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Making the Business Case for Translating Non-English Transportation Information

This digest summarizes the results of NCHRP Project 20-48(01) and is based on a study conducted by Dr. John B. Metcalf. The objectives of the study were to assess, describe, and quantify, to the greatest extent possible, the need for the U.S. transportation community to improve access to non-English published information. Dr. Metcalf identified case studies where significant new technologies were published in languages other than English and assessed the potential benefits that could have been realized if English language translations had been available. The benefits were assessed in terms of savings in money, time, or lives; reduced duplication of effort; or improvements in safety, efficiency, economy, equity, mobility, security, or the environment.

SUMMARY

This digest provides an assessment of the benefits that could be realized through translation of non-English language transportation technical information. The results provide valuable information to transportation practitioners, managers, and decision makers and suggest that cost savings in the magnitude of $100 million a year could be achieved by taking full advantage of technologies and innovation developed and published in countries where English is not the primary language of communication.

INTRODUCTION

This report addresses the objective set for NCHRP Project 20-48, "Making the Business Case for Translating Non-English Transportation Information," that is:

> "to assess, describe and quantify, to the greatest extent possible, the need for the United States transportation community to improve access to non-English published information."

It was envisioned that this might be accomplished by documentation of the origin of foreign technologies imported to and applied in the United States and an evaluation of the time lag between the initial technology development in the country of origin and U.S. application. This lag in application would be a measure of benefits foregone because of the lack of English language access to that technology.

The approach proposed to derive the loss of benefit and, thus, the value of translation was an analysis of several case studies of imported technology implementation to assess the following:

- Savings in money, time, or lives that could have resulted from earlier access to the foreign language documentation;
- Savings possibly resulting from unnecessary duplication of research or investigation of potential innovations; and
- Improvements in safety, efficiency, economy, equity, mobility, security, or the environment that could have resulted more quickly through access to existing material published in other languages.

The process included identifying and selecting a range of significant imported technologies, tracing the initial foreign language reporting of those technologies and their appearance or identification in English, and estimating the impact of any time lag identified.

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TRL - Transport Research Laboratory, United Kingdom, 23
KFV - Kuratorium fuer VerkehrsSicherheit (Austrian Road Safety Board), Austria, 24
ISTU - Institut fuer Strassenbau und Strassenerhaltung, Austria, 24
CROW - Information and Technology Center for Transport and Infrastructure, Netherlands, 25
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This report documents the imported technologies, in summary, and describes the foreign language sources (books, papers, specifications, etc.) for these technologies. The study is restricted to public documents, essentially papers published in technical journals and conference proceedings. There is also a great deal of public but "fugitive" documentation (i.e., the "gray" literature), such as government department manuals, guides, trade materials, and commercial documentation of private companies. This material is only partly addressed because of the sometimes restricted access and because much of this material is not listed in bibliographic data bases. Similarly, the documentation of countries' test procedures and criteria ("standards" cf. American Society for Testing Materials) is not covered in depth, because it usually would post-date the reporting of a development in the technical literature. Although such material is of very specific application, it is easy to access; however, the foreign language material needs translation.

The study also canvassed input from and opinions of transportation experts—in the United States and abroad—and reported on visits to several International and European transportation organizations with a significant involvement in technology transfer.

BACKGROUND

This report is concerned with the impediments to the recognition, selection, and implementation—in the United States—of technologies developed and applied in non-English language countries due to the lack of translation of documentation of such technologies. The implementation of technologies from abroad was the subject of *NCHRP Synthesis 216* (Witheford 1995), which listed factors in successful implementation including (1) proper analysis/evaluation, (2) good manuals, and (3) good technical support. These three factors in turn imply the existence of adequate English language documentation, which, in turn, must rely on adequate translation of original non-English publications. This point was specifically mentioned in the conclusions to the synthesis and listed in the "checklist for implementation."

The synthesis cited examples of successfully implemented foreign technologies, some of which are discussed below. One particular example, input to the 1985 AASHTO *Highway Capacity Manual* from German studies in 1972, indicates a 13-year delay in transfer of the technology due in large part to lack of translation.

In a report (Anon 1998) to the FHWA, the value of information is discussed in three sections: reduced costs of research, quicker implementation of innovation, and more effective decision making. Examples are given of the benefits derived from better information and related technology transfer and recommendations are made for improving existing information services. Cost-benefit ratios between 1 to 3 and 1 to 16 and time savings of 26-50 percent were suggested for improved information services.

Two recent reports (NCHRP 2001, Decina and Lococo 2001) have addressed the issue of availability of and access to foreign language sources by yielding a comprehensive listing of potential sources and discussing the means of conducting and funding translation of foreign language material. Neither report makes any assessment of the relevance of the sources, except in general terms. There is little indication of the amount of material directly relevant to innovation in highway transportation, but not available in English.

The report on accessibility of foreign information (NCHRP 2001) focuses principally on the issue of translation and distribution of material but gives, in an appendix, brief details of 62 organizations, several data bases, 55 associations, and 500 journals that could contain relevant information. It indicates that one-half the material, published as reports, standards, manuals, and statistics, is produced by four countries (Germany, France, Sweden, and Spain), and with the addition of Hungary, Holland, Greece, Japan, and Denmark, three-quarters of the published material is covered. Thus a small number of journals may provide a basis for analysis, for example:

- Revue Générale des Routes – France
- Bulletin des Laboratoires des Ponts et Chaussées – France
- Berichte der Bundesanstalt fuer Strassenwesen (BASt reports) – Germany
- Internationales Verkehrswesen – Germany
- The VTI reports – Sweden

The data base analysis suggested that some 20 percent of retrieved abstracts are non-English language, of which 35 percent are unavailable in translation. Much relevant material, such as standards and guidelines, is not represented in the usual technical publication data bases. The report also provides a first estimate of potential economic benefits of access to and translation of foreign language documentation, suggesting a range of 0.01 to 1 percent of surface transportation disbursements, that is, a benefit of some $10 million to $1 billion per year.

The Guide (Decina and Lococo 2001) also lists potential sources, 33 libraries and information centers—of which 6 are in English; 33 web sites–6 are in English; 27 document-delivery mechanisms–16 are in English; 19 data bases–18 are in English; and 75 organizations–60 operating in English (see Table 1).

Clearly, the potential for discovery of relevant material in these sources is huge, but to locate, select, translate, and distribute pertinent publications is a complex problem. The problems associated with the "fugitive" or "gray" literature (i.e., material not commercially published in books, journals, etc.); the lack of access to foreign materials because of limited holdings in the United States; and the need for a translation service are discussed in greater depth in a study (Osif 2002) conducted for the TRB.

The basis for this report is the hypothesis that an inno-

TABLE 1 Non-English Document Sources

Language	Number of sources for reports	standards	manuals	statistics
Arabic	1	1	1	0
Czech	2	5	2	2
Danish	3	1	1	1
Dutch	5	4	5	2
Finnish	1	1	1	1
French	11	7	10	5
German	20	13	18	11
Greek	4	3	2	3
Hebrew	1	1	1	1
Hungarian	5	4	4	4
Italian	1	1	3	2
Japanese	4	2	3	2
Romanian	1	2	2	2
Slovenian	3	2	2	1
Spanish	5	2	7	5
Swedish	5	3	3	2
Total	**73**	**52**	**65**	**44**

vation adopted in the United Staes can be traced, in the English language literature or in the contacts amongst English-speaking transportation professionals, to an earlier point at which the documentation language changes to that of the origin of the "foreign" process/practice/policy and so on. Throughout this report, the word "English" will be used to mean the English language, in reference to written material or English-speaking authors, and the word "foreign" to mean non-English language or authors whose first language is not English.

However, it is possible that:

a) relatively "new" examples will have been published in English from the start, as foreign authors seek publication in the international journals/conferences which are predominantly English language and
b) relatively "old" examples will be difficult and time consuming to trace because the old literature will not be readily accessible. (It may require interlibrary loan from overseas collections and may also need translation so that the significance of the material as a source can be assessed.)

Further (as noted in the introduction), while the "research-based" and strictly "technical" publications (papers, reports, journal articles, etc.) may be traceable, this is less likely to be true for manuals, specifications, policy statements, and engineering practices. Such fugitive documentation is typically in national or provincial government publications not usually accessed as "technical" literature and not catalogued as such in many library collections.

The data bases, of course, are effectively limited to published technical literature and do not cover government documents (e.g., manuals and guides for departmental use) nor the publications of the various country standards associations, such as the German DIN series. Clearly, this documentation separate from the usual "public access" technical journal literature is of great significance. This is especially important in that it is often only available in the language of the country of origin.

An overreaching issue is that many innovations may not be adopted because of political, social, or economic factors specific to a local situation but not documented in any technical publications about the technological practice developed.

Because of time and resource constraints, this report is based on a small sample of the public domain documentation of transportation technologies. Although the results are considered to be robust, they should be regarded as strongly indicative rather than comprehensively proven.

SCANNING TOUR REPORTS

The intention of this study was addressed in part by identifying technologies that have been or should be considered for adoption in the United States and by locating the link between U.S. recognition of the technology and the description of that technology in publications in the language of the country of origin. It was suggested that this may in turn identify a time lag in potential U.S. implementation and, thus, a quantifiable loss of benefit. The study, therefore, looked at the reports of the FHWA Scanning Tours

directed at various topics in highway technology and attempted to link the recommendations of a Scanning Tour report to the supporting documentation and then to the non-English publications that describe the technology. Should there be a significant non-English publication at an earlier date than the English language documentation, then an argument for the benefit of translations of non-English publications is demonstrated.

Fifteen FHWA Scanning Tour reports, selected from the 48 conducted to date (Appendix A) were examined (see Table 2). The Tours were selected to give a reasonable cross section of subject matter and timing between 1990 and 2002.

An imported technology and thus the related publication(s) for investigation were identified from the Tour reports' conclusions and were then traced from the Tour report reference(s) to other publication(s) by the same author(s). The Tour reports listed 187 references, not all cited in the texts. The on-line data base sources searched were the Transportation Research and Information System ([TRIS] www.trb.org); COMPENDEX (www.engineeringvillage2.org), available through the LSU library; and the OECD International Transport Research Documentation ([OECD/ITRD] www.stn-international.de) made available by the TRB and the host organization(s) of the author(s) where possible. In the following sections, only innovations derived from non-English language sources are considered.

It is important to note that the three literature data base collections differ, sometimes substantially. Partly as a result of their input policies, partly from the different language sources, partly from the availability of documentation to the systems, and partly due to differences in input record details. The OECD/ITRD data base contains a high proportion of non-English references not listed by TRIS or COMPENDEX, thus because of this and translation problems, it was not used for every trace reported below.

The effects of these differences are illustrated by the following comparison of citations for three authors drawn from the Scanning Tour reports (see Table 3).

The search for Christory, for example, gave 100 hits in ITRD. However, if the search was based on Christory J-P, no hits resulted. Christory J P gave 49 hits and Christory J gave 51. Out of the 100 hits, a search limited by language gave 32 hits to English and 8 French publications. Out of the 49 hits, only 6 had English titles and one record did not appear in the list of 100. There were six duplicate entries. Christory had one Transportation Research Record (TRR) paper listed by TRIS and ITRD but not by COMPENDEX.

Sommer had only one reference in TRIS but 142 in OECD/ITRD and 34 in COMPENDEX. The OECD/ITRD set had many references in the field of cementitious materials technology but of limited relevance to concrete roads. The search for Hogema gave 49 hits in ITRD, 36 had English titles, and 28 had English text, presumably leaving 21 in Dutch. Two TRR papers were listed in TRS and ITRD but only one is found in COMPENDEX.

These disparate result sets serve to illustrate the difficulty of tracing the work by a particular author and, incidentally, the value of the OECD/ITRD data base with its much

TABLE 2 Scanning Tour Reports Selected

Report	*Topic*	*Non-English Language Countries*	*Date*
1	Pavements	Denmark, France, Germany, Italy, Sweden	1990
2	Pavements	Belgium, France, Austria, Germany, Netherlands, Spain, Switzerland	1992
4	Infrastructure	Austria, France, Germany, Spain	1993
11	Safety	Japan	1994
14	Safety	Germany, Netherlands, Sweden	1995
18	Bridges	Germany, Netherlands, Switzerland	1995
21	Operations	France, Germany, Netherlands, Switzerland	1996
25	Bridges	Japan, South Korea, Taiwan	1997
28	Safety	Belgium, Sweden	1998
30	Bridges	Germany, Netherlands, Switzerland	1998
34	Pavements	Denmark, France, Germany, Netherlands, Sweden	1999
35	Planning	Germany, Netherlands, Sweden	1999
39	Planning	Denmark, Germany, Netherlands, Sweden	2000
40	Operations	France, Germany, Netherlands	2001
45	Safety	Japan	2001

TABLE 3 Data Base Search Differences

Tour	Author	Language	TRIS	ITRD	COMPENDEX
2	Christory	French	17	100	10
2	Sommer	German	1	142	34
14	Hogema	Dutch	10	49	1

greater "non-English" content. The same difficulties attend any search by a topic keyword.

Thus, the traces of earlier work by authors cited in the Scanning Tour reports cannot be precise but should be enough to reveal major trends. The ready access to TRIS and COMPENDEX with their emphasis on English language publications was therefore used for the literature traces discussed in this section of the report.

The greater number of hits in OECD/ITRD appeared to insignificantly alter the pattern. However, the fact that many foreign language references were revealed (1) illustrates the need for translation and (2) underlies the argument that earlier non-English publications do exist and are not often referenced.

There is a broad pattern among the references cited in the selected scanning tour reports (Table 4) and among the reference traces developed. First, there is a heavy reliance on English publications by foreign authors or organizations. In both the tour references and the traces, this reliance also showed an emphasis on material published by TRB or presented at its Annual Meetings and more so on material published in the proceedings of international specialty conferences. Two of the European tours were notable in that the host countries specially prepared substantial amounts of documentation in English, some 36 out of 202 documents cited, excluding the statistical tables and brochures. Second, the bulk of the non-English references traced were to conferences, papers, journals, and organization reports. Some 250 documents, about half those traced, were spread over more than 20 journals. Third, a substantial amount (some 60 documents) of organization policy, guide, manual, or standard documentation was accessed and cited.

The pattern of significance is the ready availability of foreign source but English language material (from international conferences) followed by the use of a series of established and reputable foreign language journals, followed by substantial documentation from foreign organizations including materials standards.

As Tours 18 and 35 did not cite references and Tours 40 and 45 are only published in summary form, they are not discussed below. In the discussion of the selected Tours that follows, the relevant significant findings are highlighted.

Tour [1] - European Asphalt

(NOTE: Numbers in brackets [] refer to the study tour reports, Appendix A.)

The first study tour, in 1990, was to examine European asphalt technologies in five countries and the United Kingdom. In the remainder of this report, visits to and information from English language countries will not be discussed. Although the Tour report presents recommendations for U.S. implementation from the non-English language countries—Denmark, France, Germany, Italy, and Sweden—only two publication references are given. One reference is an American paper and one to an English language paper by a Swedish author Liljedahl. A search of the TRIS, ITRD, and COMPENDEX data bases revealed no other publications by this author.

The references were not cited in the text against specific findings nor were they linked to recommendations. In part, this may be because several of the recommendations refer to policies and practices in the areas of contract procedures, and warranty provisions, which are not commonly documented in technical engineering literature.

Among the technical innovations noted is the use of modified binders, patented in France, for which there must be some technical publication, and other techniques such as

TABLE 4 Distribution of Cited Resources

Tour	TRB	Conference	Journal	Standard	Specially prepared	Other
1						1
2	2	10	4	3	17	8
4	1					23
11			1			16
14	1		5			16
18						!
21						42*
25		1	2			37*
28				2		
30		7	2	3		14
34		4	6	2	19	24
35						!
39		1		3		13
40						#
45						@

! No references cited
* Statistical data and/or brochures
# Summary only published
@ Workshop, no references

the use of Stone Matrix Asphalt (SMA), design of thin overlays, and so on.

No doubt, published material was collected and, possibly, used in reaching the recommendations but as it is not documented no further trace of the potential non-English publications behind the technologies is possible from the Scanning Tour report. However, several personal contacts stressed that SMA was an excellent example of an imported technology and this is discussed later (cf. Imported Technologies). The proprietary surfacing technology 'NOVACHIP" was also mentioned and is again discussed later.

It is evident that much of the study tour's knowledge of European practice and the basis for the recommendations is based on personal observation and discussion with European colleagues.

Tour [2] – European Concrete Highways

A review of the 44 references cited in the 1992 concrete highways Scanning Tour reveals that, for France, eight of the 12 documents cited were prepared in English for the study team visit, one is a trade document, and three are references to English language publications by French authors presented in English language conferences. On the hypothesis that the work described in these three publications may be traced to earlier publications in French, a literature search was conducted for the authors' work in TRIS, ITRD, and COMPENDEX. This trace is reported below.

The study tour references are as follows:

- Christory, J.P., "Overview and Recent Developments in Concrete Pavements in France," Paper presented at the 1991 Annual Meeting of the Transportation Research Board, Washington, D.C., 1991.
- Aunis, J.H., "CRCP on the French Motorway," 6th Conference: Road Engineering Association of Asia and Australia (SAPRR Autoroute, France) March 1990.
- Guinard, P., J. L. Nissoux, and P. Orsat, "Concrete Pavement Restoration: French Maintenance Strategy and Load Transfer Device," *Transportation Research Record No. 1183*, Transportation Research Board, 1988.

Christory is a prolific author; the search of TRIS and COMPENDEX revealed 11 papers published before 1992, including those cited (see Figure 1). Of these, four were in French and three appear directly related to the French pavement design catalogue and thus to the study tour recommendations. The ITRD search listed 26 papers before 1992, six of which were also listed in the TRIS and COMPENDEX searches.

Thus, it may be argued that a substantial proportion of this author's output was not recognized because it was not published in English and that a "translation gap" existed between 1984–1987 and 1992. This resulted in a delay of 5 to 8 years in U.S. awareness of the French technology.

Aunis yielded one other publication, in English dated 1985, with Christory and Nissoux. Guinard had no earlier papers. Nissoux published three papers, all in English, before 1992: (1) with Christory in 1989; (2) with Aunis in 1988; and (3) with Christory and Orsat in 1988. Orsat had one other paper with Nissoux, published in English.

The references to the visit to Austria reveal similar patterns. Publications traced in TRIS and COMPENDEX from the references cited are given in Table 5 and Figure 2. A search for Sommer in ITRD listed 142 papers, many not directly related to pavements.

The tentative conclusion must be that little delay is caused in access to the work of the Austrian authors by lack of translation.

The references to German technology include two papers and two project descriptions prepared in English for the tour, four standard specifications in German, and one technical paper in an international conference. The author of one of the project reports had previously co-authored one paper in German listed in TRIS with an author of the other technical reference. The trace for papers prior to the tour, i.e., before 1992, is shown in Table 6 and Figure 3. A notable difference from the other countries is a greater proportion published in the native language of the authors.

The material addresses both concrete and asphalt pavements and, clearly, during the period from the mid-1960s to the date of the tour, there existed a substantial body of German work not accessible in English.

Three references from the Netherlands were traced of which two predated the tour, one was published in English, the other in German and English.

The visit to Belgium recorded four publications, two were industry reports and two published in English in international conferences. The trace of those papers' authors gave 11 prior publications, all in English.

The Spanish visit recorded only one paper, the author of which had published six papers prior to the tour in English language conferences. TRIS gave these papers and COMPENDEX yielded one paper in 1997, published in French.

Three papers were cited from Switzerland and their authors had 10 papers published prior to the tour and recorded in TRIS and COMPENDEX. All were in English.

Italy had two citations and the trace for the authors showed 24 other publications of which 22 were prior to the tour and of those 10 were in Italian. It was difficult to relate the cited references to specific recommendations made by this study tour.

This would strongly suggest that there was little delay in accessing Belgian, Spanish, and Swiss work but some delay in knowledge of the Italian technological development over the period 1977–1990.

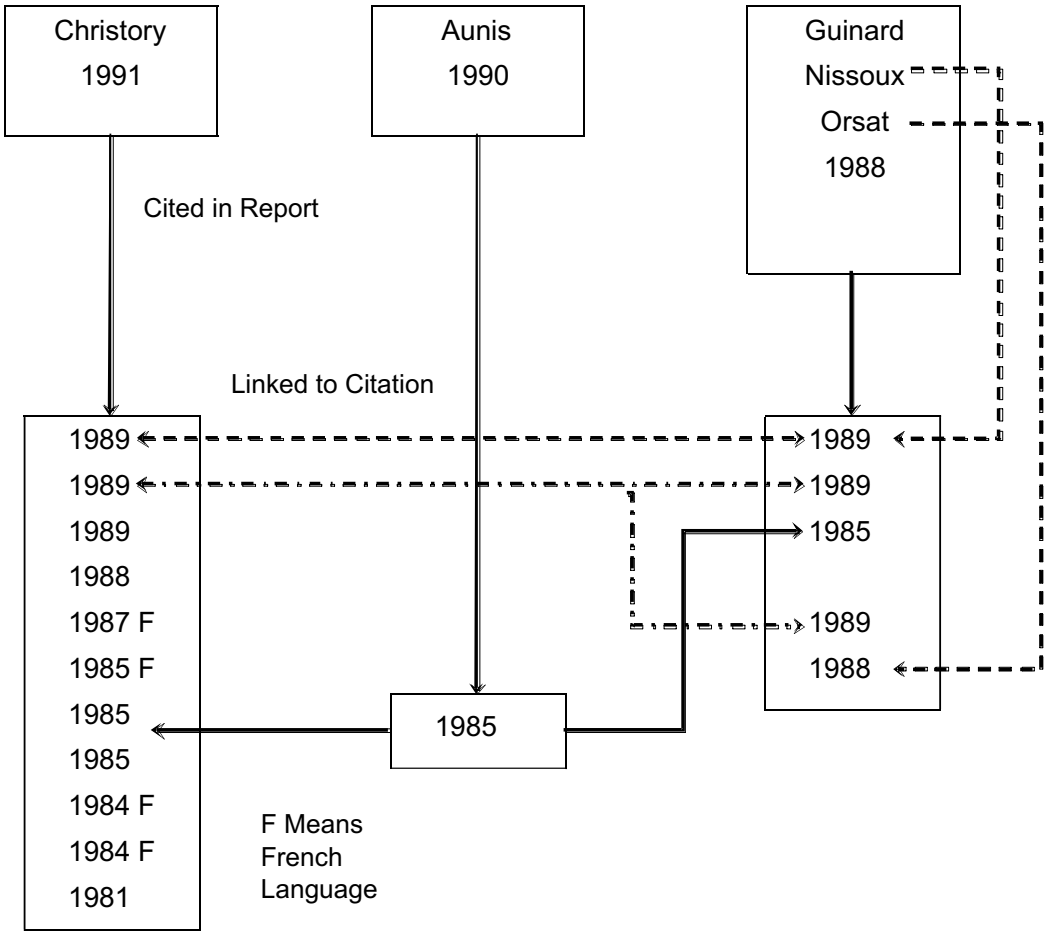

Figure 1. Reference Trace Tour [2].

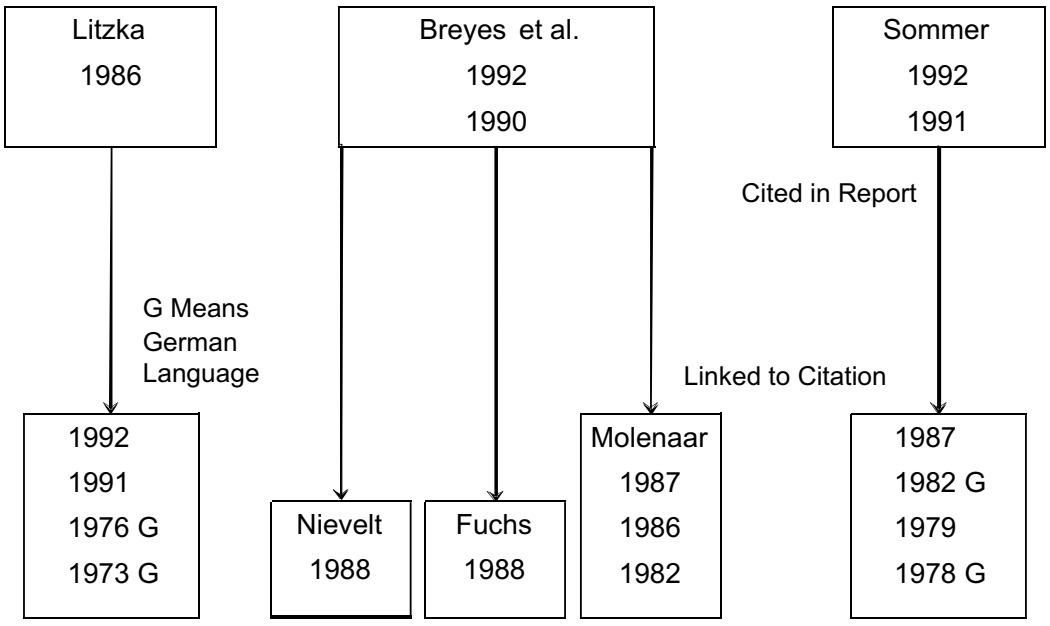

Figure 2. Reference Trace Tour [2].

TABLE 5 Reference Trace Tour [2] – Austria

Author	English Publications Number	Years	German Publications Number	Years
Litzka	5	1991–1999	3	1973–2000
Herbst	0		0	
Breyer	1	1990		
Fuchs				
Molenaar*	41	1981–2000		
Nievelt	1	1988		
Sommer	5	1979–2002	3	1978–1982

*Note that many of the Molenaar papers are related to asphalt and thus not relevant to this study.

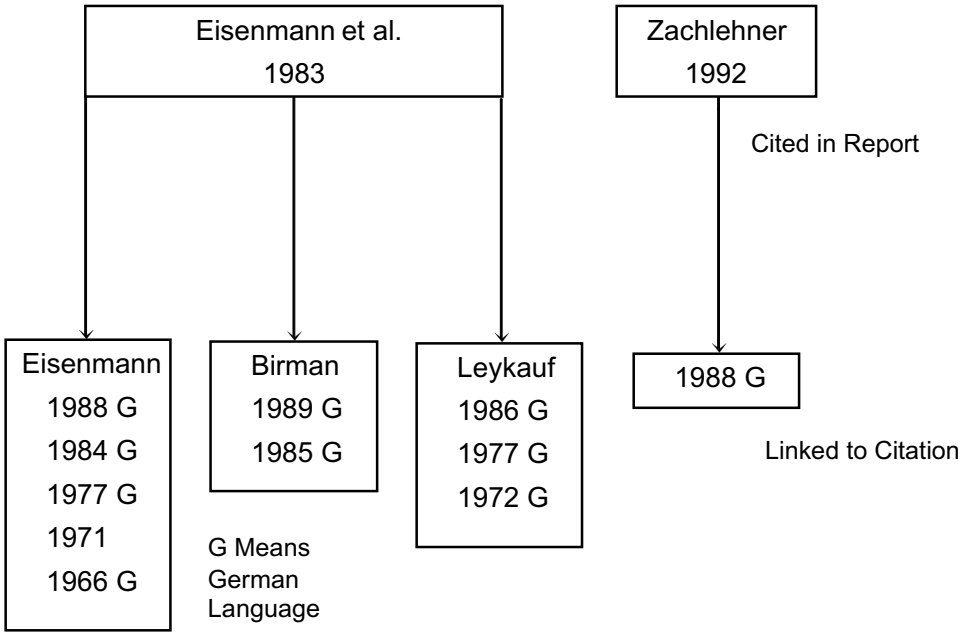

Figure 3. Reference Trace Tour [2].

TABLE 6 Reference Trace Tour [2] - Germany

Author	English Publications Number	Years	German Publications Number	Years
Eisenmann	3	1971–1984	10	1966–1988
Birman	2	1974–1983	4	1981–1989
Leykauf	7	1972–1977	3	1983–1987

Tour [4] – Contract Administration Techniques for Quality Enhancement

The 1994 contract administration study tour visited Austria, France, Germany, and Spain. Perhaps because of the nature of the topics, such as warranties, bid practices, and the use of alternative design/construct processes, no non-English references were cited. The list of contacts was also limited compared with other tours. A list of documents provided by the host agencies is given but there is no evident link to the text or recommendations of the report.

One reference to pavement design studies by Litzka and Herbst is traced in the earlier notes about Tour [2]. The remaining material appears to be government or industry publicity material for which no citation trace is possible.

Tour [11] – Highway Safety Management Systems

This 1994 tour visited Japan, Australia, and New Zealand, but the publications of interest are the six from Japan. All are agency documents for which an author trace is not possible. However, a search of the agency web pages showed that the Institute for Traffic Accident Research and Data Analysis (www.itarda.or.jp) issues a series of reports in the English language on specific safety issues (e.g., No. 38 2002, "The Child Restraint System—No Magic Chair," No. 34 2001, "Increase in Vehicle Driver and Pedestrian Fatalities During Rainfall"). The institute collects and analyzes traffic accident data from the National Police Agency, the Ministry of Construction, and the Ministry of Transport. ITARDA communicates and exchanges information with institutes abroad and is a member of OECD's International Road Traffic Accident Data Base (IRTAD www.bast.de). The Public Works Research Institute (www.pwri.go.jp) program has a road technology group focused on tunnels and pavements and publishes in the English technical literature. The National Police Agency again releases publications in English (e.g., The Road Traffic Law Enforcement Regulations - 2002 [www.npa.go.jp]).

It is suggested that the Japanese literature be examined more closely to discover if significant new material is being overlooked because of language.

Tour [14] – Speed Management and Enforcement Technology

The findings and recommendations of this tour in 1995 are summarized under two headings: speed management and enforcement technology. In the body of the report, these topics contain specific mention of work in the Netherlands, Germany, and Sweden, cited as references 1–20 in the text. There are also 20 references to Australian work that is not the concern of this study.

In the staff report on implementation (Farragut 2001), several recent U.S. initiatives to apply this foreign technology are mentioned:

- "Engineering enhancements for improved safety and operations" - directed to better management of traffic speeds and to which tour report references 5–7 and 12–19 are directly relevant,
- "Implementing radar/video technology" to which tour references 8, 9, 14 and 18–20 are directly relevant,
- "Traffic calming education" - tour references 11 and 17; and
- "Photo enforcement technologies" - tour references 8 and 9.

The four publications of interest, directly related to tour recommendations for technologies with potential for application in the United States are as follows:

- J. H. Hogema and A. R. A. van der Horst, "Evaluation of the A16 Fog Signaling System with Respect to Driving Behavior," TNO Human Factors Research Institute, Soesterberg, the Netherlands, November 1994.
- Oei Hway Liem, "Effective Speed Management Through Automatic Enforcement," Institute for Road Safety Research (SWOV), Leidschendam, the Netherlands, 1994.
- Oei Hway Liem, "Speed Management on The Motorcar A2," R-94-66, Institute for Road Safety Research (SWOV), Leidschendam, the Netherlands, 1994.
- Ruediger Lamm and Juergen H. Kloeckner, "Increase of Traffic Safety by Surveillance of Speed Limits with Automatic Radar Devices on a Dangerous Section of a German Autobahn: A Long-Term Investigation," *Transportation Research Record 974*, Washington, DC, 1984.

The Hogema paper was not detected in TRIS or COMPENDEX; however, it was in ITRD. No language is recorded but it appears to have been published in Dutch and English. A scrutiny of the current web page of the Netherlands Institute for Road Safety Research (www.swov.nl) reveals that out of five papers by Hogema in 1999, three were in English and two were in both English and Dutch. In 1998, only one Hogema paper is listed, published in Dutch and English.

The first Oei reference is related to a similar paper published in the USA (Oei 1996 "Automatic Speed Measurement in the Netherlands*," Transportation Research Record 1560*, 1996, listed in TRIS and COMPENDEX), which in turn cites seven references to previous publications in Dutch (1993–1995) and seven in English (1964–1994). His 1994 paper was in the SWOV list as published in a U.K. conference in English.

The second Oei reference is in the SWOV data base as published in Dutch (? and English) also in 1994 and clearly is related to three other papers on the topic published in English between 1992–1996 (see Table 7).

The tentative conclusion is that SWOV publishes research reports in both Dutch and English; thus, there is little potential lost benefit due to translation needs.

TABLE 7 Reference Trace Sources Tour [14]

Source	Language	Hogema	Oei	Lamm
Report	English	1994	1994(2)	1984
	Foreign			
TRIS	English	1994 1995(3) 1996(5) 1997(2) 1999	1990 1992 1996(2)	1984(2) 1985(2) 1986(2) 1987(5) 1988(3) 1989 1990 1991(2) 1993(2) 1994(5) 1995 1996 1997 1998(3) 1999 2000
	Foreign	1995 1996(2)		1986
COMPENDEX	E	1997 1999	1996	1984 1985 1993 1994(3)
	F			1980
Organization	E		1994	
	F		1994	

Lamm is a prolific author; the TRIS search located 32 papers between 1984 and 2000. COMPENDEX located seven of which one is in German, a comparison of U.S. and German traffic accident issues published in a German journal. The other six, in English, are listed in the TRIS set. Lamm, currently a Professor in Karlsruhe, Germany, spent periods in the United States and several papers are related to American studies.

The tentative conclusion is that Lamm prepares reports in English to ensure his material is known in the United States.

Tour [18] – Bridge Maintenance Coatings

This tour, in 1995, did not cite any published material. Discussion with a tour member revealed that a substantial body of documentation was collected by tour members but none found specific reference to the report text.

The conclusion, reinforced by discussions with that tour member, is that much was learned by observation and discussion on site with overseas hosts.

Tour [21] – European Traffic Monitoring Programs and Technologies

This 1996 tour to France, Germany, the Netherlands, Switzerland, and the United Kingdom listed publications in a bibliography, again not cited in the text. The link between the tour recommendations and technical publications, and thus potential translation need, is not evident. Six French publications were listed, all agency documents. Four German publications were agency documents, as were four from the Netherlands, and 11 from Switzerland. Of the 25 documents listed, six appear to be in English.

Despite the lack of direct links to report findings it is evident that translation of the content of several of these source materials would be of value, especially to non-participants in the tour seeking greater understanding of the tour recommendations.

Tour [25] – Bridge Structures: Asia

The 1997 tour to Japan, South Korea, and Taiwan collected agency documentation in the main, much of which presumably was in English. The Japanese sector alone listed three technical publications but none were cited in the text. There was reference to discussions with one author (Miki undated) in relation to field welding techniques.

This tour report lists some 40 documents used in preparation of the report, all apparently were in English. Only three are identified by author and bibliographic details given (Tanaka et al. 1993, Torii et al. 1997). None of the documents listed in the appendix to the tour report are cited in the report so, although relevance to the findings and recommendations must be assumed, there is no evidence of the significance of the published information to them. Miki is mentioned directly in the report as “discussing” the topics. Nor is there any indication of the language of the documents, other than the three identified above, so it is assumed that they were prepared in English for the tour.

TRIS and COMPENDEX searches gave the following results for the cited authors. TRIS gave 33 references for Tanaka, none seemed to be related to the topics of the tour report. His co-authors Sato, Watanabe, Arima, and Suenaga had respectively, 37 hits of which one was possibly relevant, 26 hits—one relevant, no hits, and three hits—none relevant. COMPENDEX yielded over 1,000 hits for Tanaka but none related to bridges. Similarly, Sato had 768 hits, none related. Miki had six hits in TRIS and Homma one, COMPENDEX gave 12 relevant hits for Miki and 25 for Homma, which did not seem directly related to the tour topics. Torii gave three hits in TRIS and four in COMPENDEX, all related. Kojakura had no result from either data base. Takada had 15

non-relevant hits in TRIS and 25 in COMPENDEX. Note that in these "non-relevant" examples, the author's name was the same but the papers were on unrelated topics, probably meaning it was a different person of the same name but different area of expertise.

Among the tour recommendations was a specific request that the Japanese (HSBA) bridge specifications be translated. Clearly, a further study of publications from Japanese sources is warranted to discover to what extent useful material is being published in Japan in the language of origin and not carried forward to publication in English. This task is beyond the scope of the current project.

Tour [28] – Innovative Traffic Control

The scanning tour on Innovative Traffic Control was conducted in May 1998 and made several recommendations. Those recommendations for which a paper trail could be identified are listed below with the sources of each.

- Sign colors should be more intensive
  - Road Equipment – Fixed, Vertical Road Traffic Signs – Part 1: Signs. European Standard prEN 12899-1, DRAFT, European Committee for Standardization, Brussels, Belgium, 1997.
- Raised crosswalks may have value
  - Commitment to Safety Yielded Fast Results. In VägSkäl: (Crossroads). Traffic and Public Transport Authority in Gothenburg, Gothenburg, Sweden, #2-96, 1996, pg. 11.
- Lane control signals, coordinated with variable speed limits and the use of pavement markings
  - Kronborg, Peter. MOVA and LHORVA: Traffic Signal Control for Isolated Intersections. TFK Report 1992:4E, The Swedish National Road Administration, Stockholm, Sweden, December 1992.
- Incident and queue detection and protection
  - Traffic Control in Hessen. Hessian Road and Traffic Authority, Wiesbaden, Germany, undated.
  - Cofiroute's DIVA System: Constant Surveillance for Greater Comfort and Safety. Cofiroute, Sevres Cedex, France, undated.
- Self-optimizing signal control
  - Kronborg, Peter, Fredrik Davisson, and Jan Edholm. SOS–Self Optimizing Signal Control: Development and Field Trials of the SOS Algorithm for Self Optimizing Signal Control at Isolated Intersections. TFK Report 1997:2E, The Swedish National Road Administration, Stockholm, Sweden, May 1997.
  - Kronborg, Peter. MOVA and LHORVA: Traffic Signal Control for Isolated Intersections. TFK Report 1992:4E, The Swedish National Road Administration, Stockholm, Sweden, December 1992.

A number of other recommendations are made in the report, for example:

- *an all-white system of pavement markings should be considered*

This recommendation appears to be derived from observation and discussion with the host organizations for the tour rather than research documented in publications in the technical literature.

Of the linked publications cited, only those authored by Kronborg and his colleagues could readily be traced through accessible literature data bases as shown in Table 8. A search of the organization web sites for the other cited publications gave no further information or linkage.

The TRIS search for Kronborg gave only one reference, to an unrelated topic. The COMPENDEX search gave two references, to the two cited documents as published in English. In the first case, the English conference publication predates the organization report. In the second case, the organization report predates the English journal publication.

- Development and field trials of the new SOS algorithm for optimizing signal control at isolated intersections
  - Kronborg, P. and Davidsson, F. IEE Conference Publication, n 422, 1996, Proceedings of the 1996 8th International Conference on Road Traffic Monitoring and Control, Apr 23–25 1996, London, UK, p 80–84
- MOVA and LHOVRA. Traffic signal control for isolated intersections
  - Kronborg, P. and Davidsson, F. Traffic Engineering & Control, v 34, n 4, April 1993, p 195_

A search on the co-authors, Davidsson and Edholm, in TRIS gave three references to Edholm only. They were not related to the topic. COMPENDEX yielded no additional references. However, a search of the Swedish National Road Administration web page (www.vv.se) revealed 13 publications. Of these, three were in English, including two that were directly related to the SOS technology, both published in 1997. Of the 10 in Swedish, two appear to be directly related and were published in 1997.

In Table 8, this pattern is shown by reporting the publication date against the source and author. The Belgian reference to a European Standard is available in English.

The data suggest only a minor delay, 1 year, in English language publication of Swedish technology.

Tour [30] – Bridge Scour Countermeasures

Only a digest (*NCHRP Research Results Digest 241* [July 1999]) is available for this tour, which lists 43 publications. Thus, there is no link to recommendations available. However, of the 43 publications, seven are to Dutch sources, three to Swiss, and seven to German sources. All the publi-

TABLE 8 Reference Trace Sources Tour [28]

Source	Language	Kronberg	Davidsson	Edholm
Report	English	1992 1997*	1997*	1997*
	Foreign			
TRIS	E			1962 1972 1974
	F			
COMPENDEX	E	1993 1996	1993 1996	
	F			
Organization	E	1997 2000	1997 2000	1997
	F	1991 1997(2)	1990 1991 1997(3) 2000	1969 1984 1997(3)

* indicates same SNRA technical report possibly published in both Swedish and English

cations appear to be in English though some may be Anglicized titles for non-English texts.

Of the 43 references, 12 papers by 20 authors from Germany and the Netherlands were the basis for TRIS and COMPENDEX searches. Three papers in English and one in Dutch were traced that had some relevance to the tour topic; another five references by these authors were judged not relevant. The one reference to a Swiss author yielded several earlier papers but they did not appear directly related to the topic. In the tour references to Netherlands sources, the paper by Jorrissen et al. (1995) was followed by a 1996 paper, no earlier work was detected. The paper by Abromeit and Heibaum (1996) was followed by a paper in 1999. A paper by Kohlhase (1998) could be traced to a second undated paper but on a topic of little apparent relevance.

The tentative conclusion must be that there is little indication of loss of information due to non-English publication for this topic from these sources.

Tour [34] – Recycled Materials in the Highway Environment: Use, Technology and Policies

This 1999 tour visited Denmark, France, Germany, the Netherlands, Sweden, and the United Kingdom. It lists references by country, eight, 13, 11, 13 and 10, respectively, and, strangely, none for the United Kingdom but two for the United States.

The Swedish visit referenced several papers that predate the tour, all were in English. This does not rule out the possible existence of earlier work in Swedish but simply implies that much of the Swedish work is published in English. A similar pattern exists for the German publications, although in this case, two papers by Vehlow, in 1996 and 1989, predate the tour and only one paper by Kurkowski was found dated 1997 and in German. The trace of Dutch papers gave three papers in English in 2000, 1994, and 1994.

The trace for French authors showed that two of the papers prepared for the study tour (by Corte and François) were in French. Corte had eight publications in English that predate the tour and one, in 1994, in French. François had a related paper in French dated 2000.

The tentative conclusion is that a 5- to 6-year lag may have existed between publication of some work of interest in French and German, but that this is not so likely in the other languages (Dutch, Swedish, and Danish).

Tour [39] – Highway Geometric Design

The recommendations of this 2000 tour include such topics as roundabouts, traffic calming, context sensitive design, and matters related to pedestrian and bicycle movements. Several of the source references cited are linked directly to these topics, for example, Kjemtrup (1999); Herrstedt et al. (1993); Greibe and Nilsson (1999); Greibe et al. (1999); and references to seven official publications, guides, and manuals (see Table 9). Of the 26 publications

TABLE 9 Reference Trace Source Tour [39]

Source	Language	Kjemtrup	Herrstedt	Greibe
Report	English	1999	1993	1999(2)
	Foreign	*	*	**
TRIS	E	1992	1984 1988 1992(2) 1994(3) 1998 2000	
	F			
COMPENDEX	E	1992	1992(2)	
	F		1998	
Organization	E		1993	1999
	F			

* indicates same SNRA technical report possibly published in both Swedish and English

cited in the tour report, none are noted as not in English but 10 are standards or specifications that may well be published only in the language of origin.

The results of a reference trace are given in Table 9, which shows 10 English language papers and four in Danish, found on the Road Directorate web page (www.vd.dk), which were derived from searching for work by the cited authors Kjemtrup, Herrstedt, and Greibe. Searches on the other eight authors' names yielded 10 more references, of which only one had any potential relevance to the tour findings.

Again, the researchers must conclude that most of the work from these authors and sources is available in English with little delay from any publication in the language of origin.

IMPORTED TECHNOLOGIES STUDIES

A second approach to determining the value of translations is to seek expert opinion of technologies imported to the United States and from this to seek the documentation in English that initiated the transfer and then to seek the earlier documentation in the language of origin of the technology. There was a clear need to contact a large number of individuals in both the United States and overseas but as many departments, organizations, associations, and companies are reluctant to release individual addresses to casual inquirers this relied principally on personal contacts.

Some 200 highway transportation experts were canvassed for their nomination of such significant imported technologies, selected from personal knowledge and membership of various national and international organizations and committees, etc. Unfortunately, many contacts had changed addresses and the response was less than had been hoped. However, 16 contacts named a number of imported technologies (see Table 10).

Stone Matrix Asphalt (SMA, often termed "stone mastic asphalt") was mentioned four times, road design three times, and recycling three times. The countries of origin listed were Germany, 16 times; France, nine times; the Netherlands and "Europe," four times; Austria, three times; Denmark and Switzerland, twice each; and Sweden, Finland, and Brazil, once each.

Some of the technologies suggested were described in sufficiently explicit terms (e.g., SMA) to allow a literature search for related publications whereas some were of a generic nature (e.g., road design) such as to be difficult to isolate, identify, and trace. Literature searches using the technology name or description as the keyword(s) produced the results discussed below.

Stone Matrix (Mastic) Asphalt (SMA)

SMA was introduced into the United States in the early 1990s and is becoming widely adopted for pavements where high stability under heavy traffic is required. Brown (1992) noted that SMA was already in use in Germany in the 1970s as a surfacing resistant to damage by studded tires and, later, in the 1980s to counter the effects of increased truck traffic volumes, higher axle loads, and higher truck tire pressures. The interest in the United States seems to have developed from, and after, the 1990 Asphalt Scanning tour [1] with work by Shercoman (1991) and several others in 1992 (see Figure 4). The keyword search of the TRIS online data base yielded eight hits from 1991. COMPENDEX gave 21 references dated from 1993. All these references were to English language publications. A search of the ITRD data base gave 169 references for the 1988–2002 period of which three were in Dutch in 1988, and one was a survey of German flexible pavement construction and maintenance practice published in the 1987 PIARC World Road Congress.

Other Dutch work was reported in 1984. It seems likely that other non-English publication would have occurred in this period (the 1980s) as European countries developed this SMA technology. No patent application has been filed for this technology.

It is noted here that the PIARC Congresses are published in French and English, every 4 years, and provide substantial coverage of recent innovations from the member countries of the Association. Much of this early SMA application was unknown in the United States so that a translation delay of up to 10 years could have existed.

TABLE 10 Technologies Imported to the United States

TECHNOLOGY	COUNTRY OF ORIGIN
Novachip	France
SMA	Germany/ Austria
transport economics	France
geometric road design	Sweden/Germany
bicycle policies	Netherlands
pavement design	Netherlands
recycling policies	Netherlands/Austria/Germany
Planning	Netherlands
bitumen testing	France
Styrelf, polymer binders	France
prestressed bridges	France
OPERA	France
exposed aggregate concrete	Austria
rock falls	Switzerland/France
Roundabouts	Europe
signs/logos	Europe
soil nailing	France/Germany
ground radar	Finland
reinforced earth	France
FWD	Denmark
block paving	Europe
road design	Denmark

(from inquiry responses by U.S. colleagues)

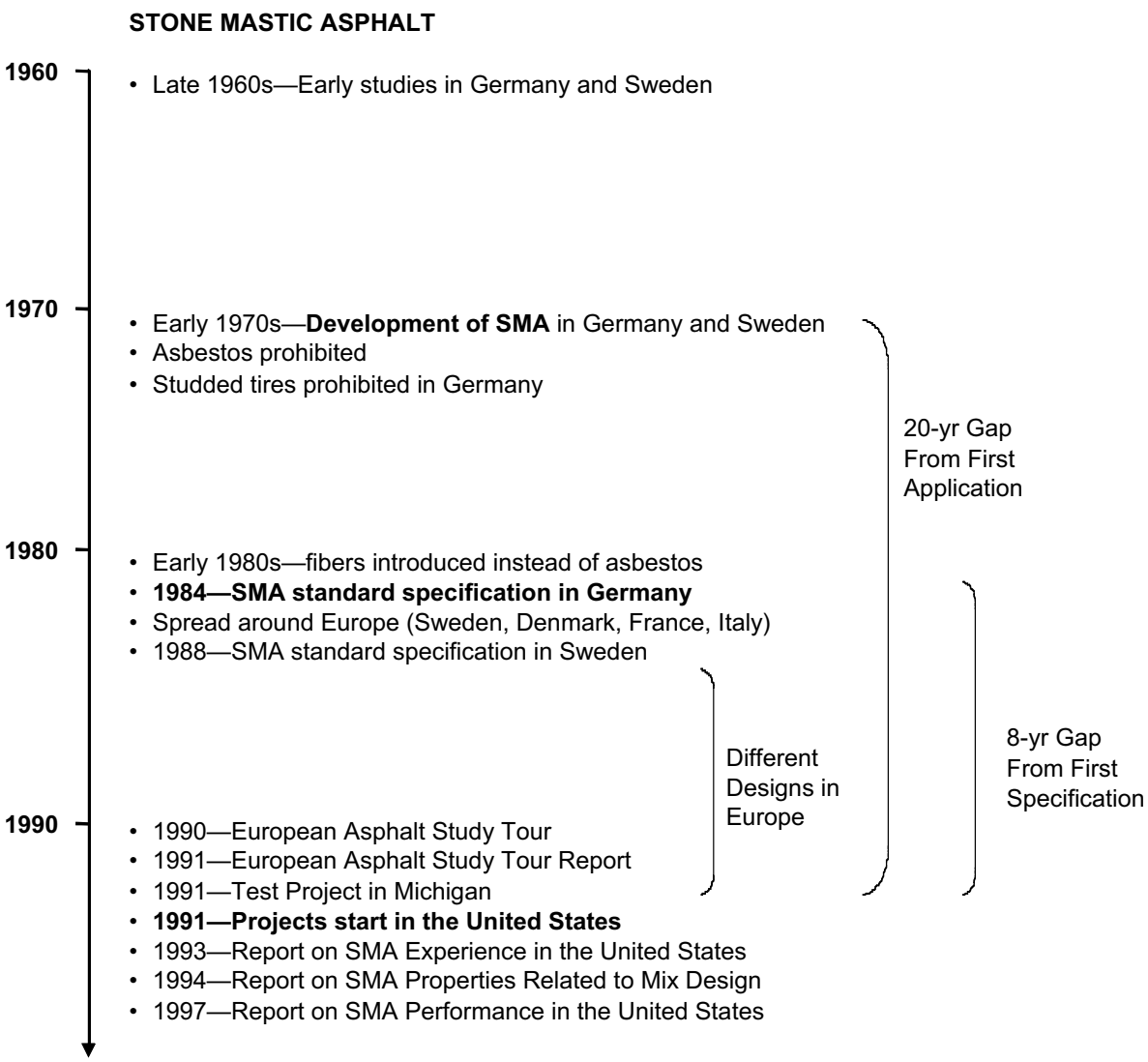

Figure 4. SMA Development Chart.

Novachip

This ultra-thin high-friction surface course technology was developed in France in the 1980s and first published in 1986 (Bense 1986). A French patent was registered in 1989, and a U.S. patent was registered in 1990. Novachip appears to have been used in the United States in 1991 (REFS), possibly as a result of the 1990 scanning tour [1] supported by publication of the technique and commercial promotion. The references accessed were in English; however, the ITRD data base gave three references in French in 1989, 1990, and 1992: Kuennen (1992) and Sheshradi (1993), followed by a report of a field trial in Mississippi (Estakhri and Button 1994) appear to be the first U.S. reports.

It appears that early information on this technology escaped U.S. notice for 2 to 4 years.

OPERA

This software, a real-time expert system package (Outil Pour l'Exploitation d'un Réseau d'Autoroutes - Morin 1988), was developed and applied to traffic engineering/ planning in France in the early 1990s. It was described to an American audience in 1992 (Morin et al. 1992) but the first English language application appears to have been in Scotland (Whyte 1997).

Exposed aggregate in concrete

COMPENDEX gave 21 English language references between 1988 and 2000 and TRIS yielded a single citation, dated 2000, in connection with surface texture measurement. It seems unlikely that other publications do not exist but

they were not detected by a simple keyword search. Certainly the use of exposed aggregate was applied in Belgium in the 1970s.

The first reference in ITRD to exposed aggregate was to American studies (Isberner 1963). However, it was not until the reduction of skid resistance on asphalt pavements became of interest in the United Kingdom (Szatkowski and Hosking 1972) that the specific application to pavements began. An article on "quiet concrete" (Anon 1992) highlighted the second application—to noise reduction on concrete pavements—and several publications followed, including a state-of-the-art report by Sommer (1992) in the PIARC journal, published in French and English. Criteria for exposed aggregate concrete pavement surfaces were published by New Zealand in 1996.

There appears to have been little reliance on imported technology for this application of exposed aggregate to concrete pavements.

Recycled concrete

TRIS yielded 555 references to the use of recycled concrete from 1972 to 2002, of which the earliest material discussed experiences between 1945 and 1986. COMPENDEX gave 10,276 hits from 1968; however, many were unrelated to highway applications. A search limited by language gave 53 German, 15 Japanese, and 11 French publications dated 1974–2000, 2000–2002, and 1972–2002, respectively. The distribution of German publications indicated periods of special interest in 1987–1988 and 1996–1997 and on a continual basis, since 1999, presumably reflecting environmental or economic influences. An ITRD search revealed that the first study of the use of recycled aggregate in concrete in the United States was Buck (1972) but application specifically to pavements was first referenced in France (Bouchard 1984). An international symposium in the United Kingdom (Dhir 1998) reported the state of the art in the United Kingdom, Japan, Denmark, Germany, and the Netherlands.

It would appear that a general awareness of this technology was widespread and that little loss due to lack of translation of non-English publications affected application in the United States.

TRANSYT

The traffic engineering software package (TRANSYT - TRAffic Network StudY Tool) was mentioned by several correspondents, but it was basically an English development (Robertson undated, Holroyd and Robertson 1973) so it is not pursued here. An application in Tucson was reported in 1985.

Falling weight deflectometer

A search for falling weight deflectometer in OECD/ITRD gave a reference (Beckedhal and Lindenbach 1995) about the introduction of the technology to Germany. TRIS gave 35 citations, eight by foreign authors but in English, from which it appears that the technology developed principally in Denmark in the early 1970s (Bohn et al. 1972) from earlier French studies. The first American reference detected was to Barenberg (1978). The COMPENDEX data base gave 261 references with a concentration of effort in the mid-1970s overseas followed by a surge of interest in the United States in the early 1990s, peaking in 1994, after which perhaps it may be said the technology was fully adopted.

This could imply a delay of 6 years in transfer of the technique.

Traffic calming

Techniques for traffic management in urban areas are commonly applied to pedestrian, cycle, and motor vehicle traffic mixes. However, the term used as a search keyword is too broad to illustrate any role of translation in adoption of such principles and methods in the United States, especially considering the often very different urban structures and travel patterns. Using "traffic calming" as the search term in OECD/ITRD gave 1,057 records, among which there were two French and six German citations between 1986 and 1993. References to work in the Netherlands, often regarded as a leader in this field, totaled 21. One thousand eleven of the references were in English with the earliest work cited in 1986 and the first American record dated 1989 (see Figure 5).

It would appear there is little difficulty accessing important developments in this field because of language barriers.

Road design

This term is too broad to allow a meaningful search; COMPENDEX alone gave over 8,000 citations of which 5,810 were in English, 204 in German, 136 in French, and 49 in Japanese. OECD/ITRD gave 1,506 hits, including 1,034 in English, 19 in French, and 17 in German. TRIS gave 762 hits in English. A sub-category of roundabouts gave 867 OECD/ITRD hits and 342 TRIS hits. Logo signs gave five hits in TRIS and one in OECD/ITRD, and symbolic signs similarly gave 21 in TRIS and 28 in OECD/ITRD all apparently in English.

Road deaths/injuries/accidents

Again, these terms used as keywords gave too many hits to evaluate in detail in this study. A sub-division into more limited topics gave, in OECD/ITRD for example, 94 hits on red light cameras, 2,180 hits on seat belts, and 10,177 on alcohol.

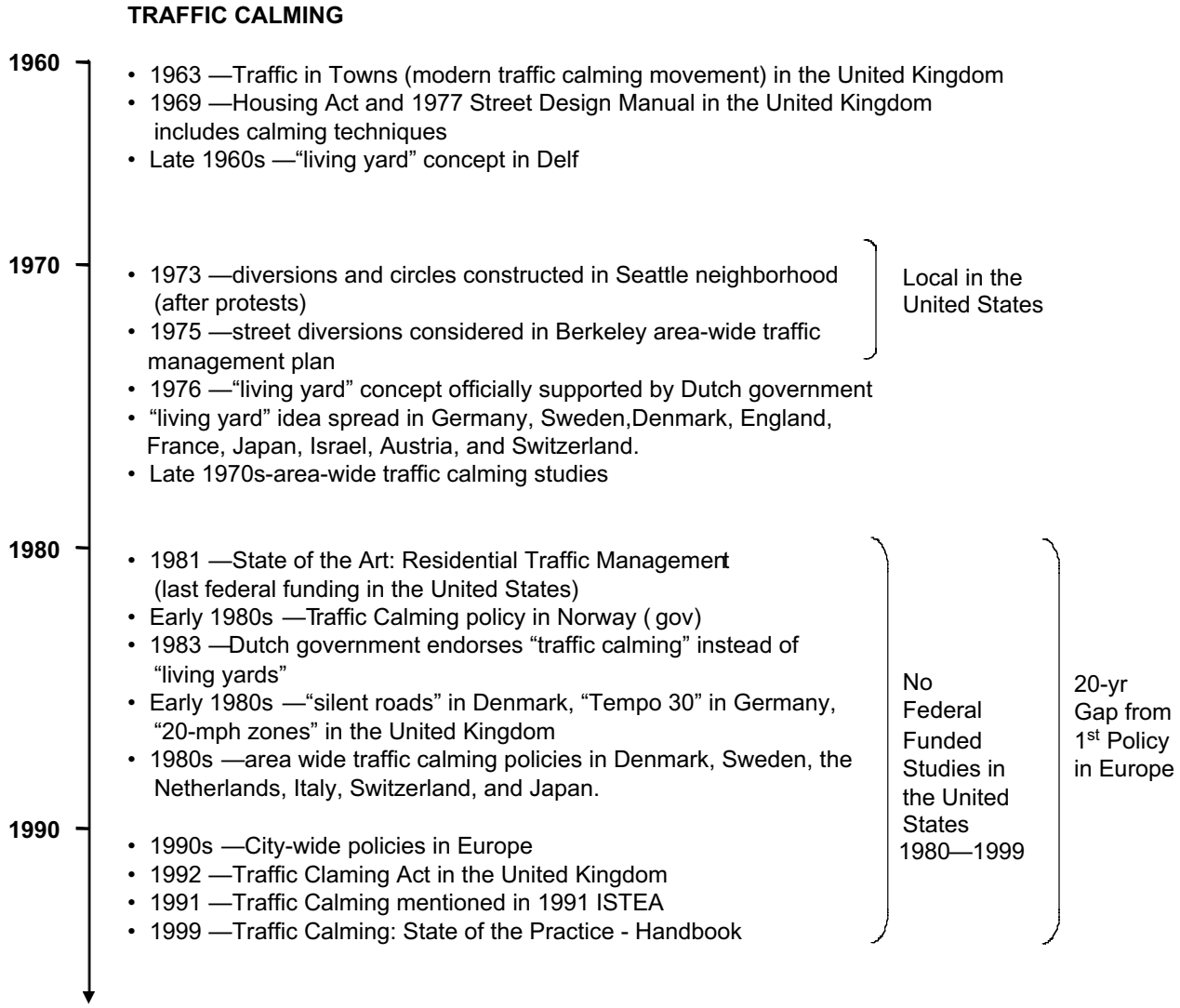

Figure 5. Traffic Calming Development Chart.

NATIONAL PUBLICATIONS

The business case for translation of non-English publications rests on three propositions: (1) that the translation will add value; (2) that the material is accessible, i.e. that it is readily located and obtained in full text in a timely and economic manner; and (3) that the volume and distribution of material for translation is manageable.

The text above addresses the first proposition and, in part, the second. The third proposition requires some discussion of the patterns of publication of technical transportation documentation.

NCHRP (2001) and Decina and Lococo (2001) covered much of this topic; however, a further brief examination of non-English sources was conducted for this study. First a review was made of the papers presented at the Annual Meetings of the TRB in 2001 and 1995, the earliest and latest electronic copy versions. This showed the pattern for the principal foreign languages of interest, French, German, and Japanese.

There is little change in this pattern over these 5 years. The majority of papers came from Japan, the smallest number from Germany. All three foreign author sets quoted extensively from English publications and sparingly from their own language technical literature. This appears to differ little from the findings of Osif (2002) that authors most frequently cite references in their own language. It would seem that the selection of references is in part driven by the perceived audience. The inference is that, at least in so far as TRIS data show, a large proportion of the technical professionals in the academic and research fields in these countries have an excellent command of English as a second language and

TABLE 11 Papers Presented at TRB Annual Meetings

Meeting	Language	Papers	References	Native	Years
1995	German	3	70	8	1962–90
612 papers	French	6	82	15	1961–93
	Japanese	11	75	8	1984–91
2001	German	4	70	21	1968–00
704 papers	French	8	123	8	1989–00
	Japanese	15	172	17	1967–98

ensure that their work is published in English to achieve international exposure and recognition.

Standards

Specific sources of technical information, the national standards organizations of countries, that are the parallels to ASTM and AASHTO. Some foreign standards organizations publish English translations of a proportion of their documents. The German standards organization, Deutsches Institut fuer Normung e.V. (www2.din.de), has released English versions of about half their publications, some 14,000 standards. European countries make translations available in the EU system and many are members of the International Standards Organization, which publishes in English. The Japan Standards Association (www.jsa.or.jp) has also released English language versions of about half of its documents. In addition, the European Union and the International Standards Organization (www.iso.org) both have English as a working language.

Journals

A listing of foreign journals was given in NCHRP (2001); however, this list did not indicate the availability of English content. The number of journals is such that any attempt to translate all foreign documentation would be impractical. Similarly, the effort to translate all contents pages and abstracts would be a daunting task. The preparation of English abstracts from the original foreign language text also would, of course, require much more effort.

A possible solution could be to target a selection of the most respected and most frequently cited journals and to provide translation of the contents pages and abstracts of the principal articles. A second stage of this process could be to provide an "on-demand" translation service, for a fee, for individual papers.

Several of the leading journals already include English contents pages and, in some cases, English abstracts. In France, for example, the Bulletin of the Laboratoires Central des Ponts et Chaussées (LCPC) carries English abstracts and so do 'Strasse und Autobahn', 'Zietschrift fuer Verkehrssicherheit,' etc., in Germany. BASt reports (with the subseries A-Allgemeines/General matters [including activity reports, research programs, etc.]; B-Bruecken und Ingenieurbau/bridge construction and structural engineering; F-Fahrzeugtechnik/vehicle technology; M-Mensch und sicherheit/Man and safety; S-Strassenbau/highway construction; and V-Verkehrstechnik/traffic engineering) included English abstracts since 1993. These English abstracts also have been available on the BASt web site since 2000.

A review of the tour references and papers traced from them shows that a small number of journals carry a large proportion of significant, cited technical papers. A search of American library holdings was therefore made in the WorldNet and Union catalogue (see Table 12).

TABLE 12 Foreign Transportation Journal Holdings in American Libraries

Journal	Language	Number of U.S. libraries
Review Générale des Routes et Aérodromes	French	16
Routes/Roads	French/English	7
Strasse u. Autobahn	German	13
Autostrade	Italian	16
Verkeerskunde	Dutch	1
Beton	German	4
Forschung Strassenbau und Strassenverkehrstechnik	German	5
Bitumen	German	8
Strassen und Tiefbau	German	14
Annales des Travaux publics de Belgique	French	0

Note: the numbers do not necessarily mean the holdings are current or complete and, also, the WorldNet and union records differ, the largest number is reported.

The inference must be that two simple and relatively inexpensive steps could materially improve U.S. access to foreign transportation technologies: (1) creation of a "library of last resort" holding preferably complete but certainly current copies of the principal journals and major conference proceedings and (2) establishment of ready access to the OECD/ITRD data base.

Organizations

Many foreign organizations have a policy of publishing information in English, including listings of reports and projects. Sometimes abstracts are provided and increasingly full-text versions of reports are becoming accessible. Much of this information is becoming available on organization web sites with downloadable text.

PIARC (the World Road Association – www.piarc.org) is a non-political and non-profit association that provides information on roads and road transport policy and practices within an integrated sustainable transport context. The organization serves its members by

1. Being a leading international forum for analysis and discussion of the full spectrum of transport issues, related to roads and road transport;
2. Identifying, developing, and disseminating best practice and giving better access to international information;
3. Providing within its activities special emphasis for developing countries and countries in transition;
4. Developing and promoting efficient tools for decision making on matters related to roads and road transport; and
5. Being a leader in technology transfer.

To achieve these aims, PIARC

1. Creates and coordinates Technical Committees;
2. Organizes a quadrennial World Road Congress, a quadrennial Winter Road Congress, and various technical seminars; and
3. Publishes a large number of documents, including a quarterly magazine (*Routes/Roads*).

Since its inception in 1909, PIARC has had two languages, French and English, in which all the activities are conducted. *Routes/Roads* is published in both languages as are the *Proceedings of the World Road Congresses*. The Congress reports are notable as collections of the state of the art in policies and practices of highway organizations around the world. PIARC recognized early the value of translation of foreign language documentation and the special difficulties of translating technical terms, such that the *Technical Dictionary* of terms used in highway transportation is now (2003) published in

- Arabic-English-French (1991)
- Chinese-English-French (1989)
- Greek-English-French-German (1992)
- Hungarian-English-French (1998)
- Japanese-English-French-German (1998)
- Khmer (2001) to be used with the English-French Dictionary
- Latvian- English-French (1998)
- Lithuanian (1994) to be used with the English-French Dictionary
- Portuguese-English-French(1991)
- Russian (1987) to be used with the English-French Dictionary
- Spanish-English-French (1991) Latin-American-specific terms included
- Vietnamese-English-French (1998)

Osif (2002) emphasized the need for such a standard vocabulary.

The Réseau Mondial d'Echanges, or World Interchange Network (WIN/RME) was originally created from the work of the PIARC technical committee for Technology Transfer. In 1997, there were 62 nodes—organizations that are prepared to respond informally to any technical enquiry on roads and road transport

The Organization for Economic Cooperation and Development (www.oecd.org) is an international organization helping governments tackle the economic, social and governance challenges of a global economy. OECD has two official languages, French and English.

OECD work on transport covers a broad set of activities directed to providing input to policy debate on current and emerging issues relevant to: aviation, maritime transport, ship building, and road and intermodal transport. The OECD works closely with other international organizations, including ECMT, APEC, EC, PIARC, UN, World Bank, and the World Trade Organization

The International Transport Research Documentation (ITRD) data base is a bibliographic data base maintained by OECD. It contains more than 300,000 bibliographical references on transport research literature in OECD and non-OECD countries. Each record contains an informative abstract, from the world's published literature on transport (reports, books, journal articles, conference proceedings). About 10,000 references are added each year. There are four official languages represented in the data base, English, French, German and Spanish, and each record is available in one of these languages.

A number of national organizations provide some English language access to their information, for example, BASt, KFV, and LCPC. In Japan, the Geotechnical Society (www.jiban.or.jp) has an English language web page with publications listed from 1984 and the Society of Civil Engineers (www.jsce.or.jp) has provided an English web page since 1990). Although Osif (2002) commented that web sites were frequently used to promote organizations rather than to provide information, the usefulness of web sites is improving and should be encouraged.

PEER CONTRIBUTIONS

In the course of the project, input was sought from a cross section of individuals, expert in the highway and information disciplines, several of which bear consideration in assembling the conclusions and recommendations. These individual colleagues were drawn from scanning tour participants, TRB committees, and personal acquaintance. Few responses directly addressed the listed topics, perhaps because of the diffuse nature of the international technology transfer process and the often long and intermittent character of the contact and interchange involved. However, comments from these expert and experienced practitioners provide insight into the transfer process and, because they were relevant to the issue of the significance of language difficulties and the role of translation, they are assembled herein. (NAMES) refer to personal communications received during the study (see Appendix B); direct quotations are italicized.

It must be said that contact with previous scanning tour members proved particularly elusive. Many members had changed jobs or addresses or had retired from active involvement in the related technical areas. In the process much of the study tour material has been archived or lost, and it is effectively beyond retrieval at least in the short term. This strongly suggests that more specific arrangements for the collection, archiving, translation and dissemination of tour documentation should be considered (for example, consideration should be given to having an information specialist attached to scanning tour teams [BALDWIN]). It would also appear that over the last 10 years, the interchange between professional colleagues is becoming less constrained by language as so many foreign counterparts have an adequate working knowledge of or are fluent in English.

The scanning tour destinations were selected on the basis of a broad appreciation of the state of the art in the particular technologies around the world, implying that if English language information on those technologies was not available, at least some osmosis among experts allowed an informed choice (CONN).

In some instances, a full translation of certain documentation would clearly have been desirable, yet no funding mechanism was available (SILLAN). Interestingly, many host organizations to the tours provided specially prepared English language briefings and documentation at the time of the tour visits. It appears that much additional material was made available to the tours, including documentation internal to organizations, advertising, and promotional material (SIEBELS). About half the material considered by the tours was such internal documentation, guides, and manuals etc. not in the usual public domain (O'NEILL). A particular difficulty often encountered is the translation of technical terms (GILLMAN, WILMOT) and the perception that the cost of translating much of the material was too high (HARRINGTON HUGHES). This seems strange set alongside the cost of the tour and should be reviewed for future tours. The existence of the PIARC multilingual technical dictionary is apparently not sufficiently widely known.

About half of the German (DIN) and Japanese (JSA) standards are available in English language versions on an as-needed basis (WARD).

It has not been possible to collect specific examples, but it is clear that an adequate understanding of the basic concepts in a foreign language document can be obtained by examination of the equations, graphs, and tabulated data (THOMAS).

Specific comments about the transfer of SMA technology include:

> *"it was developed in Germany following wear problems due to studded tires by G Zichner (1971) of the Strabag-Bau AG central laboratory. It was first laid on public roads in 1968 as an "anti-spike" course." (OLIVER), and*
>
> *"1970 and its development was oriented toward improving wear resistance…to studded tires wear" (MAHONEY) .*

OLIVER (1998) also describes how the family of asphalt surfacings was developed, commenting that;

> *"there are lots of articles about French competitors to Novachip and their performance - published before the idea was taken up overseas."*

BROWN suggests early work by four authors might assist in defining the introduction of SMA in Europe and again illustrates the value of searches of the ITRD data base (see Table 13).

The 53 references to Tappert in OECD/ITRD include only two English language publications and Bellin had only one. Clearly there was a great deal of non-English language material accessible but it needed translation. However, the value of translating all the publications must be questioned as there is no doubt some repetition of content.

JOHNSTON comments that

> *"The primary Japanese road safety journal (IATSS Review - IATSS being the International Association of Traffic and Safety Science) has short English abstracts.*

TABLE 13 Early References to SMA

Author	TRIS	COMPENDEX	ITRD	Earliest year
Tappert	4	0	53	1972
Renkes	1	0	7	1972
Bellin	1	2	13	1976
Hoppe	0	0	7	1977

All the major international journals publish in English of course. The big weakness is in the so called fugitive literature, i.e., the stuff put out in "internal" reports rather than the open literature. Here you don't even get to find out that it exists. Rarely do these reports have English summaries. Several labs, in the internet era are putting titles of reports on English language sections of their web sites so there is light at the end of the tunnel.

My current area of interest (road safety strategic thinking - how it forms, what influences action/ inaction, etc.) requires cross-cultural study and I get frustrated at the limited range of countries I can look at. The Swedes are radical in their thinking and while I can get a reasonable handle on things, it is limited. For example, the Swedes did a major study of the potential impact of adopting a range of strategic approaches and all I can access is a summary document in English. The methodology was complex and I have more questions than answers.

The advent of the European Union is changing the scene also. The EU funds a lot of research which is usually executed by a consortium of labs from several countries. Of course, they publish in English. I know the Dutch and the Swedes are good at producing English abstracts which is a great way of working out if translation is likely to be worthwhile.

My feeling is that 'globalization' is working in our favor on this one. Hence I'm not sure how much value the historical data is. Besides I don't have any war stories about delays that could have been avoided if only we'd seen the international stuff earlier. The seat belt as a protective device came out of the US for example."

This fugitive material is becoming increasingly available through the web pages of transport and transport research organizations, which increasingly are shadowing their sites with English language versions. These are often sufficient to direct attention to relevant projects and/or reports that may however, then require translation.

Several correspondents mentioned imported technologies but with insufficient detail to allow a trace of the routes to implementation. One respondent (STOPHER) implied that he was not aware of particular cases where a technology was not discovered due to lack of translation but that there have been useful publications in other languages, French, German and Spanish, in the fields of demand modeling and transport surveys. It appears, however, that

"most of the good stuff of the last 10-20 years does appear in English" (HENSHER).

In road design, European developments in the 1990s were imported into Australian practice from Swedish – 1994, German – 1996, and French design guides, all obtained through the personal contacts that are so invaluable, and understood through partial translation and the use of the equations, graphs, and data (McLean). The Danish manual on geometric design and context sensitive design released recently would be useful but is not available in translation (SILLAN).

One respondent (LANGSDORFF) suggested that even when "foreign" work was published in English, it did not attract the same attention as American (English language) work. Certainly at an early conference on accelerated pavement testing, there seemed to be a reluctance to accept and fully utilize the experiences from United Kingdom and German studies (METCALF).

A similar negative experience reported was when, in 1988, German work on their LTPP program was supplied to a SHRP meeting but seemingly not put to effective use because the bulk of the documentation was in German (LITZKA).

One particularly interesting response was from Canada, quoting the difficulties in transferring a winter maintenance technique to Quebec because it was not available in French, and the same was true of a concrete technology from Quebec available only in French (WELLS). The same respondent mentions the use of a specialty conference to exchange Canadian and Japanese technology noting that translation of some documentation would have greatly helped.

This aspect of translation issues, from English to a foreign language, was also mentioned in respect of adoption of U.S. slip form paving technology in Europe some 30 years later (HAWKS)

The Netherlands has always been known for (urban) traffic initiatives in a bicycle- and pedestrian-rich environment and MICHELS suggests two recent developments are yet to be fully recognized in the United States. Bicycle issues, recycling, and restrictive parking policies from the early 1990s have been published by CROW and are accessible on the web site (www.crow.nl). More recently, pavement design on poor sub-grades, integrated geotechnics, and software (QUASAR - Quick Analysis of Structural condition of Asphalt Roads) techniques have been described in Dutch and international conference publications.

From Japan, SHIMADA mentioned electrostatic precipitators and NOX reduction technologies for tunnels together with slurry shield construction and crack detection methods as new technologies with potential for importation to the Unites States and listed a series of sources for more information, including the Japanese Ministry of Land, Infrastructure and Transport, the Highway Public Corporation, the Public Works Research Institute, and the Society of Civil Engineers. He also pointed out that where instances of commercial application exist this may, on the one hand, promote, export, and apply a technology yet, on the other hand, may constrain publication of technical information to protect that commercial interest.

Japanese deep soil mixing technology for stabilization was also highlighted by LAMBRECHTS. He comments that while these processes were developed in Japan and Scandinavia over the past 25 years, they have only come into use in the United States in 1986. He contends that translation difficulties delayed the import of these technologies and thus caused substantial loss of benefit.

In reference to soil-nailing techniques, JAYAPRAKASH noted that much work was done in Europe, in the 1970s, before the 1998 Scanning Tour [26] and use of this technique in the United States has resulted in savings estimated at $52 million, implying that earlier access to the non-English publications would have resulted in greater savings. He also notes work on transferring rock fall protection methods has been hampered by lack of translation. Reinforced earth, pioneered in France in the 1950s, was not employed in the United States until the 1980s (HAWKS).

A feature of most responses was that the degree of "loss" from lack of translation was decreasing and decreasing quickly because English has become so widely used in technical publication and conferences. In addition, the increasing participation of many countries in international conferences has led to closer personal contacts in which language difficulties can frequently be overcome by sharing information. Similarly, the ready access by many professionals to electronic media is facilitating closer and more frequent contact and broadening knowledge of current work in other countries. This is especially so where those countries support English language versions of organizational web pages.

INTERNATIONAL ORGANIZATIONS

OECD - Organization for Economic Cooperation and Development

The Organization for Economic Cooperation and Development (OECD) is an international organization dealing with a wide range of economic and social policy issues. The OECD brings together 30 member countries and helps governments meet the challenges of a globalized economy. The OECD is headquartered in Paris, France. The general Secretariat has a Transport Division, which includes the Secretariat for the Road Transport and Intermodal Linkages Research (RTR) Program as well as the Maritime Transport Committee Secretariat. The RTR Steering Committee brings together representatives from road transport administrations in 30 member countries. The OECD "family" also encompasses the International Energy Agency and the European Conference of Ministers of Transport. The OECD Secretariat and related agencies undertake a considerable amount of transport and transport-related work ranging across economic, environmental, technical, and policy issues.

The OECD's RTR Steering Committee has a central role in coordinating and disseminating the results of road transport and intermodal linkages research undertaken around the world, in many different languages. The RTR Steering Committee oversees the operations of the OECD's International Transport Research data base.

The International Transport Research Documentation (ITRD) data base is a bibliographic data base administred by the OECD but hosted and managed by TRL (United Kingdom). It contains more than 300,000 bibliographical references on transport research literature in OECD and non-OECD countries. Each record contains an informative abstract, from the world's published literature on transport (reports, books, journal articles, conference proceedings). About 10,000 references are added each year. There are four official languages represented in the data base, English, French, German and Spanish, and each record is available in one of these languages.

OECD/ITRD is available through two main avenues:

- OECD/ITRD on-line produced by FIZ/STN
- TRANSPORT produced by Silver Platter/OVID

More information on OECD/ITRD scope, access, and so on can be found at www.itrd.org (NB web site to be opened in July 2003).

The RTR Steering Committee also oversees the operations of the International Road Traffic Accident Database (IRTAD). It gathers road traffic and accident statistics from 30 countries. More information can be found at: HtmlResAnchor www.irtad.net

The orientation of the Road Transport Research (RTR) Program has changed from its formerly more technical focus and currently places emphasis on policy/economic issues with a focus on sustainable transportation, multimodal transport, infrastructure management, and transport safety. However, RTR projects include a large international cooperative study on the Economic Evaluation of long-life pavements. All papers and reports are produced in French and English and widely sold.

All OECD research abstracts are input to ITRD and through ITRD disseminated to OECD member countries as well as Associate member countries (Brazil, Chile, China, and Saudi Arabia).

Based on comparative performance across OECD countries, discussions identified a number of research areas where translation of additional information into English could assist. This included the field of land use and transport improvements in urban areas where there is a considerable body of material available in non-English languages on transport improvements that can help achieve improved social, environmental, and energy outcomes in urban areas. Another area where better information may help is road safety, given the increasing U.S. share of road fatalities across OECD member countries in recent years.

Of course, the problems with research in different languages and the need for translation are clearly diminishing. The availability of much government documentation on the

web with increasing availability in English and full text is reducing the language barrier.

English is seen as the technical/scientific language. Nevertheless, the OECD's OECD/ITRD research data base continues to make a substantial contribution by disseminating abstracts in four languages (English, French, German, and Spanish).

INRETS - The French National institute for Transport and Safety Research, France

INRETS has a responsibility to disseminate the results of research and publishes English language abstracts in NTIS format for all publications. All INRETS work is sent to OECD/ITRD and abstracts (French and English) are available at www.inrets.fr. Full text is not available because of copyright restrictions. All French Ministry Publications are available on CD-ROM for a fee—but in French. The RTS journal has some short articles in English but as a government organization National Science Policy requires initial publications in French.

They regularly scan German (Zeitschrift fuer Verkehrssicheit, Stadtverkehr) and English literature.

One technology exported was a rail fault detection system, VOCO, in 1995.

Most access to foreign research is by personal contact and one useful mailing list of librarians in TRANSTOPIC. INRETS has an exchange agreement with Berkeley (PATH program) and would be interested in a similar arrangement with TRB GPS/GIS technologies being imported from the United States. All staff speak adequate English and are able to attend international conferences.

LCPC - Laboratoire Central des Ponts et Chaussees, France

LCPC has a policy of disseminating its programs and results in English. The keystone journal, *Bulletin de Laboratoire des Ponts et Chaussées*, was established in 1963 and always has included English abstracts. The web site (www.lcpc.fr) gives fee-for-service access to English language versions of current projects/reports and the *Bulletin*. There appears to be minimal cost recovery; however, the policy decision is to use this as a means of disseminating French technology. Most professional and technical staff are proficient in the English language.

There is less familiarity with German and German language sources are not systematically accessed. Auto translation services have been used but full translation is rarely necessary as most professional staff are bilingual.

PIARC - Permanent International Association of Road Congresses, France

One technology policy—the use of preventive maintenance—was adopted in France 10 years before the United States where it was introduced by papers at the TRB Annual Meeting. Substantial benefits are claimed from maintenance of the system in a desired condition but this is not quantified. There is French MOT documentation linked to LCPC and SETRA studies.

PIARC as an organization has used both French and English since inception in 1909. It has developed a technical dictionary now available in three languages on CD-ROM.

Language is not a barrier in Europe, and it is becoming even less so. More significant are the cultural differences and the "not-invented-here" syndrome. Many European activities are linked through the European Union (e.g., COST, CEN, OECD, ISO, FEHRL) and there are many bilateral cooperation agreements (e.g., French-German where the working language is English).

It was stated that contracting out translation work was expensive and not particularly good because of the need for some technical knowledge in addition to language skills. However, most (French) professionals speak and read English.

The United States is thought to be lagging in the use of ITS in traffic signing (e.g., for urban freeway travel time and incident messaging) yet the New Jersey barrier was imported from the United States into European practice.

Incidentally, the FHWA Scanning Tour concept was much admired.

In the government sector, INRETS and LCPC are advanced and forward-looking organizations providing English abstracts as a minimum and often full text reports on the web sites. There is no overall policy for participation in international (English language) conferences, such decisions being delegated to departmental levels.

TRL - Transport Research Laboratory, United Kingdom

The overall impression is that though few TRL staff are fluent in European languages, adequate contact to non-English services is maintained through personal contacts or through various multi-country organizations such as COST and OECD. French and German services and literature were most likely to require translation, which was done on an ad-hoc basis. Scandinavian and Netherlands sources usually published in English. In general, limited translation supported by understanding of graphical and tabular material was enough for understanding of non-English publications. TRL does not publish in other than English but has been party to French/English texts.

There is a desire to know more about Japanese developments. Several technical innovations were discussed. First, the use of SMA—introduced in Germany in the 1970s but not until the 1990s in England. The delay in implementation was due also to economic circumstances. Second, French EME (thinner/stiffer) pavements have been introduced, partly as a response to the mid-1970 oil crisis, and savings of the order of 2GBPM/pa were noted, generated by using

less asphalt for the same life. However, there was not direct delay attributable to lack of translation. The fugitive literature was a concern but it was mostly solved by networking. A primary source was the French 'Revue Général des Routes' and it was noted that an annual edition is published in English.

A new technology of interest is recycling.

The Japanese technology of epoxy coated reinforcement had not been adapted for bridge decks because of a concern for durability, which recent U.S. experience seems to show is a problem. However, a new resin coated process for prestressing cables is of interest.

In the information sector, TRL is the primary contractor to OECD for ITRD, currently in English, French, German and Spanish. Translation on demand is provided to TRL staff with a budget of 10KGBP apparently adequate.

It was noted that the OECD/ITRD thesaurus exists. No public access to whole text articles is available but there is an intranet system carrying TRL reports in .pdf format extending back to the 1970s.

China is providing input to OECD/ITRD since 1997 as does Japan but not in large volume.

Commenting on the fugitive literature, Howard stated much of the English Highways Agency material is available through the web site (www.highways.gov.uk) and a "research in progress" page is offered.

KFV - Kuratorium fuer VerkehrsSicherheit (Austrian Road Safety Board), Austria

Suggested new technology in telematics (e.g., variable signing) and noted much originates in Japan. Also suggested the policy direction toward a strategic safety program—setting targets (e.g., for fatality rates). However, it was noted that the Austrian environment is more strictly regulated than in the United States (e.g., the provisional licensing approach that resulted in a 14% drop in fatality rates for novice drivers).

Secondary task studies relevant for HUD and direction KPS systems.

European Union developing 5th Framework with DG for Transport and Energy with "sustainable development" and "networks of excellence" as themes.

Other new approaches exist in driver training and assessment using automated simulation technologies, driver rehabilitation, and graduated licensing.

Project 3 of EC investigating large-scale facilities for driver training and behavior and, vehicle performance.

The EC accepts proposals in any of its 11 languages but because each proposal requires three independent reviewers, it is usually difficult to review in original language and English is commonly used.

Motor vehicles research is published almost exclusively in English as is driver research, except for "niche" studies (e.g., motorcycling in German) but the results are still readily available in English through international conferences (e.g., "Traffic safety in two continents") run by VTI.

Some 80% of technical personnel are fluent in "Euro speak"—basically English— and international travel and cooperation is encouraged (though not always budgeted).

Publication in English is also encouraged for all except internal reports, however, some material is "commercial in confidence" under grant funding constraints. There is no current plan to make full text available on the Internet. Two key journals (*Zeitschrift fuer Verkehrsrecht*, *Zeitschrift fuer Verkehrssicherheit*) are published: the second abstracts in English and German.

SNRA publishes literature surveys contracted out by a bidding process but requires publication in English.

The general view, strongly expressed, was that there is no real language barrier to access to French and German literature and what barrier does exist is rapidly diminishing. It was also noted that use of OECD/ITRD, with if necessary, the OECD thesaurus or the PIARC dictionary, gave adequate access to all recent European technical journal documentation. There does appear to be less ready internal access to fugitive literature with few departments giving direct internet access to internal reports and documentation.

ISTU - Institut fuer Strassenbau und Strassenerhaltung, Austria

ISTU suggested recent work in recycling technology, especially the use of recycled concrete, appears to be 8 to 10 years ahead of the United States. This could be due to socio-economic factors rather than to ignorance of technical issues as the work was published in the International Concrete Roads Conferences.

Eighty percent of European professionals speak/read and write English adequately and most publish regularly in international (English) language conferences.

About half the organization's work is published in English and *Strasse und Verkehr* is the significant German publication (without English abstracts*). Strasse und Autobahn* has carried English abstracts for many years. The use of graphs, tables, and equations is often enough for translation. He noted the NORDIC countries publish in English, which is becoming the "European" language. Many country specifications and codes are language of origin but the EC-CEN approach is to have all available in English and the language of origin.

COST may generate stage reports in language of origin but the final report is in English and often a CD-ROM will also be released with the detailed reports (non-English?).

ISTU emphasized the value of personal contact and the value of the SHRP in this regard. It was recalled that a mass of German LTPP evidence was hardly studied because it needed translation. European adoption of SHRP binder testing in Europe was notable.

CROW - Information and Technology center for Transport and Infrastructure, Netherlands

Netherlands practice in bicycle usage, parking, and roundabouts would be of interest to U.S. cities.

Roundabouts are found to reduce fatalities by 75% in urban environments. The "Woonerf" concept is likely to be suspended by a 30km/h speed limit in urban residential areas. Many restrictive parking practices are in place but lifestyle differences may limit transfer to the United States (see COST 342 - Parking policy measures and their effects on mobility and the economy at http://www.cordis.lu/cost-transport/src/cost-342.htm). A bicycle manual was released in 1990 and published in English in 1994. The Dutch Traffic manual (available in English) appears useful to U.S. cities. Newer potential transfers could relate to policy development for sustainable safety; tendering and contracting; procedures, including work zone safety; and sustainable building.

CROW publishes 95% in Dutch and 5% in English but most work is referenced in ITRD with English language abstracts and is therefore accessible. All staff speak English and direct contact is welcomed.

Attention was drawn to www.CORDIS.eu and www.stellaproject.org for documentation of research projects/programs.

The role of personal contacts was again emphasized, for example, Dutch authors of five papers in the International Symposium on Transportation Technology Transfer (Proceedings: Conference on Accessing Transportation Information Resources Worldwide, FHWA, Orlando, Florida 2001) provided such contact. New technologies of interest were embedded rail structures for street cars (de Man 2002) and foamed concrete (very high air voids) now being marketed by VOORBIJ.

The integrated design of pavements (QUASAR) was introduced at the International Society for Asphalt Pavements and the International Road Federation conference (van Gurp and van Leest 2002) and may be downloaded from the CROW webpage (info-quasar@crow.nl). A low-volume roads manual (no. 157) also exists.

Most Dutch authors can write English but need time/cost justification to do so.

Most publications are sold so there is very limited text available in downloaded format and, although most Dutch government documentation is public, it is hard to locate. New technologies being studied are tunneling (Germany and Japan) and CRCP reintroduced from the United States in the 1980s.

FEHRL - Forum of European National Highway Research Laboratories

G. SWEERE, Executive Chairman of FEHRL, and Program Manager, Europe of DWW (Road and hydraulic institute of the Ministry of Transport, Public Works and Water Management, Netherlands), confirmed the view that the scanning tours were very effective TT mechanisms. The personal contact and Q/A format enabled much exchange of information. As many European professionals speak English, there is no language barrier.

In construction/maintenance, all major Dutch road works are undertaken at night or on weekends with bonus payments for rapid/on-time completion currently under study. COST 343, Reduction in Road Closures by Improved Maintenance Procedures, is addressing this issue; this is the first COST action with U.S. participation through TRB. FEHRL gives full text access through the EU web site and publications are sold at cost recovery only. Many COST studies result in state-of-the-art documents and are increasingly downloadable. Most government documentation is downloadable in Dutch.

He noted an increasing tendency to focus on broader issues (e.g., the "Roads to the Future" program) to look beyond current detailed technical concerns and the increasing use of commercial companies to motivate "exploitation" for profit in contrast to "implementation and dissemination."

Noise and air quality are major environmental concerns and new technologies of interest include changeable illuminated lane lines, in-plant prefabrication of road pavements, energy recovery from solar radiation on road pavements, and quiet pavements incorporating Helmholtz layers. He also supported the view that roundabouts were the best traffic device yet invented.

SWOV - Institute for Road Safety Research, Netherlands

SWOV produces an annual summary of projects in English and provides English abstracts to OECD/ITRD. Again the sustainable safety concept is promoted and care is taken to integrate infrastructure and human characteristics. State-of-the-art reports (c.f. COST) and personal contacts were seen as the best way to initiate TT. Though SWOV publications are mainly in report format and in Dutch, significant developments are usually published in the international journals (i.e., accident analysis and prevention, human factors). SWOV also maintains a comprehensive web site, including many transport and safety statistics.

BASt - Federal Highway Research Institute, Germany

The Bundesanstaldt fuer Strassenwesen (BASt) is primarily a government organization that prepares all reports in German because the primary audience is German professionals, administrators, and academics. English abstracts are provided. Some reports later become the basis for English language journal and conference papers but finding time to produce the translated version can be difficult. The point was made that technical translation demands a knowledge of appropriate terminology and some understanding of the subject. Thus, while most staff speak and read English, writing technical articles is more difficult and time consuming.

However many reports have English abstracts on the BASt web page and all are in the OECD/ITRD data base and many German technical journals provide English abstracts. English language presentations (usually in PowerPoint) are available from individual researchers and personal contact was mentioned as the primary TT process.

The publication of the series BASt reports is through a commercial publisher (some) cost recovery through sales. There is thus a reluctance to place full text on the Internet. However it was recognized that the pressure to publish in English for European audiences is increasing and a change in policy to release full-text .pdf files is likely.

Access to English is reasonable (TRB, ARRB, English journals make up 20% of the library collection) but foreign (French, Italian, Spanish) journals are rarely scanned. Initial access appears to be by OECD/ITRD search. A translation on-demand service is available for different languages. A significant portion of the translation demand is from German to English.

Government department publications are in German through the BMVBW where the roads department has a direct link with BASt. The Forschungsgesellschaft fuer Strassen und Verkehrswesen (FGSV) has a committee structure representing academic and industry. Some German material is available through FGSV and standards by DIN are usually equivalent to CEN. Technical regulations and specifications are listed in OECD/ITRD.

The annual handbook "Der Elsner - Handbuch fuer Strassen- und Verkehrswesen," which is privately published, contains useful information on all aspects of roads and traffic (e.g., road planning, construction and maintenance, traffic management, etc.). It provides a comprehensive overview of current regulations and an important address part. Unfortunately, this handbook is published in German only.

Summary

English is becoming the "scientific language" for Europe and, thus, language is becoming less of a barrier. Overall, the deficiency for the United States is perhaps more for knowledge of what is going on and what has been done—through full international data base searches and with use of government web sites—rather than a lack of translation of specific articles.

There are still some constraints on access to fugitive literature but more and more government organizations are allowing access to documentation through web sites. This should be encouraged.

As most text is now initiated in electronic format, some means of recognizing and rewarding authorship with some copyright protection is required to complement the potential for ready and inexpensive access to documentation.

Everyone mentions the value of personal contacts and the effectiveness of the Scanning Tour program. Therefore, a potential regeneration of the WIN concept—perhaps a chat-page format with less formal structure—should be considered. The success of the on-line TRB Committee A2B09: Full-Scale/Accelerated Pavement Testing supports this view, but perhaps the approach should be to encourage such "rooms" in specific topic areas, to ensure the interest of participants, rather than the "global" approach of WIN.

A list of transportation-related web sites is available at the FHWA International Programs web page (http://international.fhwa.dot.gov)

BENEFITS

Defining a value for translation of non-English technical publications is extremely difficult due to the very many factors influencing the adoption of a foreign technology. Not least of which are the social, economic, and environmental constraints that differ among regions in the United States as well as between the United States and other countries. A clear example of these factors can be found in reference to urban traffic calming measures in Europe compared with those in the United States. The cities' different approaches in form and the use of pedestrian and bicycle facilities reflect major cultural and lifestyle differences.

The route to a business case must perforce lie in demonstrating (a) that some imported technologies have resulted in savings to the United States, (b) that these savings could have been potentially greater had the technologies been adopted earlier, and (c) that, at least in part, this delay in adoption was due to lack of translation of appropriate technical documentation. This documentation is needed in two primary forms: (1) the technical reporting of the techniques in the scientific literature through conferences and journals, which serves to introduce the technology, and (2) the fugitive but public domain documentation of policies and practices in guides and manuals published by government departments. As mentioned earlier, where a technology has potential commercial application, there are often two opposing factors at work— promotion of the techniques for application and commercial profit and constraint on release of technical detail for commercial advantage.

Estimates of the savings from any technical improvement frequently rest upon some estimate of the penetration of that new process into an established market and/or on estimation of the change in value of a construction between the 'old' and 'new' method. Thus, some overall quantification of the expenditure on a product or process is made for the before-and-after case. Such estimates cannot be precise. A second approach is to evaluate the cost of introducing an innovation against the cost of utilizing current practice to suggest that where this cost is small then the innovation should be implemented provided some technical improvement is indicated. Some follow up of any such introduction is then of course desirable to confirm the innovation did

result in an improvement, and hopefully, but very rarely, some specific cost/benefit.

Using this approach, the report (NCHRP 2001) provided a first estimate of potential economic benefits, suggesting a range of $10 million to $1 billion per year (0.01 to 1 percent of surface transportation disbursements).

In this study, the approach has been to seek some imported technology for which demonstrable benefits are claimed and to attempt to place a value on those benefits. Clearly, in a small-scale study, this cannot be comprehensive but must be limited to examples. From the material described above two case studies are offered: the introduction of stone mastic asphalt and the application of traffic calming techniques.

Asphalt Pavement Construction and Maintenance

Asphalt concrete covers more than 90% of the paved roads in the United States and requires an annual expenditure of $15 billion to meet increasing traffic volumes and loads. In addition to the direct costs, the creation of work zones during repair and rehabilitation projects disrupts and delays traffic, and rough pavements pose safety risks and can damage tires and suspensions. In 1998, U.S. highway agencies spent $25 billion to maintain pavements, but increasing traffic volumes and truck loads test their ability to keep pace with maintenance needs. As a result, agencies face a backlog of maintenance needs, and poor pavement conditions impair highway safety and damage vehicle tires and suspensions, prompting additional negative reaction from motorists and commercial users.

Stone mastic asphalt (SMA) performed efficiently in Europe for over 20 years with enhanced resistance to rutting and studded tire damage (Pierce 2000). Germany reported 25% longer service than traditional dense HMA and Sweden 20% longer service (see Scanning Tour [1] 1990). The time scale for transfer of this technology is shown in Figure 4.

In the United States, Brown et al. (1997) summarized 140 projects reporting that most SMA had been laid as overlays with an overall performance from very good to excellent. It appears that costs may be 10% higher but if an increase in life of 20–25% can be achieved, then there is real economic benefit even without counting the indirect costs. If we assume 1% of the $25 billion maintenance expenditure is for asphalt and this can be reduced by 20% by using SMA, then an annual benefit of $50 million is predicated. Even assuming only 0.1% of the annual maintenance costs can be saved, the value of earlier use of the technology is $5 million a year. This is certainly enough to pay for the translation of a substantial amount of non-English documentation.

Traffic Calming

The European experience with traffic calming measures suggests, from 43 international studies, that there can be an 8–100% reduction of collision frequency, which clearly implies considerable cost benefit of the application of these techniques.

In the United States, Ewing (1999) has reported cost savings due to accident reductions in Seattle (WA) (see Table 14). Other results, Table 15, show the experience in collision reduction by a range of measures.

In addition to direct savings in injuries and accident costs, there are additional qualitative impacts:

- Easier street crossings for pedestrians because of slower traffic and shorter crossing distances at curb extensions;
- Safer bicycle operation, a result of slower traffic;
- Increase of property values; and
- Reduction in noise levels.

TABLE 14 Accident Cost Savings from Traffic Calming Measures

Type of Accident	Accidents Prevented 1991–1995	Cost per Accident	Cost Savings 1991–1995
Non-injury accidents	273	$6,500	$1,774,500
Injury accidents	277	$30,000	$8,310,000
All accidents	550		$10,084,500

(after Ewing 1999)

TABLE 15 Reductions in Collisions

Measure	Number of Observations	Collisions Before	Collisions After	Percent Change
12-in. Hump	49	2.7	2.4	–11
14-in. Hump	5	4.4	2.6	–41
22-ft. table	8	6.7	3.7	–45
Circles*	17	5.9	4.2	–29
Circles**	130	2.2	0.6	–73

(after Ewing 1999)

Other examples of savings are quoted by Jayaprakash (personal communication), $52 million per year from soil-nailing techniques and several listed in Anon (1998), including:

- $9 million – new concrete mix designs,
- a five times benefit from investment in library services,
- cost/benefit ratios of from 1:3 to 1:16,
- time savings from 26–50%, and
- an overall improvement of quality of work resulting from better information.

Cost savings from access to better information principally by translation and thus appreciation of foreign technology thus seem as a minimum, to be in the range $70–$120 million per year.

Set against these benefits, the costs of an "information clearing house" (NCHRP 2001) do not seem excessive. Given that the technical dictionary of PIARC exists and translation software is independently and rapidly developing, it would seem that a foreign language literature translation service could be added to the proposed national Transportation Library for a relatively modest cost in software and multilingual personnel. The concept of staff exchanges with prominent foreign transportation technology organizations has particular attraction as offering a two-way improvement in technology transfer. The success of the SHRP "loan staff" program has more than adequately demonstrated this.

The order of benefit from reduced traffic delays because of better construction and maintenance procedures can be magnified by the value assumed for delay costs of driver time, vehicle, and fuel usage, as can benefits from safety improvements depending on the indirect costs associated with injury and fatality.

The benefit from reduced duplication of effort in research and development, however, is countered by the need to prove and demonstrate new technologies in individual environments and the need for technical suitability to be compatible with social, economic, and political realities.

CONCLUSIONS

This study of technologies imported from non-English language sources has yielded evidence that the limited availability of translations of non-English documentation of foreign technologies, policies, practices, and products has delayed their adoption in the United States.

The routes by which a technology is detected, imported, and implemented are complex and, therefore, it is not possible to present a series of specific conclusions as to those routes; thus, a specific, dollar-quantified "business case" for translations of non-English documentation is difficult.

The loss of benefit, or value of translation, clearly is an elusive quantity. There is no doubt that even the existence, let alone an understanding, of technologies developed and applied in non-English language countries can be missed because of the language barrier. An estimate of the value for specific technical innovations lies around $100 million per year.

Attempting to identify technology transfer delays due to lack of documentation translations has been especially difficult where the technology is not a specific method, process, or product but rather a diffuse policy or practice. For example, there have been advances in road design and traffic calming, adapted or developed from overseas innovations, but the specifics are impossible to isolate and identify as to source. The benefits, however, can be large. The Seattle experience with traffic calming alone reduced injury accidents by some 50 per year from 1991–1995 and overall accident costs by an estimated $2 million per year over the same period. The potential benefits of nationwide application through all major cities must be very great.

If the U.K. experience, that some $20,000 per year provides translation support for the TRL staff, is multiplied in proportion to population, then a cost of some $100,000 for the United States seems trivial in comparison to anticipated benefits.

It is important to recognize that this short-term study is based principally on the published technical literature, that is, the publication of highly technical material in journals and conferences. It recognizes the importance of much documentation in the public domain, such as government policy and procedure publications, but does not analyze in depth and can only partially identify such fugitive material, which is not catalogued through libraries and/or the various literature data bases. Nor does it deal with commercial or trade reports not generally accessible to the public. This fugitive information will always remain as a little explored resource. However, more governmental organizations are placing material on web sites.

Within the above limitations, it is possible to draw some strong inferences about the role of documentation and to formulate initial recommendations for translation of potentially important future documentation from foreign sources to reduce that delay in technology transfer. These inferences are highlighted in bold throughout the preceding text.

There is strong evidence that several technologies in use in Europe, in the period since about 1970, could have been introduced to and adopted in the United States more quickly had better access to non-English documentation existed. Better access means awareness of the material, availability of full text, translation of that text in a timely manner, and, distribution of the translation to those with the interest in and need for the technology.

Quantifiable delays have been documented for some specific "stand-alone" technologies. It is evident that the use of stone mastic asphalt, for example, was widespread in Germany possibly 20 years before application in the United States. The use of special surfacing techniques in France (e.g., Novachip) predated U.S. applications by some 5 to 7 years. Italian technologies developed in the years 1977–1990

were effectively unknown until the scanning tour in 1992. The falling weight deflectometer technique for non-destructive analysis of pavement structures was developed and used in Denmark some 5 to 7 years before application in the United States commenced. However, there seems to have been little delay, perhaps only 1 or 2 years, in transfer of technology from the Netherlands and Scandinavian countries.

The transfer of technologies from Japan requires further investigation and evaluation. Clearly, in some fields, bridges, tunnels, and advanced traffic management, there is much to be learned. This study also has not considered material now developing in newly industrializing regions, such as Asia and Latin America, where again some further study may be warranted. China is not considered.

Throughout the study, it has been very evident that direct observation "on site" and personal contact between professionals is a most effective technology transfer route, if not the most effective route. This is evident in the Scanning Tour reports and also in the responses from colleagues canvassed for the study. Also, despite the lack of direct links to report findings, it is evident that translation of the content of much of the formal and informal source documentation gathered could have been of greater value, especially to non-participants in the tour seeking greater understanding of the tour recommendations. Better documentation of the discussions and observations would also be to advantage. Such material could in future be better documented, archived, translated, and disseminated.

Clearly, there is a business case for enhanced translation capability to access in a timely and effective manner the emergence of new technologies overseas. An annual benefit considerably in excess of $100 million is evident, suggesting that assuming a cost benefit ratio of 1:10 would justify the provision of $10 million per year to enhance access to foreign innovations. Several suggestions in relation to this much needed enhancement are outlined below.

It does appear, though, that these delays are lessening at an increasing rate because of the following situations:

- Many non-English authors publish in, and attend, the major international conferences related to transportation;
- Many non-English language journals have English language contents pages and/or abstracts of the principal technical papers therein;
- Many foreign organizations submit publication details, and English abstracts, to OECD/ITRD;
- Many organizations are producing English language material for publicity purposes, for international recognition, and for multinational cooperative reasons, e.g., membership of international organizations;
- Those multinational activities, e.g., the EU require multilingual documentation;
- Many international organizations, e.g., PIARC, operate in two or more languages; and
- The world wide web, whilst providing an international interface, also encourages the use of English language pages to attract attention and make more widely accessible the information thereon.

The tentative conclusion must be that three simple and relatively inexpensive steps could materially improve U.S. access to foreign transportation technologies.

- **Creation of a "library of last resort," holding preferably complete sets but certainly current copies of the principal journals and major conference proceedings;**
- **More rigorous documentation, translation, and dissemination of the published material collected by Scanning Tours; and**
- **Establishment of ready access to the OECD/ITRD data base.**

RECOMMENDATIONS

The business case for translation of non-English documentation of developments in transportation rests on the evidence for delays between non-English publication and English publication of descriptions of the existence and application of those technologies. It is evident that such delays have existed and therefore that there has been loss of benefit to the United States.

The actions necessary to eliminate, or at least substantially reduce, this delay in future are less evident but include;

- Developing a library of last resort (or a group of libraries) for foreign language transportation literature to develop and maintain a comprehensive collection of foreign journals across the appropriate fields.
  - — introducing a mechanism to provide and encourage access to the OECD/ITRD data base, possibly with a requirement that all NCHRP proposals include an ITRD search and all NCHRP projects document and translate the relevant foreign literature.
  - — encouraging access to foreign transportation web sites by linking at the ITRD web site access point.
- Linking to the library a translation on demand service at subsidized cost to encourage ready access to the non-English material for interested/qualified researchers/professionals.
  - — disseminating translated material widely.
- Linking to the collection an abstracting/translating service of (at least) titles and abstracts in English of the principal technical papers in these journals.
  - — this approach could also include consideration of some mechanism to encourage publishers of significant foreign language journals to include such English language abstracts at source.

  - — encouraging document exchange processes with major transportation authorities overseas to create and implement access to public documentation, such as departmental guides to practice, manuals for design, and so on (Note: there could be copyright and access issues).
  - — providing a "monitoring" service of journals/projects etc., possibly through FHWA/TRB/universities/embassies.
- Continuing the Scanning Tours, with closer attention to collection, translation, and dissemination of the relevant foreign language documentation. Assignment of an information expert to assist each Tour leader could be to advantage. More detailed reporting of discussions and observations could also be to advantage.
- Continuing support of and participation in the major international organizations (e.g., PIARC, OECD, etc.) and, specifically, distribution/provision of the PIARC technical dictionary.
- Developing/expanding exchanges by professional staff, of the federal and state transportation organizations and universities, with overseas organizations.
  - — actively encouraging personal professional contact.
- Further evaluating the publications emanating from Japan and the newly industrializing countries of Latin America, Eastern Europe, and Asia.

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APPENDIX A

FHWA INTERNATIONAL TECHNOLOGY SCANNING PROGRAM - Chronological List of Scans

1. European Asphalt Study Tour (May 1990)
2. Tour of European Concrete Highways (May 1992)
3. Geotechnology: Soil Nailing (September 1992)
4. Contract Administration Techniques for Quality Enhancement Study Tour (September 1993)
5. European Intermodal Programs (September 1993)
6. Pedestrian and Bicyclist Safety (September 1993)
7. National Personal Transportation Studies (October 1993)
8. Advanced Technology Applications (November 1993)
9. Winter Road Maintenance Practices (March 1994)
10. Acquiring Highway Transportation Information from Abroad (March 1994)
11. Highway Safety Management Systems (June 1994)
12. International Decision-Making Criteria for Highway Investment (July 1994)
13. Issues and Options in Highway/Commercial Vehicle Interaction: North America (September 1994) and Europe (April 1995)
14. Speed Management and Enforcement Technology (April 1995)
15. Human Factors Technology for Highway Design (May 1995)
16. Bridge Structures: Europe (June 1995)
17. Northumberland Strait Crossing Project (September 1995)
18. Bridge Maintenance Coatings (October 1995)
19. Traffic Management and Traveler Information Systems (December 1995)
20. South African Pavement and Other Highway Technologies and Practices (May 1996)
21. European Traffic Monitoring Programs and Technologies (June 1996)
22. Advanced Composites in Bridges in Europe and Japan (October 1996)
23. Road Safety Audits (October 1996)
24. Transportation Agency Organizations and Management (August-September 1997)
25. Bridge Structures: Asia (September 1997)
26. Geotechnical Engineering (March 1998)
27. Winter Road Maintenance Practices II (March 1998)
28. Innovative Traffic Control (May 1998)
29. Commercial Vehicle Safety (September 1998)
30. Bridge Scour Countermeasures (October 1998)
31. Railroad Crossing Pre-Scan (September 1997)
32. Methods and Procedures to Reduce Motorist Delays in Work Zones (May 1999)
33. Steel Bridge Fabrication Technology (May 1999)
34. Recycled Materials in the Highway Environment: Use, Technologies, and Policies (September 1999)
35. Sustainable Transportation (September 1999)
36. Segmental Concrete Bridge Durability (October 1999)
37. European Right-of-Way and Utilities Best Practices (March 2000)
38. New Roadway Lighting Techniques and Technologies (April 2000)
39. Highway Geometric Design (June 2000)
40. 21st Century Operations (March 2001)
41. Workforce Development (March 2001)
42. International Freight Logistics (June 2001)
43. Contract Administration (June 2001)
44. Pavement Preservation (July 2001)
45. Safety (September 2001)
46. Wildlife Mortality (October 2001)
47. Traveler Information Systems (Nov 2001)
48. Winter Maintenance (January 2002)

APPENDIX B

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APPENDIX C

Organizations

- **ANAS (No English Version)**
  www.enteanas.it
  No street address found

- **Asfaltindustrien (No English Version)**
  www.asfaltindustrien.dk/

- **ASFALTINDUSTRIENS HUS**
  Stamholmen 91, 2650 Hvidovre
  Denmark

- **Belgian Road Research Centre**
  www.brrc.be/brrc/e00-00.htm
  Boulevard de la Woluwe 42, B-1200
  BRUSSELS (Belgium)

The Belgian Road Research Center (BRRC) is an applied scientific research institute created in 1952 at the request of the Federation of Belgian Road Contractors, aimed at promoting research in industry.

- **Bundesanstaldt fuer Strassenwesen (BASt) Federal Highway Research Institute**
  http://www.bast.de
  Brüderstraße 53, D-51427 Bergisch Gladbach, Germany

BASt is a technical and scientific institute responsible to the Federal Ministry of Transport, Building and Housing (BMVBW). BASt's work includes the formulation of specifications and standards applying to all fields in highway-related work in close collaboration with the Road and Transportation Research Association (Forschungsgesellschaft für Straßen- und Verkehrswesen), the DIN German Institute for Standardization (Deutsches Institut für Normung), the German Institute for Construction Technology (Deutsches Institut für Bautechnik), the German Road Safety Council, (Deutscher Verkehrssicherheitsrat), competent state highway authorities, universities, associations and the highway industry.

- **CDV (Transport Research Centre)**
  www.cdv.cz/
  Lisenska 33a, Brno, Czech Republic

CDV (Transport Research Center) has more than forty years long tradition of research and development. for the Minister of Transport of the Czech Republic as the only research institute on transport issues under the responsibility of the Ministry of Transport. CDV as the national institute representing the Czech Republic is the member of IRTAD.

- **CEDEX**
  http://cedex.es/ingles/home.html
  Autovia de Colmenar Viejo, Km 18,2.
  28760 El Goloso , Madrid, SPAIN

The Centro de Estudios y Experimentación de Obras Públicas (CEDEX) was created in 1957 as an autonomous organization that provides multidisciplinary support in civil engineering technologies, construction and the associated environment to administrations, public institutions and private companies.

A copy (only available in Spanish) of the technical reports issued by CEDEX since the late eighties is resident in the CEDEX Libraries Network. A quick reference of the technical reports of CEDEX issued during the previous year can be also consulted.

- **CERI of Hokkaido**
  www.ceri.go.jp
  1-34 1-jo 3-chome Hiragisi Toyohira-ku, Sapporo,Hokkaido, 062-8602, JAPAN

The Civil Engineering Research Institute of Hokkaido aims to improve civil engineering technologies that contribute to promoting the development of Hokkaido.

- **Certu (No English Version)**
  www.certu.fr
  NO STREET ADDRESS

- **CROW**
  www.crow.nl
  Galvanistraat 1, 6716 AE Ede, The Netherlands

The national Information and Technology Center for Transport and Infrastructure (CROW) is a non-profit organization in which the government and businesses work together. The core tasks involve:

- Research in the area of traffic, transport and infrastructure;
- Standardization in this sector;
- Transfer of knowledge and knowledge management.

International co-operation takes place in working parties and involves such organizations as CEN, ICIS, OECD, PIARC and RILEM. CROW also works on behalf of the Netherlands in the EU framework and COST programs, TRB, the World Interchange Network and, of course, the ITRD. In many such cases, CROW takes on the role of the Dutch interchange at the hub of international networks.

- **Danish Transport Institute (DTF)**
  www.rft.dk
  Knuth-Winterfeldts Allé, Building 116,
  DK-2800 Kgs. Lyngby, Denmark

The Danish Transport Research Institute (DTF) is a research institute under the Danish Ministry of Transport. The purpose of the Institute is to strengthen transport research with special focus on such fields as transport safety and risk as well as transport economics and transport modeling. The Institute participates actively in national and international (including EU) research cooperation and in its coordination.

Publication of the research results obtained by Danish Transport Research Institute takes place partly in the Institute's own report and notes series, partly in relevant Danish and international journals and at conferences, etc.

- **Forum of European National Highway Research Laboratories (FEHRL)**
  www.fehrl.org
  Boulevard de la Woluwe, 42, Bte 3
  1200 Brussels, Belgium

The Forum of European National Highway Research Laboratories (FEHRL) was formed in 1989 by the national highway research laboratories in EU and EFTA countries. At present, the Forum comprises, as full members, the national laboratories in all member states of the Union, and in EEA countries. Laboratories in the Czech Republic, Hungary, Poland, Romania, the Republic of Slovenia, Croatia and Bulgaria have since been admitted as Associate members.

The purpose of FEHRL is to encourage collaborative research between European Laboratories and Institutes in the field of highway engineering infrastructure, leading to the provision of relevant knowledge and advice to governments, the European Commission, the road industry and road users.

- **Forum of European Road Safety Research Institutes**
  www.fersi.org
  (no street address given)

FERSI'S mission is to provide a forum for developing collaborative research projects aimed at producing solutions to common road safety problems within European countries; . provide support to the European Commission in defining research needs within Europe; . encourage the exchange of good practice and research knowledge between countries and encourage closer co-operation and, where appropriate, the exchange of researchers between countries.

- **INRETS**
  www.inrets.fr
  2 Avenue Général Malleret-Joinville
  94114 Arcueil France

The French National Institute for Transport and Safety Research was created in 1985. The INRETS is a state-financed scientific and technological body under the dual administrative supervision of the Ministry of Research and the Ministry of Transport.

- **Institut fur Transportwirtschaft und Logistik (No English Version)**
  www.wu-wien.ac/wwwu/institute/transport/Home.htm
  Institut für Transportwirtschaft und Logistik
  1. Stock, Kern B
  Augasse 2-6, A-1090 Wien, Österreich

- **Institute Fuer Verkehrswesen (No English Version)**
  www.boku.ac.at/verkehr/
  Peter Jordan-Straße 82 , A-1190 Wien, Österreich

- **ISBR (No English Version)**
  www.ibsr.be/fr/01home.htm
  IBSR, Chaussée de Haecht 1405, 1130 Bruxelles, Belgium

- **KFV**
  http://www.kfv.or.at/doku.data/Default.htm
  Kuratorium für Verkehrssicherheit
  Ölzeltgasse 3, A-1031 Wien, Österreich

DOKDAT, a comprehensive bibliographic database, at the Kuratorium fuer Verkehrssicherheit (Austrian Road Safety Board – KfV) makes available current international knowledge in all fields of traffic and transport (focusing on traffic safety). DOKDAT references exclusively KfV-owned literature. At international level, we deliver Austrian input to the International Transport Research Documentation (ITRD) of the Organization for Economic Cooperation and Development (OECD).

- **Laboratoire Central des Ponts et Chaussées**
  http://www.lcpc.fr
  LCPC - Paris - 58, bd Lefebvre –
  75732 Paris Cedex 15 France

LCPC was set up in 1831, it is today a State research organization working for the State and the local authorities in connection with professionals involved in civil engineering, transport, urban engineering and environment.

- **Public Works Research Institute**
  www.pwri.go.jp
  1-6, Minamihara, Tsukuba-shi, Ibaraki-ken,
  305-8516 Japan.

- **SETRA (No English Version)**
  www.setra.fr
  SETRA - Service d'Etudes Techniques des Routes et Autoroutes
  46 avenue Aristide Briand, B.P. 100,
  92225 Bagneux Cedex, France

- **Statens Vegvesen (No English Version)**
  www.vegvesen.no
  No street address found

- **Swedish National Road Administration (SNRA)**
  http://www.vv.se/for_lang/english/index.htm
  Vägverket, Röda vägen 1, 781 87 Borlänge, Sweden

The SNRA is the national authority assigned the overall sectoral responsibility for the entire road transport system. The SNRA is also responsible for drawing up and applying road transport regulations.

- **Swedish National Road and Transport Research Institute (VTI)**
  www.vti.se
  S-581 95 Linköping, Sweden

The Swedish National Road and Transport Research Institute is a national research institute organized under the Ministry of Industry, Employment and Communications.

- **SWOV**
  www.swov.nl
  P.O. Box 1090, 2260 BB Leidschendam, Duindoorn 32,
  The Netherlands

The SWOV Institute for Road Safety Research is the center point for road safety research in the Netherlands. Knowledge distribution is, therefore, a central part of SWOV.

- **TNO – Netherlands Organization for Applied Scientific Research**
  www.tno.nl
  PO Box 6050, NL-2600 JA Delft, The Netherlands

A large contract research organization, TNO provides a link within the innovation chain between fundamental research as a source of knowledge and practical application as the use of knowledge which can be commercially exploited.

- **Vejdirektoratet**
  www.vd.dk
  Niels Juels Gade 13, Postboks 1569, 1020 København K, Denmark

The Danish Road Directorate, Ministry of Transport, Denmark, is responsible for the administration and operation of the 1,618 km national road network. Its tasks consist of planning, construction, improvement, maintenance and operation of the network and provision of services and traffic information to all road users.

- **VTT – Technical Research Center of Finland**
  www.vtt.fi
  P.O. Box 1000, FIN-02044 VTT

VTT Technical Research Center of Finland is a contract research organization involved in many international assignments.

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The views expressed are my own, as are any errors and omissions.