CRISP Consultancy Commission 00-22

An Action Plan for the Highways Agency

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Executive summary

During 1999 the Construction Research and Innovation Strategy Panel (CRISP) worked on selected topic areas from its Strategic Priorities 1999. Task Groups were formed and reports were prepared. All contained recommendations about the industry's research needs. The recommendations were then drawn together into a series of five topic-based Action Plans. These covered:

- Meeting Customers' Needs,
- Design,
- Sustainable Construction,
- Motivation & Communication,
- the Construction Research Base.

An additional (sixth) source of recommendations on sustainable construction was a report prepared for CRISP entitled 'Construction for Sustainable Development: research and innovation needs', CRISP Commission 99/15. Further topics are at present being addressed by CRISP – these include the construction process, components, technology and performance – and these Task Group recommendations are expected to emerge in early 2001.

This report takes the recommended actions from the six sources, maps them onto the Highways Agency's Research Areas and Key Activities, and analyses the results of the mapping exercise. The HA's Research Areas were collated from two sources: 1) The Research Strategy 1998-2001, which was obtained from the HA's web site; 2) A report on HA Research Objectives and Priorities dated November 2000, which was provided directly by the HA. This contained a table summarising the HA's three Research Areas, and the Key Activities within each area. It is this table (slightly modified) which is used as the basis for the mapping.

Equivalent reports have been prepared for the DETR, EPSRC and ESRC. Table 5.1 summarises the construction-related research areas supported by these bodies, and table 5.2 lists all CRISP 1999/2000 Task Group recommendations and maps them against the research priorities of each funding body.

As Table 3.1 on page 10 shows, a total of 125 recommendations were made by the six CRISP sources used for this report. 24 of these are relevant to the Highways Agency, of which 12 are general recommendations, and 12 map directly onto the HA Research Areas. The remaining 101 do not map onto the Research Areas.

In terms of the HA Research Areas which attract the most recommendations, these are as follows (in decreasing order):

Research Area 1 Asset Management	10
Research Area 3 Customer & Market Research	2
Research Area 2 Traffic Management	0

This analysis shows that comparatively few of the CRISP recommendations are relevant to the Highways Agency's current research strategy. There are two main reasons for this. First, CRISP task groups have addressed their recommendations primarily towards building construction rather than civil engineering. But there is a second and perhaps more important reason. The Highways Agency's Research Areas and the Key Activities within them are concerned largely with the road network as a product, with research addressing the performance of the product – for example, smart monitoring, new materials, crash barrier improvements – not on the process of design and construction. By contrast, the CRISP Task Groups convened to date have focused very largely on design and construction process issues – such as effective communication, interdisciplinary teamwork, application of business excellence models; and on the application of research findings in practice. It is to be expected that CRISP Task Groups dealing with components, technology and performance will produce recommendations that are more relevant to the HA. Once these Task Groups report, it will almost certainly be appropriate to review and update this mapping exercise.

The 12 general recommendations about research made by the Task Groups that are of relevance to the HA are listed in table 4.1.

The Highways Agency was shown an early draft of this report and invited to respond to it. They identified the increasing importance of sustainability as a cross-cutting theme, and recommended that more of the recommendations in the CRISP 99/15 report be show as generally relevant to their programme. They also noted that many of the general recommendations were already being tackled by the Agency in-house. This report has been updated to take account of their comments.

The Highways Agency is invited to note the contents of this report when they develop their new Strategic Plan for HA Research. In particular, should they wish to put more emphasis on the design and construction process, and/or introduce wider definitions of sustainable development, then the contents of this report – including the full list of CRISP recommendations in section 5 – should provide a rich set of recommendations for consideration.

1 Overview and sources of the recommended actions

During 1999 CRISP worked on selected topic areas from its Strategic Priorities 1999. This resulted in a series of task group and other reports and recommendations being taken to CRISP's Awayday 2000. The Awayday broadly endorsed these reports and CRISP collected together the various recommendations in a series of five topic-based Action Plans. These addressed: Meeting Customers' Needs, Design, Sustainable Construction, Motivation & Communication, and the Construction Research Base. An additional (sixth) source of recommendations on sustainable construction was a report prepared for CRISP entitled 'Construction for Sustainable Development: research and innovation needs, CRISP Commission 99/15, that was not available at the Awayday. All of these six reports are available on the CRISP web site: www.crisp-uk.org.uk.

This report 'maps' the recommended actions from the six existing CRISP sources onto the Highways Agency's Research Areas. The Research Areas were collated from two sources:

1) The Research Strategy 1998-2001, which was obtained from the HA's web site
2) A report on HA Research Objectives and Priorities in November 2000, which was provided directly by the HA.

This latter source contained a table summarising the HA's three Research Areas and Key Activities within each Research Area, and it is this table (slightly modified) which is used as the basis for mapping CRISP recommendations on to HA Research Areas.

It should be noted that, at the time of writing (January 2000), other topic areas are being addressed by CRISP, but these have yet to result in action plans and recommendations. Once they do so, and as the Highways Agency's research strategy evolves, this mapping exercise will need to be updated to reflect both sets of changes. It may also be possible to add other industry recommended actions for research arising from, for example, the Construction Associate Programme and/or Built Environment & Transport programmes of Foresight; and perhaps those of the EPSRC-funded university Built Environment Research Network which has conducted its own Foresight-style exercise.

Equivalent mapping exercises have been undertaken of CRISP recommendations against the themes and priorities of the Engineering and Physical Sciences Research Council, the Department of Environment, Transport and the Regions, and the Economic and Social Research Council. A summary table of these organisations' construction-related research programmes is given in table 5.1. The full list of CRISP recommendations mapped against the research themes of each of the four bodies (DETR, EPSRC, ESRC and HA) is given in table 5.2.

It is an unfortunate consequence of the way in which this report has had to 'map' both the HA Research Areas and the recommendations of CRISP Task Groups, that it appears to place topics into isolated 'silos' or boxes. This is certainly not the intention of this report, but no feasible alternative way to carry out the analysis has been identified.

A brief description of the CRISP Action Plans follows in the rest of this section, while section 2 of the report describes the mapping exercise. Section 3 provides an analysis of the findings from the mapping exercise. The 'maps' themselves are given in Section 4 of the report. Section 5 lists, for completeness, the Task Groups' 109 recommendations that do not map onto the HA's Research Areas. Although these do not map onto HA's research, some may be of interest and attention is drawn particularly to the five recommendations from the Construction Research Base Task Group.

1.1 Meeting Customers' Needs Action Plan

This CRISP Topic Area Action Plan was based on a Construction Clients' Forum workshop held in January 2000 in collaboration with CRISP. Its aim was to identify key research and innovation actions to deliver customers' needs; to develop specific research and innovation projects; and to identify appropriate mechanisms to take these forward. At the workshop, each discussion group worked on one of the five priority areas set out in the CCF's Research and Innovation Strategy:

- Construction as a Product
- Re-integrating the Team
- Barriers to Innovation
- Costs of Ownership
- Right First Time, Every Time

to which was added the needs of Small and Occasional Clients. Actions arising are summarised in the table below. The total number of these is 23.

In terms of implementation, the CCF workshop did not identify mechanisms or people for taking its recommendations forward. Nor did it assign priorities to the actions it recommended.

Meeting Customers' Needs: summary recommended actions
1. Define the overall process of 'construction', from formulation of business need best met by construction activity through to successful operation [9 detailed actions]
2. Improve client awareness of existing research, with measures to improve up-take and application [4 detailed actions]
3. Re-assess balance of research spend between 'generating new knowledge' and 'application of new knowledge' [3 detailed actions]
4. Investigate role of insurance, e.g. for latent defects, against perceived risks of innovation [3 detailed actions]
5. Redefine role of 'professional advisors' to clients [2 detailed actions]
6. Investigate increasing need for up-dating of professional skills [2 detailed actions]

1.2 Design Task Group Action Plan

This CRISP Topic Area Action Plan was based on the work of its Design Task. CRISP identified that research into design had received relatively little attention in recent industry initiatives. Over a six month period of intensive discussion, the Task Group developed a wide strategy, fuelled by members' papers, and a specially commissioned research review of the field. The Task Group concluded with a delegate workshop to test its propositions. This led to an extended set of 39 recommended actions, which are summarised in the table below.

Design Task Group: summary recommended actions
1. Raise the quality of the built environment by placing occupancy criteria centre-field [10 detailed actions]
2. Establish sectoral frameworks for design quality supported by evidence-based research [7 detailed actions]
3. Initiate quick response project-linked research suited to the needs of industry and occasional clients [3 detailed actions]
4. Encourage widespread educational reform to support greater quality in the built environment [8 detailed actions]
5. Develop a shared language for design, releasing widest value contribution from all industry and society stakeholders [11 detailed actions]

1.3 Sustainable Construction Theme Group Action Plan

The CRISP Sustainable Construction Theme Group has been in place for some two years or so. It encourages research and innovation (R&I) to support improvements in the sustainable performance of the UK construction industry. The ultimate aim of this R&I, in the longer term, must be to maximise the industry's contribution towards global sustainable development. The phrase "Think globally, act locally" provides a succinct guide. The Group's task is to translate this into practical actions for the construction industry; acting locally here implies not only individual or company-based action, but collective sectoral action to achieve transformation of the construction market place.

The Group has commissioned a number of reports to help CRISP support this task and respond to the changing industry environment, in particular through the Egan '*Rethinking Construction*' agenda. The group seeks to promote the knowledge in the reports not just to key decision makers in leading industry-related research programmes, but also to those who have influence and interest in providing a more sustainable, effective industry and thereby a more sustainable global environment. Among these, the group has promoted and would wish to promote further its work to groups like the Movement for Innovation (M^4I) and the Laing Focus Group, in addition to other CRISP groups.

In its *Strategic Priorities* published in April 1999, CRISP identified issues relating to sustainable construction as follows:

> 'Sustainability is an issue of increasing national and global concern and, therefore, a key area for research and innovation. CRISP will continue to work to identify those areas where research could contribute quickly and most effectively and support the aims of industry improvement.'

The Theme Group sought, and is continuing to seek, to identify actions that need to be taken forward and to provide output which is as useful as possible to those who will benefit. In the CRISP Topic Area Action Plan for sustainable construction there were four summary actions shown in the table below, and a total of 15 detailed actions.

Sustainable Construction Theme Group: summary recommended actions	
1.	Identify and promote research to develop the tools for greater sustainability and help the business case for sustainability [4 detailed actions].
2.	To co-ordinate the efforts of the research funders to include Sustainable Construction research and innovation at an appropriate level in their programmes. This is to support the construction industry and others achieve greater sustainability [4 detailed actions].
3.	To influence the development and promotion of a research and innovation database related to Sustainable Construction to help co-ordinate the efforts of the research funders [3 detailed actions].
4.	To contribute to the work of other CRISP theme and task groups to ensure that Sustainability is integrated with other aspects of the work of CRISP [4 detailed actions].

1.4 CRISP Commission 99/15: 'Construction for Sustainable Development - Research and Innovation (R&I) Needs'

This study on the research and innovation (R&I) needs for sustainable construction develops and builds on the results of the CRISP-funded report 'Sustainable Construction: Future R&I Requirements, Analysis of Current Position' (March 1999). Its aims were twofold:

1. To develop the findings of a previous study for CRISP entitled 'Sustainable Construction: Future Research and Innovation Requirements, Analysis of Current Position' (March 1999), specifically to enable research funders, the construction industry and other stakeholders to identify sustainable construction R&I needs.
2. To identify methods by which sustainability principles can be embedded within generic construction research rather than treated as a stand-alone topic.

The study was conducted through consultation with the industry, including:

- Development of a questionnaire designed to identify priority areas for research and innovation;
- A consultation workshop to further define priority areas;
- A meeting with key funders designed to develop R&I actions to support these priority areas.

Three main barriers to adopting a more sustainable approach were identified as:
- Lack of awareness of the issues;
- Financial pressures;
- Industry culture.

Eight objectives for research and innovation were identified, shown in the summary table below, further subdivided into 19 themes or items.

The report states that in order to achieve the R&I Objectives, and overcome the identified barriers, a mixture of new research and more effective dissemination of existing research is proposed. Sustainable construction research needs to be interdisciplinary and collaborative with end users. More critically sufficient attention must be paid to the communication of research or innovation findings. This is to allow construction practitioners take pragmatic business decisions that reflect the current best practice understanding of how the industry can contribute to sustainable development.

CRISP 99/15 report Construction for Sustainable Development: Research & Innovation Needs
1. Increase the effectiveness of communication and dissemination of best practice and research outputs [expanded as 2 themes]
2. Prove and inform the business case for the construction industry to contribute to the aims of sustainable development [expanded as 4 themes]
3. Improve the quality and form of information to communicate technical and business data to influence key decision-makers of the benefits of a more sustainable approach [expanded as 3 themes]
4. Understand cultural barriers in the construction industry and what the most effective drivers are for moving the Construction Industry towards Sustainable Construction [expanded as 2 themes]
5. Develop and interpret Whole Life Costing (WLC) techniques [expanded as 1 theme]
6. Develop techniques and strategies to effectively manage the existing built environment and infrastructure into the future [expanded as 4 themes]
7. Understand and use Supply Chain Management to promote the construction industry's contribution to sustainable development [expanded as 1 theme]
8. Inform and influence decision-making processes of construction industry's Small Medium Sized Enterprises (SME's) [expanded as 2 themes]

1.5 Motivation and Communication Task Group Action Plan

Working from workshops and research material, the Motivation and Communication Task Group developed a strategy for improved communications and research uptake for CRISP and its stakeholders. The strategy leads to the set of recommended action summarised in the table below. Each summary action is further subdivided into more detailed sets of sub-actions, of which there are 24 in total. The organisations identified as responsible for implementation are listed against each action.

Motivation and Communication Task Group: summary recommended actions	**Importance**	**Timing**	**Owners**
1. Increase learning and knowledge creation and sharing by developing a learning company approach in construction [6 detailed actions]	1st	This year on long term programme	New CIB and others
2. Improve communication activities by better targeting and specific funding [4 detailed actions]	2nd=	This year	CIB, CIC, CRISP, DETR, EPSRC,

			ESRC
3. Increase the use of intermediaries in communicating research results [3 detailed actions]	2nd=	This year	CIB, CIC, CRISP, DETR
4. Improve the (usefulness of) interaction of people in academia and industry [3 detailed actions]	4th	This year	CIB, CIC, CRISP, DETR, M^{4}I
5. Develop and implement a CRISP marketing strategy and communications plan [5 detailed actions]	5th	This year	CRISP
6. Compare other industries' and countries experience [2 detailed actions]	6th	Medium term	CRISP, DTI, Universities, Research Councils
7. Develop networks between key stakeholders in construction research and innovation [1 detailed action]	7th	Medium term	CRISP, DETR, DTI, M^{4}I, Universities, Research Associations, Research Councils

1.6 Construction research base

This CRISP Topic Area Action Plan is based on the work of its Construction Research Base Task Group. The Task Group was established to review the condition of the construction research base and to make recommendations to the CRISP Awayday in March 2000. The construction research base is the national capacity to undertake research relevant to construction. It covers a wide range of disciplines but the primary focus below is on the main construction professions, i.e. civil engineering, architecture, and building etc. Statistics in this area are unreliable and recent accurate data is unavailable. DETR figures (1996) suggest an R & D income in 1994 of £148m: £54m in academia, £75m in RTOs, and £19m in construction businesses, including consultants.

The Group believes that the manifest misunderstanding between industry and the research base is part of a wider issue - there appears to be no organisation responsible for the health of the research base. It identified the need for a champion to speak both for and to the research base and for a simple document describing it and its achievements. The Group's set of recommended actions are summarised below.

The Task Group's over-arching recommendations are that there should be a champion for the research base and that CRISP should take responsibility for that role. While other recommendations can be taken up individually, it would be desirable that they are part of an integrated whole, co-ordinated by the champion. The Task Group looks to the CRISP Executive to determine how best to communicate these recommendations to the research base and the industry and to ensure their implementation.

Summary recommended actions	Priority	Timing	Actors
1. Develop, agree, and oversee the role of a champion for the research base	1st	This year	CIB/CRISP*****, CIC Research College
2. Improve the quality, relevance and accessibility of statistical data on the research base	3rd	This year	DETR
3. Explore desirability and feasibility of developing a set of KPIs for research organisations	4th	Medium term	CRISP, M^{4}I
4. Encourage companies to develop and focus more beneficial contact with the research base by appointment, for example, of a Director of Innovation	5th	Medium term	CRISP
5. Produce and widely distribute a simple description of the nature, role, activities and achievements of the research base	2nd	This year	CRISP, EPSRC

***** Subject to consultation on new CIB.

2 How the detailed recommendations have been 'mapped' in this document

Section 4 of this report comprises a table or 'map' of the Highways Agency's Research Areas and Key Activities. These were compiled by reference to two information sources:

- The Research Strategy 1998-2001, which was obtained from the HA's web site
- A report on HA Research Objectives and Priorities in November 2000, which was provided directly by the HA.

This latter contained a table summarising the HA's three Research Areas and it is this table (slightly modified) which is used as the basis for mapping CRISP recommendations on to HA Research Areas. Wherever a recommendation from the CRISP Topic Area Action Plans and the CRISP 99/15 report (the six source reports for this report) clearly fits into one of the research areas, it is 'mapped' against that priority in the table. The intention is to present CRISP recommendations in a form to suit the planning needs of the HA.

General recommendations from CRISP Action Plans relevant to HA's support for research have also been mapped as falling within the HA's remit, and are listed in table 4.1.

Table 4.2 presents the results of the mapping exercise:

- Column 1 describes the HA Research Area and its broad objectives.
- Column 2 lists the Key Activities identified by the HA.
- Column 3 contains some examples of research projects identified by the HA.
- Column 4 cites the CRISP Task Group recommendations relevant to that Research Area/Key Activity
- Column 5 lists the CRISP topic area Action Plan reference – so the source of each recommendation can be identified
- Column 6 indicates priorities among the recommended actions. 1 = high priority, 2 = medium priority.

For information, the full set of recommendations from CRISP Action Plans are listed in table 5.2 of the report. Those that do not map onto HA's Research Areas, may nevertheless be of interest to the HA in developing its new Strategy Plan for HA Research.

3 Analysis of CRISP recommendations against HA Research Areas and Key Activities

Table 3.1 (shown at the end of this section) presents an analysis of the CRISP recommendations showing how many of them map on to each of the HA Research Areas.

3.1 Findings and conclusions from table 3.1

First, two caveats. In interpreting table 3.1, it should be remembered that CRISP has dealt with only certain topic areas; and some areas which may be relevant to HA have yet to be addressed. So the present set of CRISP recommendations are skewed towards those Research Areas that lie within the CRISP topic areas addressed thus far. Second, simply counting recommendations in the way undertaken here, gives each of them equal weight. It therefore gives more weight to those Task Groups that made more recommendations. An additional point is that allocating recommendations to Themes is a subjective activity that might be undertaken differently by a different author. For all these reasons, the findings and conclusions presented here should be viewed with some caution.

The findings of the analysis are as follows:

1. Of the total number of 125 recommendations made by the six sources, only 24 (19%) are relevant to the Highways Agency.
2. Of the 24 recommendations relevant to HA, 12 are general recommendations and 12 map directly on to the Research Areas and Key Activities.
3. The remaining 101 do not map onto the Research Areas.

4. In terms of the relevance of each Task Group's recommendations to the HA (again as shown in table 3.1), the percentage of recommendations that map onto the Research Areas/Key Activities is as follows (in decreasing order):

CRISP 99/15 report	32%
Meeting customers' needs	17%
Sustainable Construction	7%
Design	3%
Motivation and communication	0%
Construction Research Base	0%

5. In terms of the Research Areas which attract the most recommendations, these are as follows (in decreasing order):

Research Area 1 Asset Management	10
Research Area 3 Customer & Market Research	2
Research Area 2 Traffic Management	0

The analysis presented in this report implies that relatively few of the CRISP recommendations are relevant to the Highways Agency's current research strategy. There are two main reasons for this – the first concerned with the (self-imposed) remit of CRISP task groups, the second with the apparent focus of the HA research strategy . CRISP task groups have addressed their recommendations primarily towards building construction rather than civil engineering. Many of their recommendations therefore relate to the built environment, but with no emphasis on the trunk road network. Taking the second reason, the Highways Agency's Research Areas and the Key Activities are concerned largely with the road network as a product, with research aimed largely at understanding and improving the performance of that product (for example, smart monitoring, new materials, crash barrier improvements) rather than on the process of design and construction. By contrast, the CRISP Task Groups that have reported to date have focused very largely on design and construction process issues – such as effective communication, interdisciplinary teamwork, application of business excellence models; and on the exploitation of research findings in practice.

When shown an earlier draft of this report and invited to comment, the Highways Agency identified the increasing importance of sustainability as a cross-cutting theme, and recommended that more of the recommendations in the CRISP 99/15 report be show as generally relevant to their programme. They also noted that many of the general recommendations were already being tackled by the Agency in-house. This report has been updated to take account of their comments.

It is to be expected that CRISP Task Groups dealing with components, technology and performance will produce recommendations that are more relevant to the HA's current research strategy. Once these Task Groups report, it will be appropriate to review and update this mapping exercise.

Table 3.1 Summary of number of recommendations against Highways Agency Research Areas

	Total number of recommen-dations from the Task Group	General recommen-dations applicable to HA	Research Area 1: Asset Management	Research Area 2: Traffic Management	Research Area 3: Customer & Market Research	TOTAL MAPPING ON TO HA RESEARCH AREAS	% OF TASK GROUP TOTALS MAPPING ON TO HA RESEARCH AREAS
Meeting customers' needs	23	0	4	0	0	4	17%
Design	39	3	1	0	0	1	3%
Sustainable construction	15	1	1	0	0	1	7%
CRISP 99/15 Report	19	4	4	0	2	6	32%
Motivation & communication	24	4	0	0	0	0	0%
Construction Research Base	5	0	0	0	0	0	0%
TOTAL	125	12	10	0	2	12	-

4 The tables

See Section 2 (above) for how the tables were compiled.

Table 4.1 CRISP Task Group recommendations relevant to Highways Agency in general

CRISP Task Group recommendation	Task Group reference	Priority
Encourage dialogue between sectors to learn from each other's evaluation systems.	Design 2/4	2
Establish 'Quick Response' funding for sectoral project-based research, allowing 'up-front' innovation support on a project by project basis: inception research: design experiment with operational testing.	Design 3/2	1
Provide support for communicating research efforts to all stakeholders.	Design 5/1	1
Demonstrate the benefits of research in a business context and compile a clear roadmap of industry research needs.	Motivation 5/5	1
Compare other industries and countries experience.	Motivation 6/1	2
Investigate US PAIR (Partnership for the Advancement of Infrastructure and its Renewal) as a catalyst for implementing innovation in practice.	Motivation 6/2	2
Develop and adopt mechanisms for keeping in touch with global developments in sustainable construction and wider sustainability issues.	Sustainable construction 3/1	1
Require communication plans for all research bids in business language, to cover target audience and benefits to each. The communication plan should be supported by a high level of experience among staff as in the research work. Similarly all other funding bodies to require a communication plan.	Motivation 2/2	1
Develop objective methods to assess the social impacts of the construction process.	CRISP 99/15 Objective 1, item 2	2
Prove and inform the business case for the construction industry to contribute to the aims of sustainable development – through improved understanding of the business benefits of sustainable construction practices, and industry's financial concerns and motivations.	CRISP 99/15 Objective 2, item 1	1
Understanding the key features of the construction industry and how these enable/prevent sustainable construction	CRISP 99/15 Objective 2, item 3	1
Prove and inform the business case for sustainable development – devise funding arrangements to promote innovative technologies.	CRISP 99/15 Objective 2, item 4	1

Table 4.2 CRISP Task Group recommendations mapped on to Highways Agency Research Areas

Research Area and objectives	*Key Activities*	*Examples provided by Has*	*CRISP Task Group Recommendations*	*CRISP Task Group reference*	*Prio-rity*
Asset Management: efficient asset management, improved value for money through WLC savings and reduced future maintenance. Asset based research also addresses congestion, safety and environmental issues.	Whole life cost (WLC) management Reliability based bridge management	Development of WLC models for bidding and management	Investigate successes and failures at a design level of the PFI initiatives commissioned by government to date, by sector.	Design 2/2	2
			Investigate the influence of supply chain integration on costs of ownership.	Meeting customers' needs 1/2	2
			Promote adoption of whole life costing as basis of procurement decisions.	Meeting customers' needs 1/4	2
			Develop standard system for preparation and presentation of Whole Life Cost data	Meeting customers' needs 1/5	2
			Increase awareness of manufacturers of the need to demonstrate the reliability of whole life costs and performance predictors in relation to international standards.	Meeting customers' needs 1/6	2
			Develop and interpret whole life costing techniques.	CRISP 99/15 Objective 5, item 1	1
			Improved management of the existing built environment and infrastructure into the future – through a mixture of building and infrastructure re-use and refurbishment, including impact assessment of refurbishment on sustainable urban development.	CRISP 99/15 Objective 6, item 1	1
			Materials management – assess the sustainability costs and benefits of off-site assembly, trial standard specifications for recycled materials.	CRISP 99/15 Objective 6, item 2	2
			Develop tools to implement environmental good practice throughout construction industry including Learning by Doing and the application of Whole Life Costing	Sustainable construction 1/2	2
	Smart Monitoring	Crack and Seat – Rehabilitation of concrete roads			
	Safety Improvements	Development of High Speed Road monitoring			
	Development of new pavement materials and techniques	Crash barrier improvements	Use of innovative technologies to minimise resource use.	CRISP 99/15 Objective 6, item 3	2
	Innovation in bridge construction	New bridge strengthening techniques			
	Urban environment improvements	Development of Underground Space			

Traffic Management: Improved level of service provision to road users, including better information. and incremental congestion and safety improvements.	Strategic traffic control	Journey time reliability surveys			
	Tactical/incident control	Driver behaviour at merges under congested conditions			
	Traffic monitoring and traffic information	Automatic incident detection			
	Modelling and assessment	Vehicle tracking using mobile phones			
	Traditional traffic management	Motorway merge/diverge - Controlling capacity			

Customer & Market Research: improved understanding of the transport sector and encouragement of modal shift	Priority lanes and road space allocation Vehicle/ Infrastructure links Study of travel patterns	Influencing modal shift using Variable Message Signs			
	Investigations into modal choice	Factors affecting mode choice on longer journeys			
	Use of industrial by-products	Sustainable development in road construction materials			
	Measures to reduce emissions and their impact	Environmental impact of freight distribution	Improve the quality and form of information to communicate technical and business data to influence key decision-makers of the benefits of a more sustainable approach – through quantified targets/indicators.	CRISP 99/15 Objective 3, item 2	1
			Develop risk management techniques for sustainable construction.	CRISP 99/15 Objective 3, item 3	1

5 Other recommended actions arising from CRISP Task Groups 1999-2000

The table 5.1 summarises the construction-related research programmes of DETR, EPSRC, ESRC and the Highways Agency. Table 5.2 then lists all the CRISP Task Group recommendations from 1999/2000, and maps them against the research programmes of these four funding bodies.

Table 5.1 Research funding bodies and their programmes

	FUNDING BODY AND PROGRAMMES			
	DETR Themes	**EPSRC Programme Landscapes**	**ESRC Thematic Priorities**	**Highways Agency Research Areas**
Source of information about programmes	DETR Construction Research & Innovation Programme: Prospectus 2000	EPSRC Programme Landscapes 2000-2001. Also the IMI Construction as a Manufacturing Process call for proposals, October 2000, and the LINK MCNS Call for Proposals, October 2000.	ESRC Thematic Priorities 2000	Highways Agency Research Strategy 1998-2001 (from HA web-site), plus internal HA report on HA research objectives and priorities, dated November 2000
Programmes, priority areas, themes or research areas:	• New and improved technologies and techniques • Codes and Standards • Business improvement • Promoting innovation and culture change • Construction process • Social impacts • Also: Fast Track	• General Engineering Programme • Engineering for Manufacture Programme • Engineering for Infrastructure, the Environment and Healthcare Programme • Innovative Manufacturing Initiative – Construction as a Manufacturing Process • LINK Meeting Client's Needs through Standardisation	• Economic Performance and Development • Environment and Human Behaviour • Governance and Citizenship • Knowledge, Communication and Learning • Lifecourse, Lifestyles and Health • Social Stability and Exclusion • Work and Organisations	• Asset Management • Traffic Management • Customer & Market Research

Table 5.2 Recommended actions arising from CRISP Task Groups 1999-2000 as they map onto the priority areas of DETR, EPSRC, ESRC and HA

	CRISP recommended action	DETR Themes	EPSRC Programme Landscapes	ESRC Thematic Priorities	Highways Agency Research Areas	CRISP reference	Prio-rity
1.	Develop, agree, and oversee the role of a champion for the research base: mobilise sufficient resources for making appropriate and convincing cases for research funding to funding bodies; collect informed opinion on significant trends and issues in research base; monitor effectiveness of mechanisms to maintain and develop research base; identify and promote opportunities for construction industry to benefit from the contribution of the research base.					Construction Research Base 1	1
2.	Improve the quality, relevance and accessibility of statistical data on the research base.			Economic Performance and Development		Construction Research Base 2	2
3.	Explore desirability and feasibility of developing a set of KPIs for research organisations.			Economic Performance and Development		Construction Research Base 3	2
4.	Encourage companies to develop and focus more beneficial contact with the research base by appointment, for example, of a Director of Innovation.			Economic Performance and Development		Construction Research Base 4	2
5.	Produce and widely distribute a simple description of the nature, role activities and achievements of the research base.		General Engineering			Construction Research Base 5	1
6.	Examine effectiveness of establishing a networking exchange on buildings in use for all stakeholders.	Construction process				Design 1/1	1
7.	Commission scoping studies into existing methodologies for assessing value in buildings.	Social impacts				Design 1/2	2
8.	Examine current cost-in-use studies in practice, their limitations and areas requiring refinement.	Business improvement				Design 1/3	1
9.	Investigate flexibility of building uses, to encourage sustainable design through time, to develop a rating system accessible to owners, users and planners.	Construction process		Environment and Human Behaviour		Design 1/4	1
	Test methods for improving industry's capacity to express its needs – in particular workshops, dialogue, deepening understanding between estranged parties.					Design 1/5	2
	Conduct research into how can understanding of cost, value and worth be improved throughout the project team.	Construction process				Design 1/6	1
	Invite proposals to research and establish Design KPI's from all (construction) sectors.	Social impacts				Design 1/7	2
	Conduct longitudinal research into building performance over time, including historical and contemporary post-occupancy analysis.		Engineering for Infrastructure, the Environment and	Lifecourse, Lifestyles and Health		Design 1/8	2

			Healthcare				
	Integrate building economics into parameters for change on terms understood by all stakeholders.	Business improvement				Design 1/9	2
	Establish appropriate and new ways of approaching post-occupancy assessment			Lifecourse, Lifestyles and Health		Design 1/10	2
	Conduct research into sectoral initiatives to establish design value, with systematic ordering of criteria to assist comparison and respect differences	Business improvement				Design 2/1	1
	Investigate successes and failures at a design level of the PFI initiatives commissioned by government to date, by sector.		Construction as a Manufacturing Process (IMI)		Asset Management	Design 2/2	2
	Integrate urban design into the emerging matrix of building studies.					Design 2/3	2
10.	Encourage dialogue between sectors to learn from each other's evaluation systems.	Business improvement			GENERAL	Design 2/4	2
11.	Commission international scoping comparison of design assessment methods in practice including cultural identifiers (Japan, Holland, Scandanavia)	Business improvement				Design 2/5	2
12.	Commission scoping review how professional institutes in other countries contribute to design awareness and value definition. [also in IMI]	Business improvement				Design 2/6	1
13.	Conduct research into the effective communication of complex processes with trans-sectoral comparisons.					Design 2/7	2
14.	Conduct research into the design values of the demonstration projects offered by industry, including conception, development, construction and post-occupancy stages.	Business improvement				Design 3/1	1
15.	Establish 'Quick Response' funding for sectoral project-based research, allowing 'up-front' innovation support on a project by project basis: inception research: design experiment with operational testing.	Fast Track			GENERAL	Design 3/2	1
16.	Establish connecting feedback loops so studies take effect and are seen to do so.	Promoting innovation and culture change				Design 3/3	2
17.	Raise the profile of Built Environment design within National Curriculum to equal the enthusiasm accorded to the Natural Environment.					Design 4/1	1
18.	Provide public educational support through regional architecture centres as crucibles for change, debate and visualisation.					Design 4/2	1
19.	Commission international survey of educational institutes' initiatives at developing common design language – at primary, secondary and tertiary levels.					Design 4/3	2
20.	Promote education of design professionals in production management with cross-industry placements to fertilise the construction field.		Engineering for Manufacture			Design 4/4	2
21.	Expand education of design professionals to include methods of thinking, ethics, social context, communication, as fundamental		Engineering for Manufacture			Design 4/5	2
22.	Conduct research into obstacles to raising profile and status of Building Services as a career; sustainability champions.					Design 4/6	2
23.	Re-integrate architectural research into the demand led improvement of building					Design 4/7	2

	quality, usefulness and delight; building types, symbolic and aesthetic contribution of architecture are all valuable and sought after.						
24.	Educate current players, encouraging continuing professional education for change and feedback, using trans-disciplinary events and seminars providing specific merit awards.					Design 4/8	2
25.	Provide support for communicating research efforts to all stakeholders.	Promoting innovation and culture change		GENERAL	GENERAL	Design 5/1	1
26.	Investigate inhibitors to team working training during design professionals; 'whole-life' education and illustrate successful initiatives that break this mould.		Engineering for Manufacture			Design 5/2	1
27.	Assess effectiveness of 'learned society' model for inter-specialist tasks and interdisciplinary challenges.					Design 5/3	2
28.	Investigate and monitor institutional (City) inhibitors to client-centred improvement and demonstrate positive alternatives.					Design 5/4	2
29.	Encourage cross-disciplinary learning from other sectors (medicine, manufacturing, psychology)		Engineering for Manufacture			Design 5/5	2
30.	Establish best practice for briefing languages and value-systems by means of successful examples/case studies.	Construction process				Design 5/6	1
31.	Conduct research into effectiveness of establishing a think-tank for industry wide research into design, embracing all disciplines across the asset/revenue divide.					Design 5/7	2
32.	Extend government sponsorship of design champions in the field of the built environment linking CABE, Design Council and regional initiatives.					Design 5/8	1
33.	Encourage EPSRC/ESRC and other key research sponsors to communicate more widely their current support for interdisciplinary research teams, since such teams are necessary to capture answers to interdisciplinary problems.		GENERAL	GENERAL		Design 5/9	1
34.	Encourage research sponsors to develop specific policies for design research to guide and invite the issues raised [by the Design Task Group].		GENERAL			Design 5/10	1
35.	Encourage research sponsors to call for 'outside the box' research into interdisciplinary design issues, with experimental funding outside the conventional research review time cycle, to underpin longitudinal research, encourage short penetrative research commissions that publish and be damned. The industry can provide a wealth of committed individuals prepared to offer valuable support in kind provided their contribution is time limited.	Fast track				Design 5/11	1
36.	Examining point of entry to construction process relative to client satisfaction.	Construction process				Meeting customers' needs 1/1	2
37.	Investigate the influence of supply chain integration on costs of ownership.	Construction process			Asset Management	Meeting customers' needs 1/2	2
38.	Study potential impact of greater standardisation and factory/off-site fabrication on image and appeal of industry, especially to new entrants.					Meeting customers' needs 1/3	2
39.	Promote adoption of whole life costing as basis of procurement decisions.	Business improvement		Environment and Human Behaviour	Asset Management	Meeting customers' needs 1/4	2
40.	Develop standard system for preparation and presentation of Whole Life Cost data	Business		Environment and	Asset Management	Meeting customers' needs 1/5	2

		improvement		Human Behaviour			
41.	Increase awareness of manufacturers of the need to demonstrate the reliability of whole life costs and performance predictors in relation to international standards.	Business improvement			Asset Management	Meeting customers' needs 1/6	2
42.	Expand coverage of existing databases of whole life costs and performance information.	Business improvement				Meeting customers' needs 1/7	2
43.	Research and map sources of [building] defects.	Construction process				Meeting customers' needs 1/8	2
44.	Research application of Business Excellence Model to construction to achieve zero defects.	Business improvement				Meeting customers' needs 1/9	2
45.	Improve definition and benchmarking of client skills.					Meeting customers' needs 2/1	1
46.	Promote the development of defining client requirements.	Construction process				Meeting customers' needs 2/2	1
47.	Examine incentives for providing innovative high quality design.	Promoting innovation and culture change		Work and Organisations		Meeting customers' needs 2/3	2
48.	Investigate the feasibility of establishing a 'virtual learning organisation' to identify clients' dissatisfaction using post occupancy satisfaction evaluation.	Promoting innovation and culture change				Meeting customers' needs 2/4	2
49.	Investigate barriers to the uptake and application of existing research knowledge, particularly management and human factors.	Promoting innovation and culture change		Work and Organisations		Meeting customers' needs 3/1	1
50.	Integrate existing information and assistance sources to provide 'one stop shop' access.	Promoting innovation and culture change				Meeting customers' needs 3/2	2
51.	Investigate the feasibility of establishing a small and occasional client-friendly access route to best practice information.	Promoting innovation and culture change				Meeting customers' needs 3/3	2
52.	Investigate insurance and project funding barriers to the adoption of innovative approaches.	Promoting innovation and culture change				Meeting customers' needs 4/1	2
53.	Examine the impact of risk management and risk transfer policies on integration.		Construction as a Manufacturing Process (IMI)	Work and Organisations		Meeting customers' needs 4/2	1
54.	Conduct scoping study of the barriers to adopting voluntary latent defects insurance for contractors.					Meeting customers' needs 4/3	2
55.	Review, with professional institutions, the function of clients' advisers and changing duties towards clients.	Construction process				Meeting customers' needs 5/1	1
56.	Ensure training and education encourage and support innovation.	Promoting innovation and culture change				Meeting customers' needs 5/2	1
57.	Investigate the management of cultural and personnel issues within procurement teams.			Work and Organisations		Meeting customers' needs 6/1	1

58.	Examine the impact of ICTs and object modelling on the structure of project teams.	Construction process		Work and Organisations		Meeting customers' needs 6/2	2
59.	Commission scoping study to provide more detail about real issues and generate understanding of what is needed for SMEs and others and identify 'owners' who will deliver different approaches. Study best practice in learning and knowledge sharing (including the use of case studies) and promote appropriately.	Promoting innovation and culture change				Motivation 1/1	1
60.	Promote general awareness of the importance and benefits of learning and knowledge creation and sharing.	Promoting innovation and culture change		Knowledge, Communication and Learning		Motivation 1/2	1
61.	Promote the idea of a strategic approach to knowledge and understanding that knowledge is value.	Promoting innovation and culture change		Knowledge, Communication and Learning		Motivation 1/3	2
62.	Promote work to understand how firms can be changed into learning organisations.	Promoting innovation and culture change		Work and Organisations		Motivation 1/4	2
63.	Deepen understanding of how to capture and use project-based knowledge.	Promoting innovation and culture change		Knowledge, Communication and Learning		Motivation 1/5	2
64.	Develop the wider use of independent post-occupancy reviews.	Business improvement				Motivation 1/6	2
65.	Change research assessment process in line with Royal Academy of Engineering recommendations.					Motivation 2/1	1
66.	Require communication plans for all research bids in business language, to cover target audience and benefits to each. The communication plan should be supported by a high level of experience among staff as in the research work. Similarly all other funding bodies to require a communication plan.	GENERAL	GENERAL	GENERAL	GENERAL	Motivation 2/2	1
67.	Provide funds for the synthesis of research outputs and highlight issues from range of sources into a form usable by the construction industry.	Promoting innovation and culture change		GENERAL		Motivation 2/3	1
68.	Commission guidance on how to communicate research findings to meet the needs of industry to demonstrate the benefits and develop new criteria for successful communications.	Promoting innovation and culture change				Motivation 2/4	1
69.	Fund intermediaries to undertake 'user friendly' communication.	Promoting innovation and culture change				Motivation 3/1	1
70.	Co-ordinate more active communication by professional institutions.	Promoting innovation and culture change				Motivation 3/2	1
71.	Develop merchants and DIY stores and channels of communication.	Promoting innovation and culture change				Motivation 3/3	2
72.	Produce case studies of successful interactions.	Promoting innovation and				Motivation 4/1	1

		culture change					
73.	Unbiased research on which types of transfer work best and highlighting success and benefits.	Promoting innovation and culture change				Motivation 4/2	1
74.	Encourage development of networks.	Promoting innovation and culture change				Motivation 4/3	2
75.	Raise awareness and profile of CRISP in industry					Motivation 5/1	1
76.	Act as a facilitator to capture vision of future construction industry and the research required to deliver it.					Motivation 5/2	1
77.	Develop 'learning toolkit' from [vision-of-future research] and promote to firms (CEO, Human Resource managers) and individuals (through professional institutions and journals), thus moving CRISP from being an industry follower to a leader.	Promoting innovation and culture change				Motivation 5/3	2
78.	Repackage to add more business emphasis to CRISP topics and papers.					Motivation 5/4	2
79.	Demonstrate the benefits of research in a business context and compile a clear roadmap of industry research needs.	Promoting innovation and culture change			GENERAL	Motivation 5/5	1
80.	Compare other industries and countries experience.	Business improvement			GENERAL	Motivation 6/1	2
81.	Investigate US PAIR (Partnership for the Advancement of Infrastructure and its Renewal) as a catalyst for implementing innovation in practice.	Business improvement			GENERAL	Motivation 6/2	2
82.	Investigate a broker body to negotiate between researchers and industry (cf US National Science Foundation).	Business improvement				Motivation 6/3	2
83.	Increase the effectiveness of communication and dissemination of best practice and research outputs [for sustainable construction] through improved dissemination routes and communication strategies and practices.	Promoting innovation and culture change		GENERAL		CRISP 99/15 Objective 1, item 1	1
84.	Develop objective methods to assess the social impacts of the construction process.	Social impacts	Engineering for Infrastructure, the Environment and Healthcare	Environment and Human Behaviour	GENERAL	CRISP 99/15 Objective 1, item 2	2
85.	Prove and inform the business case for the construction industry to contribute to the aims of sustainable development – through improved understanding of the business benefits of sustainable construction practices, and industry's financial concerns and motivations.	Promoting innovation and culture change	Engineering for Infrastructure, the Environment and Healthcare	Environment and Human Behaviour	GENERAL	CRISP 99/15 Objective 2, item 1	1
86.	Develop a framework of economic & business assessment methods to assess costs and benefits of sustainable construction practices.	Promoting innovation and culture change	Engineering for Infrastructure, the Environment and Healthcare	Environment and Human Behaviour		CRISP 99/15 Objective 2, item 2	1
87.	Understanding the key features of the construction industry and how these enable/prevent sustainable construction	Promoting innovation and culture change	Engineering for Infrastructure, the Environment and Healthcare	Environment and Human Behaviour	GENERAL	CRISP 99/15 Objective 2, item 3	1
88.	Prove and inform the business case for sustainable development – devise funding	New and improved		Environment and	GENERAL	CRISP 99/15 Objective 2, item	1

	arrangements to promote innovative technologies.	technologies and techniques		Human Behaviour		4	
89.	Improve the quality and form of information to communicate technical and business data to influence key decision-makers of the benefits of a more sustainable approach – through improved stakeholder communications.	Promoting innovation and culture change				CRISP 99/15 Objective 3, item 1	1
90.	Improve the quality and form of information to communicate technical and business data to influence key decision-makers of the benefits of a more sustainable approach – through quantified targets/indicators.	Business improvement			Customer & Market Research	CRISP 99/15 Objective 3, item 2	1
91.	Develop risk management techniques for sustainable construction.	Business improvement	Engineering for Infrastructure, the Environment and Healthcare	Environment and Human Behaviour	Customer & Market Research	CRISP 99/15 Objective 3, item 3	1
92.	Understand cultural barriers in construction industry and what the most effective drivers for moving construction industry to sustainable construction – cultural characteristics of the construction industry	Promoting innovation and culture change	Engineering for Infrastructure, the Environment and Healthcare	Environment and Human Behaviour		CRISP 99/15 Objective 4, item 1	1
93.	Understanding the role of legislation and market forces to promote change (towards sustainable construction)	Codes and standards		Environment and Human Behaviour		CRISP 99/15 Objective 4, item 2	2
94.	Develop and interpret whole life costing techniques.	Business improvement	Engineering for Infrastructure, the Environment and Healthcare	Environment and Human Behaviour	Asset Management	CRISP 99/15 Objective 5, item 1	1
95.	Improved management of the existing built environment and infrastructure into the future – through a mixture of building and infrastructure re-use and refurbishment, including impact assessment of refurbishment on sustainable urban development.	New and improved technologies and techniques	Engineering for Infrastructure, the Environment and Healthcare	Environment and Human Behaviour		CRISP 99/15 Objective 6, item 1	1
96.	Materials management – assess the sustainability costs and benefits of off-site assembly, trial standard specifications for recycled materials.	New and improved technologies and techniques	Engineering for Infrastructure, the Environment and Healthcare	Environment and Human Behaviour		CRISP 99/15 Objective 6, item 2	2
97.	Use of innovative technologies to minimise resource use.	New and improved technologies and techniques	Engineering for Infrastructure, the Environment and Healthcare	Environment and Human Behaviour	Asset Management	CRISP 99/15 Objective 6, item 3	2
98.	Understand impact of IT and societal and organisational changes on building requirements, construction industry practices, and design and construction of buildings and infrastructure ('City of Tomorrow').		Engineering for Infrastructure, the Environment and Healthcare	Lifecourse, Lifestyles and Health		CRISP 99/15 Objective 6, item 4	1
99.	Understand and use supply chain management to promote the construction industry's contribution to sustainable development.	Construction process	Engineering for Infrastructure, the Environment and Healthcare	Environment and Human Behaviour		CRISP 99/15 Objective 7, item 1	1
100.	Understand the impact of domestic construction activities on the UK environment.	Promoting	Engineering for	Environment and		CRISP 99/15 Objective 8, item	1

		innovation and culture change	Infrastructure, the Environment and Healthcare	Human Behaviour		1	
101.	Inform and influence the decision making processes of construction industry's SMEs towards sustainable construction.	Promoting innovation and culture change	Engineering for Infrastructure, the Environment and Healthcare	Environment and Human Behaviour		CRISP 99/15 Objective 8, item 2	1
102.	Disseminate convincing evidence of the business (the business and triple bottom line) benefits of environmental good practice throughout construction industry, recognising the nature of SMEs in meeting customers' needs.	Promoting innovation and culture change		Environment and Human Behaviour		Sustainable construction 1/1	1
103.	Develop tools to implement environmental good practice throughout construction industry including Learning by Doing and the application of Whole Life Costing	Business improvement		Environment and Human Behaviour	Asset Management	Sustainable construction 1/2	2
104.	Develop explanation of 'what is' sustainable construction.	Business improvement		Environment and Human Behaviour		Sustainable construction 1/3	1
105.	Provide information on who is taking effective action with a more effective network of players including champions – examine interaction between the construction industry and key players (planners, utilities, regulators, etc.)	Business improvement		Environment and Human Behaviour		Sustainable construction 1/4	2
106.	Embed sustainability within the core remit of research funders and develop a more effective taxonomy of industry structure to inform decisions about the applicability of sustainability research.	Business improvement	GENERAL	Environment and Human Behaviour		Sustainable construction 2/1	1
107.	Investigate how to achieve maximum leverage within industry to achieve best diffusion of R&D through sector, especially SMEs with housing, repair, maintenance and refurbishment, respect for people and land use planning.	Promoting innovation and culture change				Sustainable construction 2/2	1
108.	Develop appropriate sustainability tests for assessing priorities and research projects. Focus on developing issues and research issues of interest to business, that impact on the triple bottom line.			GENERAL		Sustainable construction 2/3	1
109.	M4I to operationalise and demonstrate the work done by Theme Group and not 'go it alone'	Business improvement				Sustainable construction 2/4	1
110.	Develop and adopt mechanisms for keeping in touch with global developments in sustainable construction and wider sustainability issues.	Business improvement			GENERAL	Sustainable construction 3/1	1
111.	Set up email discussion group and linked web pages.	Promoting innovation and culture change				Sustainable construction 3/2	2
112.	Develop appropriate sustainability tests for assessing priorities and research projects.	Business improvement	GENERAL			Sustainable construction 3/3	1
113.	Develop appropriate sustainability tests for assessing priorities and research projects and develop sustainability index and criteria covering all drivers relevant to all CRISP key priorities and themes. Make sustainability an intrinsic driver behind each priority.	Business improvement				Sustainable construction 4/1	1
114.	Place theme group member on each of the Groups					Sustainable construction 4/2	1
115.	Identify champions for the sustainability agenda.					Sustainable construction 4/3	1
116.	Create new themes on: industry positioning; globalisation and industry structures; respect for people focusing on diversity, equality and quality of life issues for construction staff/employees, end users, and wider communities; regulatory codes;					Sustainable construction 4/4	2

	financial/fiscal theme.						
	TOTAL NUMBER APPLICABLE TO EACH FUNDING BODY	84	27	44	17		