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intelligent speed adaptation

Deliverable D1

Implications of Travel Patterns for ISA

May 2003

INSTITUTE FOR TRANSPORT STUDIES
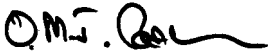**DOCUMENT CONTROL INFORMATION**

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1. INTRODUCTION

Since January 1999, British police injury accident reports have contained provision for recording the post-code details of drivers involved in accidents. Undertaken by Opus International Consultants Limited, on behalf of the Institute for Transport Studies of the University of Leeds, this study investigates the relationship between accident location and drivers' home addresses. The study forms part of a research programme into Intelligent Speed Adaptation (ISA), commissioned by the Department for Transport.

1.1 Objective

The object of this study is to determine which accidents are "local" and could therefore be addressed by a "local" ISA system, i.e. a system implemented only in a particular area of the country. A beacon-based ISA would almost certainly be rolled out locality-by-locality, so the scenario of a "local" ISA is one that needs to be studied.

1.2 Data Sources

In order to meet this objective, the following data sources have been used in this analysis:
1. Injury accidents reported to the Police and recorded in the STATS 19 database for the calendar year 2000, supplied by DfT. This data is supplied as three separate files providing details as follows:
    a. Accident.dat   (circumstance) with one file record per recorded accident
    b. Vehicles.dat   (involved) with one file record per vehicle/driver involved
    c. Injured.dat   (persons) with one file record per injured person.
    The data in these files are linked using a common accident reference number.

2. A commercially available dataset containing the spatial coordinates for the centroids of UK post-codes, which was purchased from Geoplan.

1.3 Methodology

In order to determine which accidents were local, and therefore could potentially be addressed by a "local" ISA system, it was necessary to:
1. Match the spatial co-ordinates of the drivers home address post-code onto the driver records in the Vehilces.dat file
2. Calculate the "crow fly" distance from home address co-ordinates to the accident location co-ordinates
3. Determine which accidents involved vehicles that:
    a. could in the future be ISA capable
    b. which were "local" to the drivers home address

The process by which this was achieved is outlined in Figure 1.
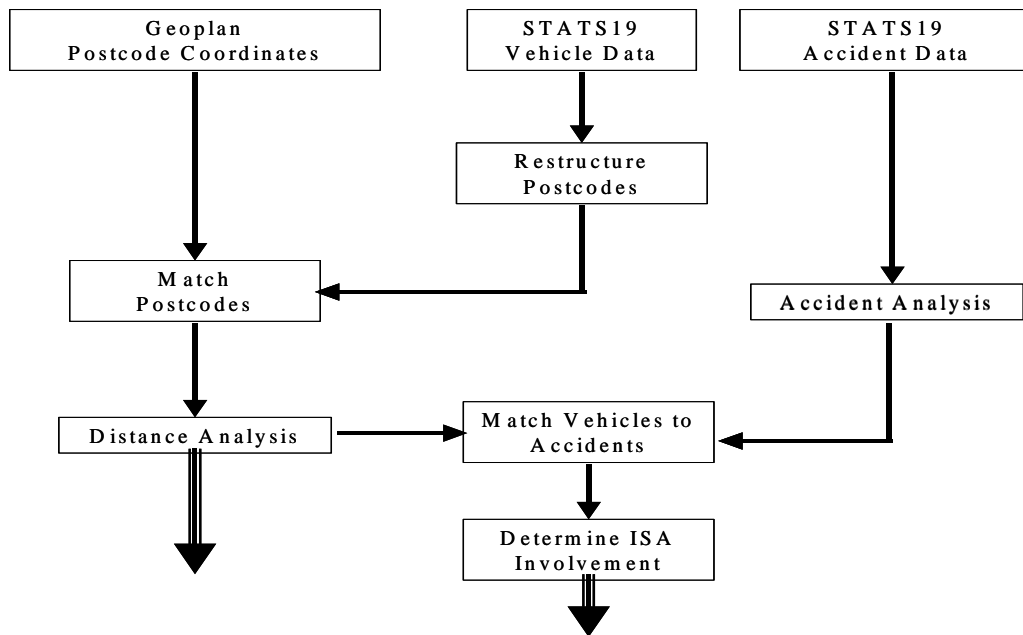
Figure 1: Analysis procedure

2. ANALYSIS

2.1 Postcodes

2.1.1 Postcode Recording

Although the recording of driver postcodes began in January 1999 this is by no means widespread. Of the 429,945 vehicle records in the accident database, complete postcode records, sufficient to allow a drivers home location to be identified at the area level, were available for 223,331 cases representing a 51.9% match rate.

In the majority of cases unmatched postcode entries were either blank, had too few characters or an illegitimate sequence. This included the coding of postcodes as "unknown", "non-UK resident" or "parked, driver unknown". However, where legitimate postcodes (those with length 5, 6, or 7) are available a good match rate has resulted, as shown in Table 1.

Table 1: Analysis of recorded postcodes

Length of Postcode	Unmatched		Matched		Total
	Frequency	**As a % of total**	**Frequency**	**As a % of total**	
0 characters	935	0.2%	0	0.0%	935
1 character	152,745	35.5%	0	0.0%	152,745
2 characters	5,325	1.2%	0	0.0%	5,325
3 characters	11,047	2.6%	0	0.0%	11,047
4 characters	6,568	1.5%	0	0.0%	6,568
5 characters	2,547	0.6%	5,390	1.3%	7,937
6 characters	19,544	4.5%	129,726	30.2%	149,270
7 characters	7,903	1.8%	88,215	20.5%	96,118
All	**206,614**	**48.1%**	**223,331**	**51.9%**	**429,945**

The above analysis is based on the disaggregating of the postcode character sequence and it should be noted that in a number of cases codes such as 0, 00, or 000 have been input. Such codes are reported as being 1,2 or 3 characters respectively, in Table 1.

It might have been possible to improve the match rate by matching at the postcode area level (i.e. first two characters of postcode) and calculating the coordinates of the postcode area as the average of the coordinates of the component sectors. This would mean that some distances would be less accurate than others. Another possible improvement in the match rate could be achieved by searching for possible errors in transferring the written record to computer record, e.g. mistaking an 8 for a B, or 5 for an S. However, without access to the original records such "corrections" would be pure supposition. In each case, the data of Table 1 suggests only a marginal improvement would result.

2.1.2 Analysis of Recorded Postcodes

The recorded postcode match has been compared across vehicle type, driver gender, driver age, speed limit, time of day and police force code (see Tables 2 through 7). From Table 4 it can be

observed that some very young driver ages are coded in the data. These ages may be legitimate (children actually at the wheel) or the result of data entry errors. In general, there was little significant variation across these various factors, except and not surprisingly between the police forces.

Table 2: Comparison of vehicle type and driver postcode matches

Vehicle Type	Unmatched (%)	Matched (%)
Pedal Cycle	52.8	47.2
Moped	46.1	53.9
Motorcycle 125cc and under	48.5	51.5
Motorcycle over 125cc	47.0	53.0
Taxi	45.2	54.8
Car	47.1	52.9
Minibus (8-16 passenger seats)	47.5	52.5
Bus or coach (17 or more pass seats)	48.5	51.5
Other motor vehicle	63.8	36.2
Other non-motor vehicle	70.4	29.6
Ridden horse	57.6	42.4
Agricultural vehicle (includes diggers etc.)	46.1	53.9
Tram	51.7	48.3
Goods 3.5 tonnes max gw and under	51.3	48.7
Goods over 3.5t and under 7.5t	52.3	47.7
Goods 7.5t max gw and over	55.1	44.9
All	**48.0**	**52.0**

Table 3: Comparison of driver gender and driver postcode matches

Gender	Unmatched (%)	Matched (%)
Male	46.6	53.4
Female	41.6	58.4
Gender unknown	97.4	2.6
All	**48.1**	**51.9**

Table 4: Comparison of driver age and driver postcode matches

Age	N	Unmatched (%)	Matched (%)
0-4	85	55.3	44.7
5-14	5,722	55.3	44.7
15-24	77,580	43.8	56.2
25-34	108,914	44.4	55.6
35-44	87,175	43.4	56.6
45-54	56,900	43.0	57.0
55-64	31,186	41.8	58.2
65-74	13,505	41.6	58.4
75-84	6,074	43.5	56.5
85-94	951	46.6	53.4
95-98	18	50.0	50.0
All	**388,110**	**43.7**	**56.3**

Table 5: Speed limit at accident site and driver postcode matches

Speed Limit (mph)	Unmatched (%)	Matched (%)
20	54.8	45.2
30	48.7	51.3
40	46.4	53.6
50	44.9	55.1
60	47.0	53.0
70	48.0	52.0
All	**48.1**	**51.9**

Table 6: Time of day and driver postcode matches

Time of day	Unmatched (%)	Matched (%)
7am-6pm	47.8	52.2
6pm-7am	50.4	49.6
All	**48.1**	**51.9**

Table 7: Comparison of police force code and driver postcode matches

Police Force	Area	Unmatched (%)	Matched (%)	% of All Vehicles
1	Metropolitan Police	53.0	47.0	15.40
3	**Cumbria**	**100.0**	**0.0**	**0.80**
4	Lancashire	33.9	66.1	2.36
5	Merseyside	44.6	55.4	2.90
6	Greater Manchester	34.4	65.6	5.20
7	Cheshire	12.3	87.7	2.13
10	Northumbria	68.7	31.3	2.07
11	Durham	42.4	57.6	0.79
12	North Yorkshire	82.8	17.2	1.40
13	West Yorkshire	35.3	64.7	3.97
14	**South Yorkshire**	**100.0**	**0.0**	**2.06**
16	Humberside	17.9	82.1	1.45
17	Cleveland	35.5	64.5	0.66
20	West Midlands	19.9	80.1	4.53
21	Staffordshire	31.8	68.2	2.06
22	West Mercia	24.9	75.1	1.64
23	Warwickshire	35.6	64.4	1.01
30	Derbyshire	52.9	47.1	1.69
31	**Nottinghamshire**	**100.0**	**0.0**	**1.84**
32	Lincolnshire	32.5	67.5	1.08
33	Leicestershire	62.3	37.7	1.65
34	Northamptonshire	42.1	57.9	0.95
35	Cambridgeshire	34.5	65.5	1.55
36	Norfolk	46.3	53.7	1.13
37	Suffolk	42.4	57.6	1.00
40	Bedfordshire	51.0	49.0	0.90
41	Hertfordshire	47.3	52.7	2.24
42	Essex	36.6	63.4	3.11
43	Thames Valley	40.8	59.2	3.83
44	Hampshire	33.9	66.1	3.20
45	**Surrey**	**100.0**	**0.0**	**2.13**
46	Kent	84.6	15.4	2.64
47	Sussex	25.8	74.2	2.61
48	City of London	59.0	41.0	0.15
50	**Devon and Cornwall**	**100.0**	**0.0**	**2.35**
52	Avon and Somerset	47.3	52.7	2.32
53	Gloucestershire	40.9	59.1	0.86
54	Wiltshire	20.4	79.6	1.09
55	Dorset	87.9	12.1	1.27
60	North Wales	47.3	52.7	1.16
61	Gwent	88.6	11.4	0.66
62	South Wales	84.1	15.9	1.51
63	Dyfed-Powys	30.5	69.5	0.70
91	Northern	52.7	47.3	0.30
92	Grampian	12.8	87.2	0.47
93	Tayside	13.6	86.4	0.46
94	Fife	17.5	82.5	0.32
95	Lothian and Borders	16.4	83.6	1.28
96	Central	29.4	70.6	0.26
97	Strathclyde	32.0	68.0	2.67
98	Dumfries and Galloway	41.3	58.7	0.17
All		**48.1**	**51.9**	**100.00**

2.2 Distance Travelled By Drivers

Although the aim of the study was to determine which accidents involve vehicles which are "local", what constitutes local was not defined in advance. In order to define local an analysis of the distance between home and accident was undertaken.

The location of each accident is recorded in the accident dataset using the Ordinance Survey Grid Reference System (OSGRS) and is reported to the nearest 10 metres. This data has been matched to the driver records. The straight line or "crow fly" distance between the accident location and the drivers home has been calculated using the OSGRS co-ordinates of the:
1. Accident location and
2. Centroid of the postcode of the driver's home address.
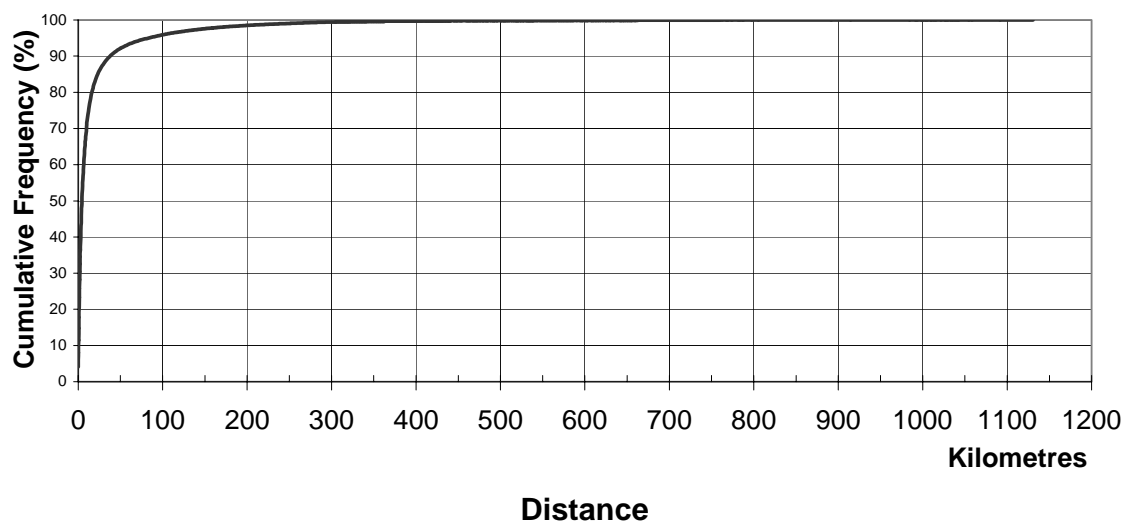
Distance

Figure 2: Cumulative frequency distribution of distance from drivers home address to accident location

The cumulative frequency distribution of distance is shown in Figure 2. This indicates that approximately 92% of all accidents involve drivers/riders who are within 50km of their home address. A more detailed plot over the range 0 to 50km is shown in Figure 3.

On this basis and considering the distribution of Figure 3 it appears reasonable to take the analysis forward using 3 alternative definitions of "local":
1. <5 km from home address (accounting for approximately 53% of vehicles)
2. <10 km from home address (accounting for approximately 70% of vehicles)
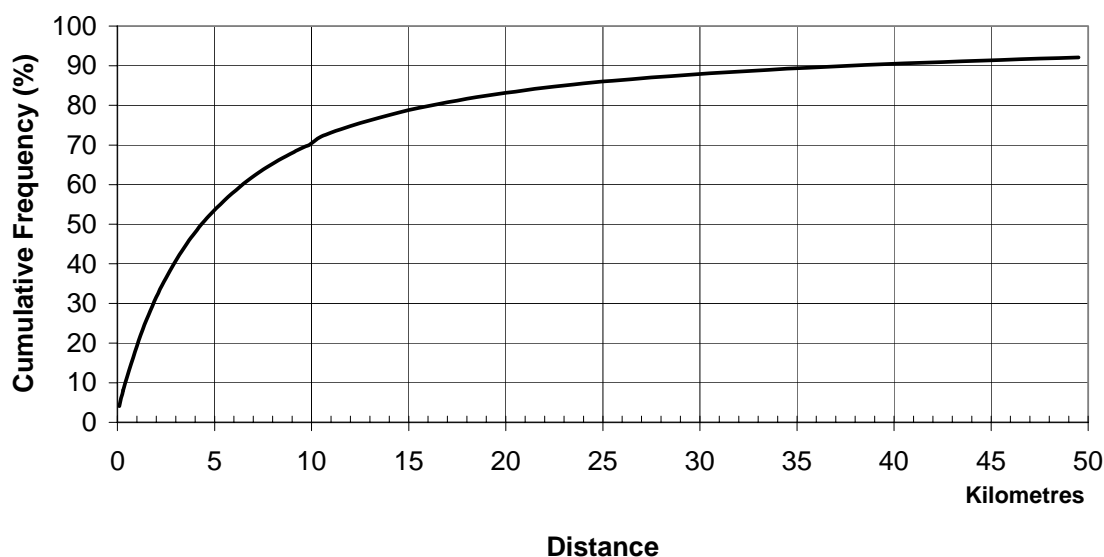3. <15 km from home address (accounting for approximately 80% of vehicles)

Figure 3: Cumulative frequency of distance from drivers home address to accident location, cases <50 km

To this point we have been looking at all vehicle involved in accidents. This includes those riding pedal cycles, horses mopeds etc. Table 8 provides details of accident involvement by vehicle type and confirms that the majority of vehicles involved in accidents are motorised.

Table 8: Involvement by vehicle type

Vehicle Type	Frequency	Percent	Percent of Non-Missing
Pedal Cycle	21,055	4.9	4.9
Moped	4,356	1.0	1.0
Motorcycle 125cc and under	7,653	1.8	1.8
Motorcycle over 125cc	17,227	4.0	4.0
Taxi	4,776	1.1	1.1
Car	323,647	75.3	75.3
Minibus (8-16 passenger seats)	1,423	0.3	0.3
Bus or coach (17 or more pass seats)	11,733	2.7	2.7
Other motor vehicle	3,630	0.8	0.8
Other non-motor vehicle	267	0.1	0.1
Ridden horse	158	0.0	0.0
Agricultural vehicle (includes diggers etc.)	892	0.2	0.2
Tram	29	0.0	0.0
Goods 3.5 tonnes max gw and under	17,671	4.1	4.1
Goods over 3.5t and under 7.5t	3,226	0.8	0.8
Goods 7.5t max gw and over	11,968	2.8	2.8
All	**429,711**	**99.9**	**100.0**
Missing	**234**	**0.1**	
Total	**429,945**	**100.0**	

2.3 Accident Analysis

In order to take the analysis further and identify which *accidents* may be addressed by a local ISA system it is necessary to identify which accidents have involved vehicles, which are:

    a. ISA capable in the future
    b. Travelling in their *local* area.

To do this it is necessary to map the 429,945 vehicle records onto the 233,729 accident records. This is a many-to-one relationship with up to 21 vehicles having been recorded as being involved in some accidents, as shown in Table 9.

Table 9: Frequency table of number of vehicles involved in accidents

No. of Vehicles	Frequency	Percent	Cumulative Percent
1	70,025	30.0	30.0
2	138,951	59.4	89.4
3	19,347	8.3	97.7
4	3,977	1.7	99.4
5	923	0.4	99.8
6	294	0.1	99.9
7	125	0.1	100.0
8	36	0.0	100.0
9	30	0.0	100.0
10	11	0.0	100.0
11	2	0.0	100.0
12	2	0.0	100.0
14	2	0.0	100.0
16	1	0.0	100.0
17	2	0.0	100.0
21	1	0.0	100.0
Total	233,729	100.0	

For the purposes of this study, only accidents involving 1, 2, 3 or 4 vehicles have been included in this further analysis. This simplification takes account of 99.4% of all accidents. In order to determine the proportions of ISA capable vehicles involved in accidents, the following data is required for each vehicle involved in an accident:

    1. vehicle type
    2. coordinates of the accident location
    3. driver postcode

Unfortunately as the number of vehicles involved in an accident increases, the chances of not having the above prerequisites for every vehicle also increases. Incomplete data for the accidents produced the match results shown in Table 10.

Table 10: Number of accidents by number of vehicles involved

No. of Vehicles	Complete data available	All cases	Matched (%)
1	36,113	70,025	51.6
2	50,159	138,951	36.1
3	5,434	19,347	28.1
4	844	3,977	21.2
Total	**92,550**	**232,300**	**39.8**

An analysis of accidents on the basis of road type and speed limit has been undertaken for each group of accidents in Table 10. Details of the number of accidents in by road type and speed limit are provided in Table 11 and Table 12 respectively. The complete cross tabulation is provided in the Appendix.

Table 11: Proportion of accidents by road type

No. of Vehicles	Motorway	A(M)	A	B	C	Unclassified	All
1	0.8%	0.1%	12.7%	3.9%	2.7%	9.9%	30.1%
2	2.3%	0.1%	29.3%	7.3%	4.9%	15.9%	59.8%
3	0.7%	0.0%	4.6%	1.0%	0.5%	1.5%	8.3%
4	0.3%	0.0%	1.0%	0.1%	0.1%	0.2%	1.7%
Total	**4.1%**	**0.3%**	**47.5%**	**12.4%**	**8.2%**	**27.5%**	**100.0%**

Table 12: Proportion of accidents by speed limit

No. of Vehicles	Speed Limit						
	20	**30**	**40**	**50**	**60**	**70**	**All**
1	0.1%	20.9%	1.7%	0.3%	5.4%	1.7%	30.1%
2	0.1%	39.1%	5.6%	1.1%	10.1%	3.8%	59.8%
3	0.0%	4.3%	1.0%	0.3%	1.7%	1.1%	8.3%
4	0.0%	0.7%	0.2%	0.1%	0.4%	0.4%	1.7%
Total	**0.2%**	**64.9%**	**8.4%**	**1.8%**	**17.6%**	**7.1%**	**100.0%**

In the next step we seek to identify which of these accidents may be addressed by a local ISA system which operates on ISA-capable vehicles within a:
1. 5km radius from a driver's home address
2. 10km radius from a driver's home address
3. 15 km radius from a driver's home address.

The ISA capability has been determined by vehicle type as set out in Table 13. Although an ISA-equipped motorcycle is to be built and demonstrated in the current project, motorcycles were counted as non-ISA capable for a couple of reasons:

- The operation of an ISA on a motorcycle is as yet unknown and therefore it is not possible to make accurate predictions about the extent to which ISA might curtail speeding;
- The relationship between speed and accidents has not been studied for motorcycles.

Table 13: ISA capability

Vehicle Type	ISA Capable
Pedal Cycle	N
Moped	N
Motorcycle 125cc and under	N
Motorcycle over 125cc	N
Taxi	Y
Car	Y
Minibus (8-16 passenger seats)	Y
Bus or coach (17 or more pass seats)	Y
Other motor vehicle	N
Other non-motor vehicle	N
Ridden horse	N
Agricultural vehicle (includes diggers etc.)	N
Tram	N
Goods 3.5 tonnes max gw and under	Y
Goods over 3.5t and under 7.5t	Y
Goods 7.5t max gw and over	Y

Having established which vehicles would have ISA functionality and whether these vehicles are within the specified range from the driver's home postcode it is then possible to consider which accidents involve ISA-capable vehicles.

Table 14 sets out the number of accidents involving:

No   ISA capable vehicles, either because the vehicle is unlikely to possess ISA functionality or it is deemed non-local (because the distance from home address exceeds the specified criteria);

At least one   ISA capable vehicle traveling within the distance criteria involved in a single- or multi-vehicle accident;

All   ISA capable vehicles traveling within the distance criteria involved in a single- or multi-vehicle accident.

Table 14: Accidents involving ISA-capable vehicles travelling within a specified distance of driver's home address

ISA Capable Vehicles	Within 5 km		Within 10 km		Within 15 km	
	Number	**%**	**Number**	**%**	**Number**	**%**
None	85,600	36.8%	51,111	22.0%	37,174	16.0%
At least one	72,213	31.1%	107,797	46.4%	126,580	54.5%
All	74,487	32.1%	73,392	31.6%	68,547	29.5%
Total	232,300	**100.0%**	232,300	**100.0%**	232,300	**100.0%**

The tables in the Appendix describe the data behind Table 14. This includes the number of ISA-capable vehicles involved in 1, 2, 3 and 4 vehicle accidents at 5, 10 and 15 km from a driver's home address. The data is disaggregated by road type and speed limit.

3. ACCIDENT REDUCTIONS

Having established which accidents may involve ISA capable vehicles and may as a result be addressed by a local ISA system it is necessary to determine to what extent the ISA system will be effective in reducing such accidents. The External Vehicle Speed Control Project provides estimates of the accident reduction potential of ISA as shown in Table 15 below.

Table 15: Estimates of the possible accident reductions from EVSC

ISA System Status	Speed Limit System	Low Estimate (%)	Best Estimate (%)	High Estimate (%)
Advisory	Fixed	2	10	21
	Variable	2	10	22
	Dynamic	3	13	27
Voluntary	Fixed	5	10	21
	Variable	6	11	22
	Dynamic	10	18	27
Mandatory	Fixed	11	20	31
	Variable	12	22	33
	Dynamic	19	36	50

By combining the best estimate of the accident reductions with the information on the presence of ISA vehicles in local accidents, it is possible to calculate the expected savings from a "local" ISA system, based on a driver's home location. The results are given in Table 16. The assumption here is that an accident results from a unique series of actions, a chain of events, and that breaking one link in the chain will destroy the sequence that resulted in the accident. Thus if a single ISA vehicle is present, the accident can be prevented.

Table 16: Expected accident reductions (2000) resulting from a local ISA system

ISA System Status	Speed Limit System	Within 5 km		Within 10 km		Within 15 km	
		Number	%	Number	%	Number	%
Advisory	Fixed	14,670	6.3%	18,119	7.8%	19,513	8.4%
	Variable	14,670	6.3%	18,119	7.8%	19,513	8.4%
	Dynamic	19,071	8.2%	23,555	10.1%	25,367	10.9%
Voluntary	Fixed	14,670	6.3%	18,119	7.8%	19,513	8.4%
	Variable	16,137	7.0%	19,931	8.6%	21,464	9.2%
	Dynamic	26,406	11.4%	32,614	14.0%	35,123	15.1%
Mandatory	Fixed	29,340	12.6%	36,238	15.6%	39,025	16.8%
	Variable	32,274	13.9%	39,862	17.2%	42,928	18.5%
	Dynamic	52,812	22.8%	65,228	28.1%	70,246	30.2%

From Table 16 it is clear that a substantial increase in accident savings occurs as the definition of "local" is increased from 5 km from the driver's home address to 10 km, but the increase from 10 km to 15 km is smaller. An ISA system that provided coverage of roads within 5 km of a driver's home would be 63% as effective as an ISA system covering the whole of Great Britain. One providing coverage over a radius of 10 km would be 78% as affective as a system covering the whole country. An increase in coverage to a radius of 15 km would mean a system with 84% of the effectiveness of a system with full coverage.

An alternative assumption is that the probability of ISA "saving" an accident is directly related to the proportion of ISA-capable vehicles involved in the accident. Thus,. when considering two-vehicle accidents in which only one of the two vehicles involved in an accident is fitted with a Fixed Speed Limit Advisory, local ISA system, it is assumed that only 50% of these accidents will achieve the estimated 10% (Best) estimate of accident reductions. This results in the expected reductions of Table 17, which are considered an under-estimate of the likely accident reductions. Overall, the estimates in Table 16 are considered more reasonable.

Table 17: Alternative version of expected accident reductions (2000) resulting from a local ISA system

ISA System Status	Speed Limit System	Within 5 km		Within 10 km		Within 15 km	
		Number	%	Number	%	Number	%
Advisory	Fixed	5,993	2.6%	7,980	3.4%	8,919	3.8%
	Variable	5,993	2.6%	7,980	3.4%	8,919	3.8%
	Dynamic	7,791	3.4%	10,374	4.5%	11,595	5.0%
Voluntary	Fixed	5,993	2.6%	7,980	3.4%	8,919	3.8%
	Variable	6,592	2.8%	8,778	3.8%	9,811	4.2%
	Dynamic	10,787	4.6%	14,364	6.2%	16,054	6.9%
Mandatory	Fixed	11,986	5.2%	15,960	6.9%	17,838	7.7%
	Variable	13,184	5.7%	17,556	7.6%	19,622	8.4%
	Dynamic	21,574	9.3%	28,729	12.4%	32,109	13.8%

4. CONCLUSIONS

The objective of this study was to ascertain how effective a local ISA scheme, i.e. one covering just a local area, would be in terms of accident reduction, as contrasted with a national scheme. A comprehensive analysis of accident location in relation to the postal address of each driver involved has been carried out.

The overall conclusion is one that confirms previous findings that most drivers involved in accidents are not very far from their place of residence. The best estimate is that a local ISA system which covered an area with a 5 km radius, i.e. 79 km^2, would have approximately 63% of the effectiveness of a national ISA for accidents occurring within that area.[1] Extending the area covered to one with a radius of 10 km, i.e. 314 km^2, would provide 78% of the effectiveness of a national ISA. And finally, making the area even larger with a radius of 15 km and an area of 707 km^2, would make the local ISA 84% as effective as a national ISA. Thus local ISA could be an valuable tool for accident reduction.

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[1] This is an approximation. The real proportion of accidents affected would be subject to the pattern of accidents within the area and the relative concentration of accidents in different zones.

5. APPENDIX

Table 18: Number of accidents by main road type, speed limit and number of vehicles involved

No. Veh. in accident	Speed Limit	Main Road Type						All
		Motorway	**A(M)**	**A**	**B**	**C**	**Unclassified**	
1	20	0	0	31	10	19	157	217
	30	31	4	18,413	5,683	4,429	19,913	48,473
	40	31	8	2,650	576	211	454	3,930
	50	47	15	613	60	19	45	799
	60	64	13	5,691	2,731	1,601	2,465	12,565
	70	1,783	85	2,103	28	11	31	4,041
Group Total		**1,956**	**125**	**29,501**	**9,088**	**6,290**	**23,065**	**70,025**
2	20	0		37	9	21	111	178
	30	252	44	39,508	11,432	8,317	31,250	90,803
	40	245	27	9,456	1449	528	1,225	12,930
	50	181	46	2,114	149	44	117	2,651
	60	279	33	12,633	3,960	2,476	4,082	23,463
	70	4,359	198	4,209	47	46	67	8,926
Group Total		**5,316**	**348**	**67,957**	**17,046**	**11,432**	**36,852**	**138,951**
3	20	0		5	2		10	17
	30	14	4	4,636	1,436	812	2,996	9,898
	40	32	7	1,701	251	80	160	2,231
	50	58	14	499	34	7	16	628
	60	37	4	2,799	640	272	289	4,041
	70	1,442	54	1,022	1	5	8	2,532
Group Total		**1,583**	**83**	**10,662**	**2,364**	**1,176**	**3,479**	**19,347**
4	20	0				3	1	4
	30	5	1	741	201	116	465	1,529
	40	5	3	386	31	19	23	467
	50	14	2	140	5		3	164
	60	7	1	709	86	39	48	890
	70	561	24	329	2		7	923
Group Total		**592**	**31**	**2,305**	**325**	**177**	**547**	**3,977**

Table 19: Proportion of accidents by main road type, speed limit and number of vehicles involved

No. Veh. in accident	Speed Limit	Main Road Type						All
		Motorway	**A(M)**	**A**	**B**	**C**	**Unclassified**	
1	20			0.0%	0.0%	0.0%	0.2%	0.3%
	30	0.0%	0.0%	26.3%	8.1%	6.3%	28.4%	69.2%
	40	0.0%	0.0%	3.8%	0.8%	0.3%	0.6%	5.6%
	50	0.1%	0.0%	0.9%	0.1%	0.0%	0.1%	1.1%
	60	0.1%	0.0%	8.1%	3.9%	2.3%	3.5%	17.9%
	70	2.5%	0.1%	3.0%	0.0%	0.0%	0.0%	5.8%
Group Total		**2.8%**	**0.2%**	**42.1%**	**13.0%**	**9.0%**	**32.9%**	**100%**
2	20			0.0%	0.0%	0.0%	0.1%	0.1%
	30	0.2%	0.0%	28.4%	8.2%	6.0%	22.5%	65.3%
	40	0.2%	0.0%	6.8%	1.0%	0.4%	0.9%	9.3%
	50	0.1%	0.0%	1.5%	0.1%	0.0%	0.1%	1.9%
	60	0.2%	0.0%	9.1%	2.8%	1.8%	2.9%	16.9%
	70	3.1%	0.1%	3.0%	0.0%	0.0%	0.0%	6.4%
Group Total		**3.8%**	**0.3%**	**48.9%**	**12.3%**	**8.2%**	**26.5%**	**100%**
3	20			0.0%	0.0%		0.1%	0.1%
	30	0.1%	0.0%	24.0%	7.4%	4.2%	15.5%	51.2%
	40	0.2%	0.0%	8.8%	1.3%	0.4%	0.8%	11.5%
	50	0.3%	0.1%	2.6%	0.2%	0.0%	0.1%	3.2%
	60	0.2%	0.0%	14.5%	3.3%	1.4%	1.5%	20.9%
	70	7.5%	0.3%	5.3%	0.0%	0.0%	0.0%	13.1%
Group Total		**8.2%**	**0.4%**	**55.1%**	**12.2%**	**6.1%**	**18.0%**	**100%**
4	20					.1%	0.0%	0.1%
	30	0.1%	0.0%	18.6%	5.1%	2.9%	11.7%	38.4%
	40	0.1%	0.1%	9.7%	0.8%	0.5%	0.6%	11.7%
	50	0.4%	0.1%	3.5%	0.1%		0.1%	4.1%
	60	0.2%	0.0%	17.8%	2.2%	1.0%	1.2%	22.4%
	70	14.1%	0.6%	8.3%	0.1%		0.2%	23.2%
Group Total		**14.9%**	**0.8%**	**58.0%**	**8.2%**	**4.5%**	**13.8%**	**100%**

Accidents within 5 km of home address

Table 20: Four-vehicle accidents

	Frequency	Percent	Cumulative Percent	Scaled[2]
Non-ISA veh's or beyond 5 km	299	7.5	35.4	1,408.9
1 veh within 5 km and ISA	174	4.4	56.0	819.9
2 veh within 5 km and ISA	162	4.1	75.2	763.4
3 veh within 5 km and ISA	123	3.1	89.8	579.6
4 veh within 5 km and ISA	86	2.2	100.0	405.2
Sum	844	21.2		
System missing	3,133	78.8		
Total	3,977	100.0		3,977

Table 21: Three-vehicle accidents

	Frequency	Percent	Cumulative Percent	Scaled
Non-ISA veh's or beyond 5 km	1,571	8.1	28.9	5,593.3
1 veh within 5 km and ISA	1,475	7.6	56.1	5,251.5
2 veh within 5 km and ISA	1,455	7.5	82.8	5,180.3
3 veh within 5 km and ISA	933	4.8	100.0	3,321.8
Sum	5,434	28.1		
System missing	13,913	71.9		
Total	19,347	100.0		19,347

Table 22: Two-vehicle accidents

	Frequency	Percent	Cumulative Percent	Scaled
Non-ISA veh's or beyond 5 km	15,734	11.3	31.4	43,586.5
1 veh within 5 km and ISA	22,342	16.1	75.9	61,892.0
2 veh within 5 km and ISA	12,083	8.7	100.0	33,472.5
Sum	50,159	36.1		
System missing	88,792	63.9		
Total	138,951	100.0		138,951

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[2] To the total number, to compensate for the vehicles for which postcode information was missing.

Table 23: One-vehicle accidents

	Frequency	Percent	Cumulative Percent	Scaled
Non-ISA veh's or beyond 5 km	18,056	25.8	50.0	35,011.5
1 veh within 5 km and ISA	18,057	25.8	100.0	35,013.5
Sum	36,113	51.6		
System missing	33,912	48.4		
Total	70,025	100.0		70,025

Table 24: Summary of local set at distance 5 km

Scaled total number of accidents within 5 km	Frequency	Percent
Non-ISA veh's or beyond 5 km	85,600	36.8
1 veh within 5 km and ISA	102,977	44.3
2 veh within 5 km and ISA	39,416	17.0
3 veh within 5 km and ISA	3,901	1.7
4 veh within 5 km and ISA	405	0.2
Total	232,300	100.0

Accidents within 10 km of home address

Table 25: Four-vehicle accidents

	Frequency	Percent	Cumulative Percent	Scaled
Non-ISA veh's or beyond 10 km	160	4.0	19.0	754
1 veh within 10 km and ISA	135	3.4	35.0	636
2 veh within 10 km and ISA	176	4.4	55.8	829
3 veh within 10 km and ISA	191	4.8	78.4	900
4 veh within 10 km and ISA	182	4.6	100.0	858
Sum	844	21.2		
System missing	3,133	78.8		
Total	3,977	100.0		3,977

Table 26: Three-vehicle accidents

	Frequency	Percent	Cumulative Percent	Scaled
Non-ISA veh's or beyond 10 km	840	4.3	15.5	2,991
1 veh within 10 km and ISA	1,101	5.7	35.7	3,920
2 veh within 10 km and ISA	1,705	8.8	67.1	6,070
3 veh within 10 km and ISA	1,788	9.2	100.0	6,366
Sum	5,434	28.1		
System missing	13,913	71.9		
Total	19,347	100.0		19,347

Table 27: Two-vehicle accidents

	Frequency	Percent	Cumulative Percent	Scaled
Non-ISA veh's or beyond 10 km	8,542	6.1	17.0	23,663
1 veh within 10 km and ISA	22,033	15.9	61.0	61,036
2 veh within 10 km and ISA	19,584	14.1	100.0	54,252
Sum	50,159	36.1		
System missing	88,792	63.9		
Total	138,951	100.0		138,951

Table 28: One-vehicle accidents

	Frequency	Percent	Cumulative Percent	Scaled
Non-ISA veh's or beyond 10 km	12,224	17.5	33.8	23,703
1 veh within 10 km and ISA	23,889	34.1	100.0	46,322
Sum	36,113	51.6		
System missing	33,912	48.4		
Total	70,025	100.0		70,025

Table 29: Summary of local set at distance 10 km

Scaled total number of accidents within 10 km	Frequency	Percent
Non-ISA veh's or beyond 10 km	51,111	22.0
1 veh within 10 km and ISA	111,914	48.2
2 veh within 10 km and ISA	61,152	26.3
3 veh within 10 km and ISA	7,266	3.1
4 veh within 10 km and ISA	858	0.4
Total	232,300	100.0

Accidents within 15 km of home address

Table 30: Four-vehicle accidents

	Frequency	Percent	Cumulative Percent	Scaled
Non-ISA veh's or beyond 15 km	100	2.5	11.8	471
1 veh within 15 km and ISA	123	3.1	26.4	580
2 veh within 15 km and ISA	147	3.7	43.8	693
3 veh within 15 km and ISA	217	5.5	69.5	1,023
4 veh within 15 km and ISA	257	6.5	100.0	1,211
Sum	844	21.2		
System missing	3,133	78.8		
Total	3,977	100.0		3,978

Table 31: Three-vehicle accidents

	Frequency	Percent	Cumulative Percent	Scaled
Non-ISA veh's or beyond 15 km	586	3.0	10.8	2,086
1 veh within 15 km and ISA	851	4.4	26.4	3,030
2 veh within 15 km and ISA	1,641	8.5	56.6	5,843
3 veh within 15 km and ISA	2,356	12.2	100.0	8,388
Sum	5,434	28.1		
System missing	13,913	71.9		
Total	19,347	100.0		19,347

Table 32: Two-vehicle accidents

	Frequency	Percent	Cumulative Percent	Scaled
Non-ISA veh's or beyond 15 km	5,779	4.2	11.5	16,009
1 veh within 15 km and ISA	20,713	14.9	52.8	57,379
2 veh within 15 km and ISA	23,667	17.0	100.0	65,563
Sum	50,159	36.1		
System missing	88,792	63.9		
Total	138,951	100.0		138,951

Table 33: One-vehicle accidents

	Frequency	Percent	Cumulative Percent	Scaled
Non-ISA veh's or beyond 15 km	9,596	13.7	26.6	18,607
1 veh within 15 km and ISA	26,517	37.9	100.0	51,418
Sum	36,113	51.6		
System missing	33,912	48.4		
Total	70,025	100.0		70,025

Table 34: Summary of local set at distance 15 km

Scaled total number of accidents within 15 km	Frequency	Percent
Non-ISA veh's or beyond 15 km	37,174	16.0
1 veh within 15 km and ISA	112,407	48.4
2 veh within 15 km and ISA	72,098	31.0
3 veh within 15 km and ISA	9,411	4.1
4 veh within 15 km and ISA	1,211	0.5
Total	232,300	100.0