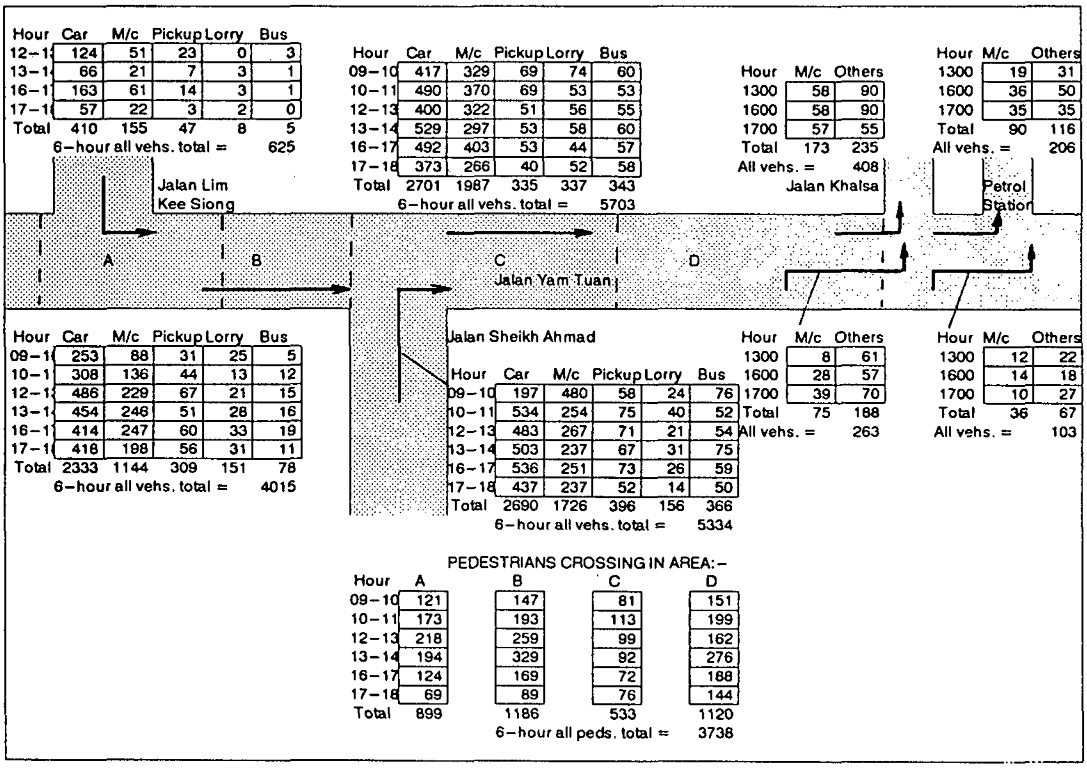

Fig. 7 Pedestrian and vehicle flow counts at Node 225, Seremban

found not to be excessive with a mean speed of 30km/h and 85th percentile speed of 37km/h, which may explain why the large majority of conflicts were classified as 'slight'.

Table 2. Traffic Conflicts at Node 225, Seremban

Conflict Manoeuvre type	Number of Slight and { *Serious* } conflicts at junction of J. Yam Tuan/J. Sheikh Ahmad in hour beginning: 09:00	10:00	12:00	13:00	16:00	17:00	6-hour total
Merging	34 { *1* }	29 { *2* }	38 { *3* }	39 { *1* }	37	38 { *1* }	215 { *8* }
Pedestrian	0	1	6 { *1* }	8 { *1* }	2	5	22 { *2* }
Rear-end	6	2	7	8	4	6	33
Crossing	4	5	3	1	1	2	16

Pedestrian conflicts were also relatively common and pedestrians were observed to have obvious difficulties in finding suitable gaps in the traffic stream. There are currently no pedestrian crossing facilities provided.

2.3.2 Proposed countermeasures

In view of the very high conflict rate involving merging vehicles, and the need to provide an optimum low-cost solution, the recommendation was to install a solid, low delineator as shown in Fig. 8. The objective of this would be to narrow the merging stream down to a single lane and phase in the merge more gradually, and also to prevent the staggered crossing manoeuvre from Jalan Sheikh Ahmad to Lorong Khalsa or the petrol station: traffic is able to turn left at a major junction slightly further downstream. The raised pavement extension in the mouth of Jalan Sheikh Ahmad would also serve as an additional traffic calming device by providing a chicane and visual narrowing which should help to reduce the higher vehicle speeds.

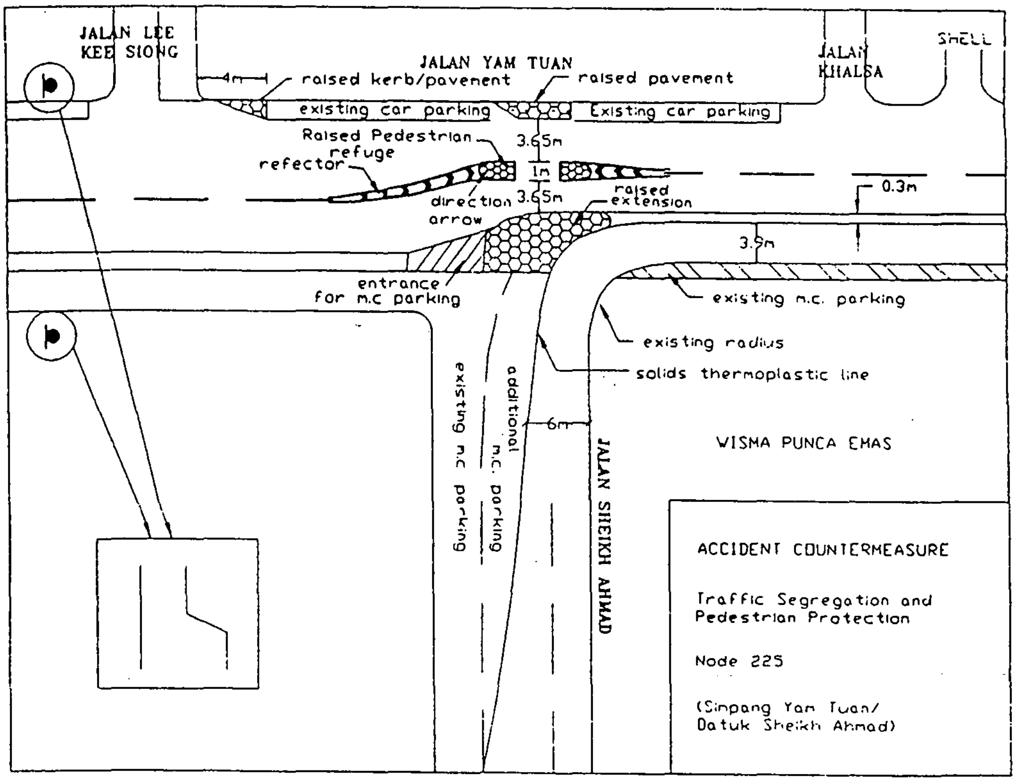

Fig. 8 Proposed countermeasures of channelisation and pedestrian refuge at Node 225, Seremban

The refuge shown in Fig. 8 is intended to reduce vehicle-pedestrian conflicts as drivers attention should be focused at this chicane point. It is also assumed that pedestrians would be attracted to this easier place to cross, as it means they would now only have to make gap judgements about one traffic lane at a time. It was recommended that the hatched area be bounded by large road studs which should serve as an additional warning to the 'road narrows' signs to help reduce the likelihood of collisions with the refuge.

It is hoped that this method will improve the safety at this junction with minimal disruption to the traffic flow (unlike traffic signals). It has been learnt subsequently that the Municipal Authority is likely to adopt much of this suggestion but will be constructing a pedestrian bridge in favour of the refuge.

3. NATIONAL IMPLEMENTATION

Several minor changes were made to the Police coding form following the experience gained in the pilot areas, and the revised version was introduced nationwide in January 1992 following an extensive training programme for traffic police officers.

As the process of forms being sent to Police Headquarters, Bukit Aman, in Kuala Lumpur for entry onto mainframe computer (together with other crime data) is well established, this system was retained with the new POL27 form. On a monthly basis the data is now downloaded to microcomputer and the file converted into MAAP format (see Baguley, 1992), at which stage it is made generally available and can be interrogated easily using MAAP facilities.

Existing investigation papers, including separate 'aftermath' sketches for each accident, continue to be necessary for prosecution purposes and, owing to the considerable additional time required to fill in each new POL27 form, it was agreed that the Public Works Department (JKR) provide assistance on location coding. The Police still record as much information as possible about the accident site and the local JKR District offices are sent copies regularly of the two relevant sheets of each accident form. They are required to check location details of each accident and complete the coding of route number, closest kilometre (or section) post number, and nearest 100m from the relevant post. The completed parts of the forms are then sent to the Highway Planning Unit (HPU) of the Ministry of Works, where the location information is further checked and entered onto computer. This will eventually be merged with the corresponding accident records received from the Police. The process is shown diagrammatically in Fig. 9 and, in theory, the database is now complete for analysis by all interested parties.

The number of recorded accidents in Malaysia is increasing sharply and, as all accidents are required to be reported to the Police, they are currently faced with recording the details of more than 120,000 per year (for 1992). Most of these, of course, involve vehicle/property damage only and a compromise was therefore reached when the new forms were introduced such that the very minor cases, classed as 'no further action' (NFA), would no longer be recorded on computer and thus would not require a POL27 form. For 1992 this has resulted in a total of about 67,000 accidents on computer. Direct comparisons with previous years' data, however, should at least still be valid for those accidents involving injury.

4. THE NEED FOR FURTHER IMPROVEMENT

When the new form was introduced nationally there were a number of initial problems associated chiefly with a lack of clarity about the new responsibilities, and the fact that these extra tasks had to be absorbed into present work schedules without additional manpower being allocated. Early returns of forms containing location data to HPU were rather poor. Only about 81 per cent of the forms which should have been completed for Federal and Expressway roads

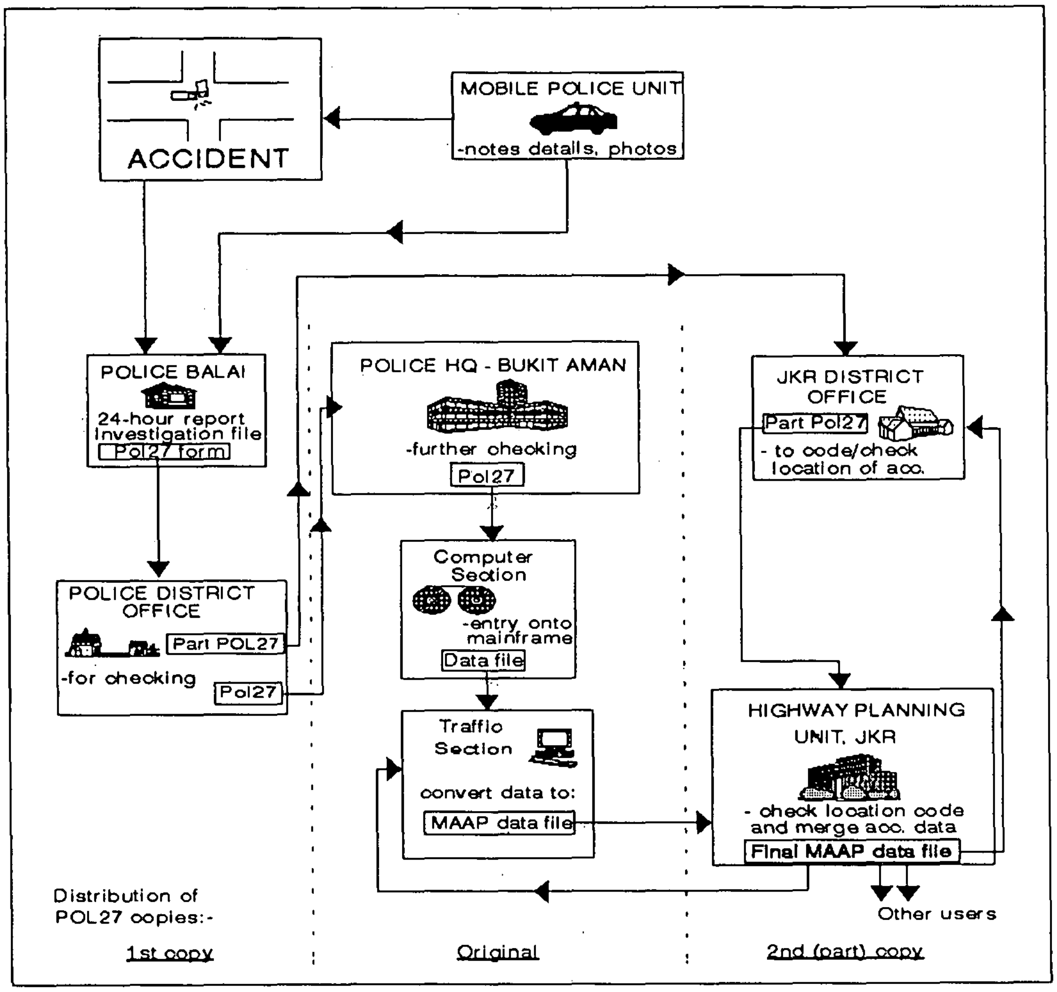

Fig. 9 Production of accident database in Malaysia

(20,887 records) were in fact received at HPU. Of these, 34 per cent contained either incorrect or missing data with respect to accident location. However, by holding a series of workshops in each State of Malaysia for the Police and local JKR staff to determine the problems, followed up by training sessions, HPU is trying hard to improve this situation.

One common problem was that descriptions of accident locations on the POL27 form were not always adequate for the local JKR staff to be able to recognise the site, eg. the location sketch simply contained the road name without any other reference point. This could possibly be due to a lack of awareness of its importance by the particular reporting officer, or that he was not actually required to attend the scene (as in most damage-only accidents where witness statements are acceptable, but are rarely precise about location). Another common reason given was that the nearest kilometre post to the accident is frequently missing or simply not installed (as on many State roads). Indeed, for the State roads (12,399 accidents) the majority of accident records do not yet contain location information.

It should also be noted that, owing to the fact that JKR have responsibility for the Federal and State roads only, there is currently no location coding being entered on the database for roads under the jurisdiction of a Municipal authority, ie. most roads within a town or city.

4.1 Accuracy of recorded location data

As an example check on the location data which is now on computer, over 2,000 accidents along Federal Route 1 were searched for the recorded values of the nearest 100m from the relevant kilometre post, and the frequencies of these are shown in Fig. 10.

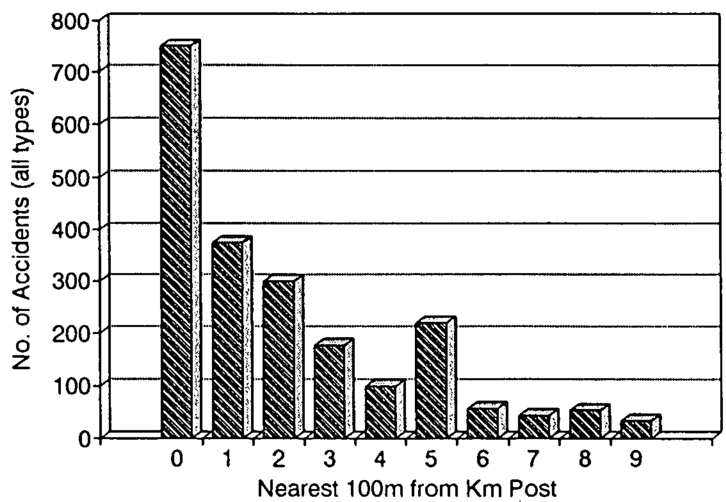

Fig. 10 Accident frequency on Federal Route 1 by 1/10ths km from Posts

It can be seen that, rather than a fairly even distribution as might be expected, there appears to be a strong bias towards accidents being recorded at the kilometre post, and perhaps also a rounding to 0.5km. The higher numbers at 0.1, 0.2 and 0.3km may also indicate the inclusion of a proportion actually occurring at 0.9, 0.8 and 0.7km respectively. The latter arises from a common confusion of location being estimated to the nearest 100m from the closest post and not then corrected to the lower Section number of the two posts up and downstream of the accident. Surprisingly, the distribution of 100m accident location coding for damage-only accident types is very similar to the separate distributions for fatal, serious and slight injury accidents even though, in the latter cases, the Police will most probably have attended the scene.

There is currently no coordinate system used to record accident location as in the pilot project, and thus use cannot be made of the geographical mapping facilities available in the latest version of MAAP.

5. NEW TRIALS

In terms of accident location the pilot experiment was very successful but this may have been largely due to the fact that it was a controlled experiment with trained full-time staff who supplied all the mapping needs. In an effort to improve the national situation, therefore, IKRAM have initiated some trials in the local JKR District area.

The first of these is to demonstrate the production and use of base maps in as simple a manner as possible by adapting existing appropriate topographical maps in such a way as to aid the process of accident location coding. Another proposed trial is to utilise recent advances in technology in the field of position logging, using hand-held Global Positioning (GPS) instruments at the scene of each accident. This should greatly assist and simplify the process of recording grid coordinates which are, themselves, of increasing importance in view of the recent trend towards the use of Geographical Information Systems. Another application of advanced technology will shortly be attempted by UPM in the storage of accident collision sketches on a national scale by the use of CD ROMs or optical disks. These are discussed in more detail below.

5.1 Detailed maps

Topographical 1:25,000 maps for the area have been acquired from the Department of Census and Mapping which were the most up-to-date available and of optimum practical size. With the use of a calibrated measuring wheel attached to a car, all State and Federal roads in the Kajang area have been slowly driven along and the position of kilometre posts and other landmarks in relation to reference points which are already marked on the map (eg. road junctions) have been recorded as accurately as possible. On average, a feature or fairly permanent landmark was noted at about ¼ km intervals.

This information was transferred to the maps and an example of part of such a map (of which there are 7 for the Kajang area) is given in Fig. 11.

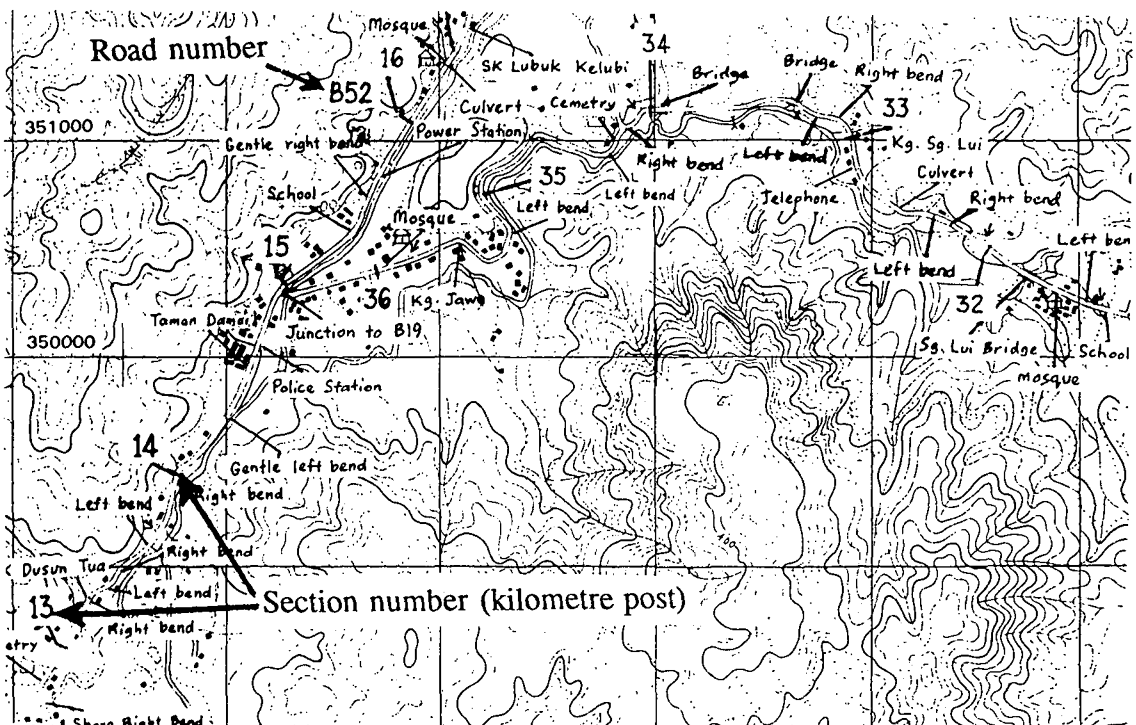

Fig. 11 Example of part of landmark 1:25,000 map for Kajang area

Where not already shown, one kilometre squares were accurately drawn on the maps corresponding to the position of the national grid coordinates. With the additional landmark information and Police descriptions on the POL27 form, it is hoped that the JKR engineer or technician will be able to pinpoint accidents much more easily on the appropriate map, and will then be able to check the position of the accident in relation to the nearest kilometre post. The JKR officer will also note the X and Y coordinates for each accident location to the nearest 10m. The use of this method will be monitored and, if successful, it is hoped that the technique will be adopted throughout Malaysia.

For towns it would also be desirable for a node system to be assigned as in the pilot project. This, however, necessitates the use of even larger scale maps (eg. 1:5,000), and unfortunately, up-to-date versions of such maps are unlikely to be available for some considerable time.

5.2 Hand-held GPS units

A growing number of leading electronics companies are now manufacturing portable Global Positioning System (GPS) units which make use of the American satellite system to receive radio signals from which they are able to calculate present location on earth and display coordinates. The use of these instruments by police attending the scene of accidents to perform the task of recording precise location automatically is obviously a very attractive one, as long as they are accurate, easy to use, and the unit cost is not prohibitive.

Tests were carried out on five different units (currently costing between RM3,500 and RM11,000) at a known GPS survey station near Rawang. Unfortunately, there are several factors that affect the accuracy of the reading, for example, satellite clock errors, ionospheric and tropospheric delay, receiver noise, and even purposeful random degradations of position known as Selective Availability imposed by the Department of Defense, USA. Owing to these factors it was found that the instruments used in the field often displayed readings in excess of 50m in error in one or more of the coordinates and occasionally the error could be as much as 200m.

However, it is possible to improve on the accuracy by the use of a differential GPS system (claimed to be within 5-10m). This is a second GPS ground station at a precisely known location which will receive the same satellite signals as the mobile unit and will therefore be able to calculate the instantaneous errors. The errors can ideally be transmitted immediately via VHF radio to the mobile unit which should then be able to automatically apply the same correction at that instant to its computed position.

This system will, of course, substantially increase the cost of providing the Police with adequate coverage and it is therefore important that such equipment is thoroughly tested for practicality and reliability before a decision is taken for wide-scale application. IKRAM will thus shortly be purchasing a system for trials within the Kajang police area. It is proposed that for a period of about six months a team will be on standby to be called out to the scene of accidents, and will themselves record location and other details using a second hand-held GPS unit and scale map.

5.3 Collision sketch retrieval

Space for a collision sketch is provided as part of the POL27 (pin 1/91) form and sketches of this type have proved invaluable for investigators looking for common patterns of accident, or simply to clarify details of a particular accident. Cataloguing these for the whole nation is currently being carried out by the Accident Research Unit, UPM but this has been found to be both time and space consuming. A project has recently been initiated to develop a system of scanning the sketch page of the POL27 form to be stored on either CD ROM or optical disk.

However, greater storage efficiency is required since a single scanned diagram page consumes about 1Mbyte of memory space. Some kind of compression was thus required and an early trial using special software and a cofax compression card offers considerable improvement by reducing a 1Mbyte sketch diagram in rasta format to about 200Kbytes. Assuming that about 5,000 accidents per month are recorded in Malaysia, this would require the use of a 1Gbyte optical disk (a typical size of optical disk) for storage each month.

It is envisaged that when an engineer needs to view the collision sketches of a group of accidents this will eventually be very quick and easy to do via computer, by simple input of the relevant accident reference codes and access to the set of optical disks.

6. SUMMARY AND CONCLUSIONS

Although accident data has been recorded on computer since 1974, it has not been readily accessible to engineers and did not contain adequate information to indicate exactly where problem areas exist and what could be done in terms of engineering measures to alleviate the problems.

In 1991 a major advance was made in the design of a new accident report form which was both simpler to fill in (principally ticking coded boxes) and more comprehensive with regard to information of direct relevance to engineers. The form was linked to the MAAP microcomputer system and was fully tested in two pilot areas in Malaysia. Problem sites were identified in the pilot areas and some in-depth studies carried out with countermeasure recommendations in order to demonstrate the use of the database in improving blackspots.

Following the success of the pilot project the system was introduced nationwide from the beginning of 1992. There were a number of initial problems associated with this and, even after the establishment and clarification of the various responsibilities for the data, the database still remains deficient, notably on the aspect of accident location (of vital importance to the highway engineer).

Trials of the introduction of large-scale 'landmark' maps and GPS systems are being carried out. It is recommended that such maps are produced as early as possible across the whole country, and if the GPS trial proves feasible, funding should be allocated to supply this labour-saving equipment to the Police. Without an easy-to-use and comprehensive accident database and analysis system in place, engineers in local highway authorities are much less able to play an efficient role in the regular investigation and treatment of safety problems in their respective areas. This is desperately needed on a wide scale in order that they can contribute effectively to the nation's very necessary efforts to improve road safety.

7. ACKNOWLEDGEMENTS

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