The Recognition of Macrostructure: A Pilot Study

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This paper describes an exploratory study designed to examine the differences and/or similarities in the way native and non-native speakers of English process complete texts, and to examine the possible uses of a macro-textual approach in the teaching of foreign language reading.

The *problem-solution* discourse structure is one of the few models which combine surface linguistic study and local levels of text analysis with the overall structure of text. This model was used to analyse texts, from which four separate summaries were constructed. One was a 'model' summary, but the other three distorted the original discourse structure in some way. The informants were asked to read the original texts and then to rank the summaries in terms of 'quality'.

Although the results of the study do not provide very clear indications of the differences between native and non-native processing, they are extremely homogeneous and lend strong support to the argument here for reading research and teaching methodology to include the macro-textual elements involved in reading.

INTRODUCTION

Most definitions and descriptions of text developed during the past few years have been concerned with 'local' levels of discourse analysis: with the mechanisms of textual cohesion within and between sentences, which include anaphora, reference and substitution, ellipsis, conjunction, sentence adverbs, etc (eg Widdowson 1975; Halliday and Hasan 1976; van Dijk 1977). This approach to discourse analysis, which can be described as *micro-textual*, has gradually influenced theoretical model-building, research and teaching in both first and second language reading. While this in itself reflects a welcome move away from the lower level elements involved in reading (graphemic, morphological, lexical and syntactic), it is suggested in this paper that both theoretical reading models and teaching methodology must be extended beyond sentence-level, micro-textual processing in reading, to incorporate the processing of complete texts.

Until quite recently, *macro-textual* analysis was very much neglected in linguistics and, consequently, in the study of reading behaviour and the development of teaching methodology, although as Hutchins (1977) points out, it has long been the province of literary criticism, rhetoric and folk-tale analysis.

The 'problem-solution' model of discourse structure, developed by Winter (1969, 1976, 1977) and extended by Hoey (1979, 1982, 1983) is one of the few models which combine surface linguistic study and local levels of text analysis with the overall structure of text. This model was used for the analysis of texts in the exploratory study described in this paper. The study was designed to examine the differences and/or similarities in the way native and non-native speakers of English process complete texts, and to examine the possible uses of a macro-textual approach in the teaching of foreign language reading.

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The problem-solution structure is one of a number of macro-structures which has been identified in English. In its most recent and systematic description by Hoey (1983) it consists of the following elements:

Situation; Problem; Solution or Response; Result and Evaluation

Hoey gives the following (made-up) example:

> I was on sentry duty. I saw the enemy approaching. I opened fire. I beat off the attack.

In this example, the first sentence answers the question *What was the situation?*, the second *What happened?* or *What problem occurred?*, the third *What was the response?* and the fourth *What was the result?* or *How successful was the response?* Hoey points out that certain versions of this discourse are incomplete, eg.

> I was on sentry duty. I saw the enemy approaching. I opened fire.

This text is incomplete in that it lacks a result; as Hoey puts it (1983:47) 'it has to be followed by a "to be continued" tag.' This view is of major relevance to the study described below.

Hoey states that his interest and concern with the problem-solution structure is a direct result of his involvement with the difficulties of teaching communication skills to those whose main talents lie elsewhere. He also states that "the thorny question of how to improve the communicative skills of student scientists and technologists might in part be answered by demonstrating to them not only the typical problem-solution structure, but also the signalling system available to make the structure clear of whatever they write". The study described below is concerned with reading skills, rather than writing skills, and with foreign language reading, as well as native language reading, but the pedagogical implications of the problem-solution discourse structure, and the extent to which it might practically be applied to the teaching of communication skills are clearly equally, if not more, relevant. Some of these implications and applications are examined in the concluding section of this paper.

EXPLORATORY STUDY

The purpose of the study was to observe readers' attempts to process complete texts, and to compare the extent to which native and non-native readers are able to recognise and utilise the underlying discourse structure of English texts.

SUBJECTS

The nine subjects who participated in the study were all postgraduate students taking a one-year MSc course in Transportation and Traffic Planning or Construction Management at Birmingham University. Four were native English speakers. Three spoke English as a second language. One of these was Nigerian, with Bura as his native language, and the other two were Malaysian with Chinese as their first language. Finally there were two Algerians, who spoke Arabic as their first language, fluent French as a second language and English as a foreign language.

TEXTS

Two texts were selected for use in the study (cf. Appendix 1). The first, entitled

"Measurements of Skidding Resistance", was taken from chapter 6 "The Road User, the Vehicle and the Road" in *Traffic Planning and Engineering* (Hobbs 1979: 298-299). This is a standard engineering textbook and the text was, therefore, typical of the material the informants were regularly required to read throughout their courses. The second text, entitled "Laser Surveys Speed Up Road Checks", was taken from the *New Civil Engineer* (15 October 1981: 30-31) - a technical journal produced by the Institution of Civil Engineers. A journal article was selected as the second text, because it was considered that a short article, which could be used in full, would actually be a more valid means of examining the informants' processing of complete texts, than an extract from a textbook.

Originally, it was intended to use a journal article from the field of economics, rather than two engineering texts, but no articles of suitable length could be found. If this had been possible, it is likely that the informants' reading performance would have varied according to their previous experience of reading texts in the two subject disciplines. Johns (1980:156) notes that foreign students in the Department of Transportation and Environmental Planning at the University of Birmingham "find their engineering texts relatively easy - their difficulties lie with the novel areas of economics, sociology and 'applied aesthetics' ".

SUMMARIES

A primary analysis of the two texts was carried out, using the problem-solution model of discourse structure. Once sections of the texts had been broadly classified as *situation, problem, solution* or *evaluation,* four separate summaries (cf. Appendix 2) of each text were constructed, as detailed below:

1.   A 'model' summary, which reflected the complete structure of the original texts and included **situation, problem, solution, (negative evaluation),** and **positive evaluation.**

2.   A 'no-problem' summary, which distorted the original structure of the texts, by omitting all those sections which referred to the **problem.**

3.   A 'no-solution' summary, which distorted the original structure by omitting all references to a **solution** to the problem.

4.   A 'random' summary, constructed simply by summarising every third sentence of the original texts.

'No-situation' and 'no-evaluation' summaries were also constructed, but these were not included for two main reasons. Firstly, when these summaries were re-analysed, they were found to be perfectly acceptable as texts, even though the underlying structure did not necessarily reflect that of the originals and was not necessarily one of problem-solution. Secondly, it was considered that together with the original texts, 8 summaries (2 x 4) were all that subjects could reasonably be asked to cope with.

PROCEDURE

Individual interviews were held with each informant, during which they were asked to read the first original text and the accompanying summaries. They were then asked to rank the summaries in order of preference. When this had been done, a tape recorder was switched on and the informants were asked to state their choice of order and to

give any reasons they had for their choices. The procedure was repeated for the second text. The tape recordings were transcribed in full, for the purpose of data analysis.

RESULTS

Table 1 shows from top to bottom, the order of preference of each subject with respect to Summaries 1 to 4.

Table 1 Rank Order of Subjects' Preferences

TEXT 1

Subjects:	Natives					Non-natives				
	a	b	c	d		a	b	c	d	e
	1	1	1	2		1	1	1	1	1
	2	2	2	1		2	3	3	3	2
	3	3	3	3		3	2	2	2	4
	4	4	4	4		4	4	4	4	3

TEXT 2

Subjects:	a	b	c	d		a	b	c	d	e
	1	1	2	1		2	3	1	1	1
	3	2	1	3		1	1	2	2	2
	2	3	4	2		3	2	4	3	3
	4	4	3	4		4	4	3	4	4

Thus, for example, among the natives, 3 chose *Summary 1* (the model) as their first choice for text 1, while the remaining subject chose *Summary 2*.

The following results are noteworthy:

1. In the case of Text 1, the results are remarkably homogeneous; 8 out of 9 subjects made *Summary 1* their first choice; similarly, 8 out of 9 made *Summary 4* (the random version) their fourth choice.

2. With one exception, the native subjects ranked *Summary 2* (no problem) second; all placed *Summary 3* (no solution) third. The non-native subjects were slightly less consistent with respect to these two texts, but showed a slight tendency to prefer 3 to 2.

3. The results for Text 2 are rather less homogeneous, but 6 out of 9 ranked *Summary 1* first and 7 out of 9 ranked *Summary 4* last.

4. In the case of Text 2, the non-natives showed slightly more of a tendency to place *Summary 2* second and *Summary 3* third.

The reasons the informants gave for their choice of order were generally of two kinds. In the first place, they made general comments about the 'readability' of the summaries, about how they 'flowed', etc, and about whether the summaries included

the 'most important information' from the original texts. Secondly: there were less predictable comments about the 'structure' of the texts. Overall, it was the native speakers who made the more general comments about readability, style and information-content, and the non-natives who commented on the structure of the summaries.

DISCUSSION

Although this study was essentially 'exploratory', rather than hypothesis-testing, it was anticipated that there would be more differences between the order in which the native and non-native informants ranked the summaries, and that there would be common trends within the two groups. It was assumed that if this was so, it would be possible to draw tentative conclusions about the informants' conscious or subconscious awareness of the underlying discourse structure of written texts, and about how this awareness affects their acquired or learned ability to process complete texts.

However, the results of the study show quite clearly that the informants were, in general, able to identify not only the summaries which most reflected the structure of the original texts, but also those which reflected it least, regardless of whether they spoke English as a first, second or foreign language. There was only one non-native who did not identify the model summary as the best and the random summary as the worst, for at least one of the texts, and the overall number of instances when the best and worst summaries were not identified is very small. The fact that the results are so homogenous provides, of course, very firm evidence of the existence of the problem-solution discourse structure since it can be recognised even by people not trained to do so.

Given the extent to which the informants were able to identify the best and worst summaries, there is one aspect of the results which is surprising, namely the inconsistency in the ordering of the 'no problem' and 'no solution' summaries. It was expected that the 'no problem' summary would be ranked above the 'no solution' summary, at least by the native speakers, because even texts which do not explicitly state a problem are likely to imply one, as soon as a solution is introduced. A text which includes an 'unsolved' problem, on the other hand, is clearly incomplete. Indeed, texts which include negative evaluations, because the responses do not 'solve' the problems, continue until a successful response is introduced and followed by a positive evaluation. It was, therefore, expected that the informants would demonstrate the ability to infer the problem in the 'no problem' summary, especially since they had access to the original text, in which the problem was overtly stated. However, as noted above, the 'no problem' summary was ranked above the 'no solution' summary in only twelve out of eighteen cases. This inconsistency was most apparent in the non-natives' responses, but it also occurred in those of the natives. There does not appear to be any other feasible explanation for these results, other than the limitations of the informants' ability to recognise the structure.

The most significant differences between the native and non-native informants emerged from an examination of the reasons they gave for their choice of order. These showed that although the native speakers were generally more consistent in demonstrating their ability to identify the best and worst summaries, this seems to reflect an acquired, subconscious skill. Their comments indicate that they processed

the texts in terms of the information-content and in terms of style. The non-natives, on the other hand, appeared to be much more conscious of the structure of the texts and of the summaries as samples of language, rather than information. They are clearly very advanced learners of English as a foreign language, but they do not seem to have shaken off their awareness of English as language, rather than as a means of communication or as a means of conveying information.

FURTHER RESEARCH

The findings of this study are limited because of the very small size of the sample, and it will clearly have to be replicated with larger numbers. Different kinds of subjects may produce different results. It is anticipated for example that quite different results to those in this study would emerge from a similar study with either younger informants or with informants less experienced in terms of their general academic background and proficiency in English. Such students may not demonstrate the same ability to recognise and utilise the underlying discourse structure of complete texts in reading. This is because they will certainly not have been taught about discourse structure and they will perhaps not have had sufficient time to learn or acquire the ability to recognise it for themselves, as the subjects in this current study appear to have done.

Further research is also necessary to establish conclusively if, how and when learners of English as a foreign language develop the ability to recognise the overall structure of texts and to use this ability to help solve lower level syntactic and lexical problems in reading.

The procedure developed to examine how far students can recognise the structure of texts in this study could be useful for such research. One of its major advantages is that the summaries themselves represent 'complete' texts and there is no intermediary sentence level stage involved in the research.

TEACHING IMPLICATIONS

One of the most important ways in which the learner of English as a foreign language can utilise the ability to recognise the problem-solution discourse structure is in deciding the importance or otherwise of trying to solve sentence-level syntactic and lexical problems she or he encounters. Every teacher is familiar with the problem of trying to persuade learners of all levels that extensive reading does not necessarily demand that they understand every word or every grammatical construction, in order to understand the message, the new information, the solution to a problem or simply what it is the writer sets out to communicate.

If the ability to recognise discourse structure is useful in the reading process, then there are obvious advantages to be gained from presenting it overtly in foreign language teaching (and first language courses in communications and study skills). As in theoretical model-building and empirical research, the emphasis in the teaching of foreign language reading in the past has tended to be on sentence-level syntax and lexis. It is not suggested here that discourse structure should be taught instead of the sentence level features of texts, but that it should supplement this work. As Hoey (1982:21) states, "while it is important to teach the cohesive devices of English, these are not sufficient by themselves to account for the organisation of written discourses". He goes on to say that "the notion of discourses in general as made up of answers to questions and the four 'problem-solution' questions in particular are well worth familiarising a student of English with".

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APPENDIX 1

Primary Analysis of Text 1

MEASUREMENTS OF SKIDDING RESISTANCE

Situation:

Skidding resistance measurement has, in the past, usually required a vehicle and often elaborate equipment. One of the earlier methods was to lock a vehicle's wheel by violent braking application usually for a periods of 1s at 48 km/h and to measure the skidding resistance directly with a decelerometer or indirectly in terms of stopping distance.

Problem:

This method has many disadvantages and cannot be used at many sites.

Solution/Response:

A more suitable, although expensive, way is to use a fifth wheel which may be either:

(a) *A brake trailer towed behind a vehicle.* The wheel is locked by an electrically operated brake and deceleration is measured from a pressure capsule in the draw-bar. Tests at very high speeds can be made with this equipment. The ratio of the frictional force to the total load on the wheel is a measure known as the braking force coefficient.

(b) *A side-slipping wheel* with a smooth tyre is mounted within a car wheelbase or as the sidecar wheel of a motor-cycle combination. In either case the wheel is rotated at an angle to the direction of travel. The sideways force, applied to maintain the wheel in its angular position, is measured and the sideways-force coefficient can then be expressed as the ratio of the sideways force to the total load on the wheel.

In order to measure the road surface coefficients the percentage wheel slip, with the braking force coefficient, and the wheel angle, with the sideways force coefficient, must exceed critical values. Slip is a relationship of the towed wheel's revolutions in a braked condition R_B to those in a freely rolling condition R_F; the difference is taken up by tyre distortion and slipping:

$$S \text{ (percentage slip) } \% = \left[R_F - \frac{R_B}{R_F} \right] \times 100.$$

Both measurements refer to the dynamic coefficient of friction and are less than the coefficient of static friction. The maximum retardation is achieved between 10 and 20% slip, dependent on tyre and road surface conditions.

Negative Evaluation:

Neither of the fifth wheel methods are suitable for normal use by highway authorities.
. .

Solution

. . . and the Road Research Laboratory has developed a machine, code named SCRIM (Sideways-force Coefficient Routine Investigation Machine), which can measure and data log coefficients at regular intervals over networks of streets without interfering with normal traffic. The test wheel is side mounted, on a motorised tanker, with a spray nozzle to wet the surface under test.

Positive Evaluation:

Accurate measurements can be taken for a range of speeds between 15 and 100 km/h and at the design test speed of 50 km/h some 80 km/day can be tested.

Source: Hobbs, F.D. (1979) *Traffic Planning and Engineering.* Oxford: Pergamon. (Chapter 6, The Road User, the Vehicle and the Road, pp 298-299)
417 words (excluding formula)

Primary Analysis of Text 2

LASER SURVEYS SPEED UP ROAD CHECKS

Problem:

Road construction and maintenance engineers have always used relatively slow, labour intensive survey methods to check compliance with specification and to assess maintenance priorities on existing roads.

Positive Evaluation:

But judging by the very promising results from a prototype high speed laser sensing surveying instrument they could now have a fast, efficient and economical tool that could revolutionise measurement of new and existing trunk roads.

Solution:

The profilometer, as the instrument is called, could also eventually be used to monitor closely performance of the various repaving and asphalt recycling machines currently in use in the UK.

Novel and comparatively cheap, the instrument has been designed and developed by the Transport and Road Research Laboratory at Crowthorne, under the guidance of Patrick Jordan and Peter Still. It measures the longitudinal road surface profile, wheel ruts and macro texture. From recorded surveys engineers can quickly and easily evaluate the structural integrity of the road pavement and detect any early surface deterioration within a few metres of the located problem area. A deflectograph can then accurately determine the state of deterioration.

And because the profilometer is towed behind a vehicle at normal traffic speed up to a maximum 80 km/h the UK's complete trunk road network could be regularly surveyed using several machines shared among local authorities at a very low cost.

This regular inspection at say six monthly intervals would clearly indicate change and the rate of change in profile way before failure, enabling engineers to make a quick assessment of deterioration. This could lead to more economic repairs.

The instrument is based quite simply on a series of four lasers with matching sensors mounted on a rigid 4.5m long beam. The triangular section beam made from long tubes and heavily braced together is filled with expanded polystyrene to help it respond uniformly to ambient temperature and prevent warping which would affect readings from the laser sensors.

The vertical distance of each laser and sensor from the road surface is calculated using the change in intensity of the reflection from infra red light pulsed by each unit at up to 3300 flashes per second. One pair of sensors computes the average surface profile height every 2.14 m travelled while the other measures it at 107 mm intervals.

The two wave lengths are superimposed to give a composite profile of the road surface.

The road surface displacements measured by the sensors, together with the distance travelled by the profilometer is fed into a mini computer. Profile data is stored on a dual drive floppy disc system and can be quickly analysed on site using programmes developed by TRRL. The results of profile analysis can be called up on a graph plotter,

printer or visual display unit housed with the computer in the back of the towing vehicle.

New Problem:

Rut depth, which is normally measured in the UK slowly, and hazardously, with straight edge and wedges can also be measured by profilometer.

Solution

The wheels of the instrument's trailer ride in the ruts and the laser sensor repeatedly measures the axle displacement from the road surface along a line centred between the wheel tracks. The difference between the axle displacement measured on a rutted surface and non-rutted surface gives the rut depth average over both wheel tracks.

Evaluation:

TRRL says that measurements obtained using the profilometer compared with average rut depth derived from straight edge and wedge measurements have shown agreement to within ± 2 mm. Rut depth records can also be stored on floppy discs.

Further development of the profilometer is still needed but with these machines, which will probably cost about £170000, the Department of Transport could quickly and efficiently survey the existing road system for only £2 - £3/km.

Source: *New Civil Engineer* (15.10.81), No.462, pp 30/31
               609 words

Note: The problem-solution analysis of this text has been extremely simplified, for the purpose of this study. The sections labelled here simply as 'solution', for example, include much detail about what the instrument does, and how it works.

APPENDIX 2

'Model' Summary of Text 1

SKIDDING RESISTANCE MEASUREMENT

Previously, skidding resistance measurement required elaborate equipment. One method was to lock a vehicle's wheels by violent braking and measure resistance with a decelerometer or in terms of stopping distance. A more suitable, though expensive, way is to use a fifth wheel on a brake trailer and measure deceleration from a pressure capsule in the draw-bar or to mount the wheel within the vehicle wheel base and measure the sideways force applied to maintain it at an angle to the direction of travel.

Neither method is suitable for highway authorities and the RRL has developed a Sideways-force Coefficient Routine Investigation Machine which measures and logs coefficients without interfering with normal traffic. The test wheel is side-mounted on a motorised tanker with a spray nozzle to wet the test surface. Measurements can be taken between 15 and 100 km/h and at design test speed of 5 km/h, 80 km/day can be tested.

(151 words)

'No Problem' Summary of Text 1

SKIDDING RESISTANCE MEASUREMENT

One early method of measuring skidding resistance was to lock a vehicle's wheels by violent braking application and measure resistance directly with a decelerometer or indirectly in terms of stopping distance. Another way is to use a fifth wheel. This may be attached to a brake trailer and deceleration is measured from a pressure capsule in the draw-bar or it may be mounted within a vehicle wheelbase to measure the sideways force applied to maintain it at an angle to the direction of travel.

A third method is to use a machine, code-named SCRIM (Sideways-force Coefficient Routine Investigation Machine), which can measure and data log coefficients at regular intervals over networks of streets. The test wheel is side mounted on a motorised tanker with a spray nozzle to wet the test surface. Measurements can be taken between 15 and 100 km/h and at the design test speed of 50 km/h, 80 km/day can be tested.

(155 words)

'No Solution' Summary of Text 1

SKIDDING RESISTANCE MEASUREMENT

In the past, skidding resistance measurement required a vehicle and elaborate equipment. One of the earlier methods was to lock a vehicle's wheels by violent braking and measure resistance directly with a decelerometer or indirectly in terms of stopping distance. This method has many disadvantages and cannot be used at many sites.

The RRL possesses a machine, code named SCRIM (Sideways-force Coefficient Routine Investigation Machine), which can measure and data log coefficients at regular intervals over networks of streets without interfering with normal traffic. The test wheel is side mounted on a motorised tanker with a spray nozzle to wet the test surface. Measurements can be taken between 15 and 100 km/h and at a design test speed of 50 km/h, 80 km/day can be tested.

(126 words)

'Random' Summary of Text 1

SKIDDING RESISTANCE MEASUREMENT

Locking a vehicle's wheels by violent braking and measuring skidding resistance directly with a decelerometer or indirectly in terms of stopping distance is a method which has many disadvantages and cannot be used at many sites. Tests at very high speeds can be made with this equipment. The wheel is rotated at an angle to the direction of travel. Slip is a relationship of the towed wheel's revolutions in a braked condition to those in a freely rolling condition; the difference is taken up by tyre distortion and slipping.

Neither of the fifth wheel methods is suitable for use by highway authorities and the RRL has developed a machine, code named SCRIM (Sideways-force Coefficient Routine Investigation Machine), which measures and data logs coefficients at regular intervals over networks of streets without interfering with normal traffic.

(135 words)

'Model' Summary of Text 2

LASER SURVEYS SPEED UP ROAD CHECKS

Survey methods to check compliance with specification and to assess maintenance on existing roads have always been slow and labour intensive. But judging by the results from the profilometer, a high speed laser sensing surveying instrument, developed by the TRRL, such work could become faster, more efficient and more economical.

The profilometer measures longitudinal road surface profile, wheel ruts and macro texture. It is based on a series of four lasers with matching sensors mounted on a beam, specially constructed to give uniform readings. Changes in reflection intensity from infra red light are used to calculate the distance of the lasers and sensors from the road surface. The data is fed into a mini computer and stored on floppy discs.

The instrument can also be used to measure rut depth, which is normally slow and hazardous, by measuring axle displacement from the road surface.

Profilometer measurements compare well with straight edge and wedge measurements. Further development of this instrument is needed, but it could be used to survey existing roads for only £2-£3/km.

(174 words)

'No Problem' Summary of Text 2

LASER SURVEYS SPEED UP ROAD CHECKS

The profilometer is a high speed laser sensing surveying instrument, designed and developed by the TRRL. The machine measures the longitudinal road surface profile, wheel ruts and macro texture. It can be towed behind a vehicle at normal traffic speed up to a maximum 80 km/h.

The instrument is based on a series of four lasers with matching sensors mounted on a beam, made from long tubes, heavily braced together and filled with polystyrene. One pair of sensors measures the average profile height every 2.14 m travelled and the other every 107 mm. The two wave-lengths are then superimposed.

The road surface displacements are fed into a mini computer and stored on floppy discs. The results can be called up with the computer in the back of the towing vehicle.

The wheels of the trailer ride in the ruts and the sensor measures axle displacement. The difference between measurements on a rutted and non-rutted surface gives the rut depth average.

Profilometer measurements compare well with straight edge and wedge measurements. Further development of this instrument is needed, but it could be used to survey existing roads for only £2-£3/km.

(189 words)

'No Solution' Summary of Text 2

LASER SURVEYS SPEED UP ROAD CHECKS

Road construction and maintenance engineers have always used slow, labour intensive survey methods to check compliance with specification and to assess maintenance priorities on existing roads. Performance of various repaving and asphalt recycling machines used in the UK also have to be monitored closely.

The profilometer, a high speed laser sensing surveying instrument, developed by the TRRL, measures longitudinal road surface profile, wheel ruts and macro texture. It is based on a series of four lasers with matching sensors mounted on a beam. The beam is made from long tubes, braced together and filled with polystyrene.

The distance of the lasers and sensors from the road surface is calculated using changes in reflection intensity from infra red light. The data is stored on a floppy disc system. Rut depth is normally measured in the UK slowly, and hazardously.

Profilometer measurements compare well with straight edge and wedge measurements. Further development of the instrument is needed, but at a probable cost of £170,000, it could be used to survey existing roads for only £2-£3/km.

(173 words)

'Random' Summary of Text 2

LASER SURVEYS SPEED UP ROAD CHECKS

The profilometer could be used to monitor performance of the repaving and asphalt recycling machines currently used in the UK. Engineers can use recorded surveys to evaluate the structural integrity of the road pavement and to detect early surface deterioration within metres of the problem area. Six monthly inspections would indicate change and rate of change in profile, enabling a quick assessment of deterioration.

The triangular section beam made from long tubes and heavily braced together is filled with polystyrene to help uniform response to temperature and prevent warping which would affect the laser sensor readings. The wave lengths are superimposed to give a composite profile of road surface.

The results of profile analysis can be called up on the computer in the back of the towing vehicle. The difference between axle displacement on a rutted and non-rutted surface gives the rut depth average.

Further development of the profilometer is needed, but at a probable cost of £170,000, it could be used to survey existing roads for only £2-£3/km.

(170 words)