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# Controlled dissemination and uptake of research

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# CONTROLLED DISSEMINATION AND UPTAKE OF RESEARCH

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**Key Words:** Research & Development, dissemination, guidance, uptake

### Abstract

A key theme of the recent review of the joint Defra/Environment Agency Flood and Coastal Erosion Risk Management (FCERM) research programme was the need to do more to ensure a greater uptake of research outputs, both within the Environment Agency and the wider industry. Much has been done to address this in terms of the learning process and the requirements for good uptake. However, achieving consistent success in the appropriate uptake of science findings remains a significant challenge. This paper aims to identify some of these issues and put forward some suggestions for good practice that may help to achieve this goal.

The appropriate use of a 'partnering' approach to the management of science programmes and delivery of science projects is central to successful and timely delivery of science to policy/practice. This approach brings together key end users who are responsible for taking forward the outputs from a study with the researchers engaged in the delivery of the science. It provides a mechanism that can help researchers understand the business context of the research and the optimum approach to communicating key messages and/or tools and techniques. It also helps end users to understand what science can provide and to develop ownership of the resulting products with more confidence that the resulting outputs are appropriate and will work. In addition, with every research project, the individuals concerned (including the scientists involved) all go through a learning process as they:

- develop awareness of science outputs,
- become interested in the output and realise its relevance to real issues,
- understand the findings and commit to implementing them, and finally
- implement and use the outputs within the context of their business.

This process takes time and wherever possible we need to ensure that the groups involved go through the process at the same time and not one after the other. Adopting this partnering approach develops collective knowledge and shortens the uptake time through to the use of research in policy, process or operational work. However, in doing so there is a need to recognise a number of stages within the research process (e.g. scoping, development of “proof of concept”, development of operational tools, and implementation/uptake). Importantly, we also need to be clear that not all research will be taken up across the FCERM industry – it may only have relevance to specific individuals or may feed into some further product. Also the conclusion of the research may be that a particular approach is not likely to succeed or that a hypothesis is incorrect

A key part of the partnership approach to research is the need to ensure careful planning of the way in which we communicate research aims, activities and findings. Experience suggests that research trials, pilot testing and application uptake, for example, can be confused. This runs the very real risk of discrediting perfectly valid approaches because they are used with

inappropriate input data or by users who have not fully understood the appropriate context (scale, data resolution, etc), or simply because trial results are being taken and applied as useable outputs. There is thus a need for all involved to appreciate the role of research and its status at any given time. The partnership approach, if properly implemented, can assist with this by ensuring that the communications plan is appropriate, taking into account wider business processes and protocols and delivering key outputs to the optimum schedule in the right media/language. This requires full engagement of and commitment from the end-user partners and equally, it is incumbent on the researchers to ensure adequate controls are in place so that the risks associated with the communications plan are clearly understood by all concerned. This is particularly relevant in the move from Flood and Coastal Defence to Flood and Coastal Erosion Risk Management where there is pressure to develop and implement quickly a wide range of new or improved policies and practices.

Using selected case examples we endeavour to explore these issues and illustrate how we can effectively manage the uptake process.

## Introduction

The successful dissemination and uptake of research has been a key objective of the Joint Defra/Environment Agency Flood and Coastal Erosion Risk Management (FCERM) R&D Programme since it's inception in 2000. Fostering the implementation and use of research findings is a critical factor in realising the benefits of any applied research programme, and this was recognised in the Flood and Coastal Defence Research and Development Advisory Committee Report (1999) which concluded that "As a guideline,… a minimum of 5% (of the budget) should be spent on managing research dissemination and take-up (about £275,000 p.a.)".

In response to the above, the Joint Programme management structure was designed to promote uptake through the adoption of a thematic research structure that engages with the FCERM community to identify research needs/priorities and to promote ownership and the use of the resulting outputs. In addition, a range of other end user oriented actions were taken from the outset to gather awareness of research needs and generate engagement, including the use of concerted actions and scoping studies to improve the specification of research areas and specific R&D projects. These approaches have proved successful and are still being used today.

**Table 1 Recommendations of the *Improving the implementation and adoption of Flood and Coastal Defence R&D results***

| Recommendation | Current situation |
|---|---|
| 1. Provide specific support for uptake (dissemination, implementation and adoption) of FCD R&D. | In place – both Defra and the Environment Agency have appointed staff specifically for this work and have initiated the publication of "Research News" a key dissemination tool for the Joint Programme. |
| 2. Agree an Implementation Plan for the delivery of each R&D output. | Within both Defra and Environment Agency dissemination options must be considered by the Project Officer/Manager at the outset of a project. |
| 3. Prepare, involve early, and train users for delivery and use of R&D outputs. | This is carried out where appropriate with both Defra and EA outputs, although often via follow on work once a key output has been produced and better awareness of the appropriate uptake routes achieved. |
| 4. Provide R&D Project managers with easy to use guide to R&D uptake– a "Route Map". | This was achieved via the uptake study; however, there are issues for project managers in accessing this guidance currently. See Figure 1 |

| | |
|---|---|
| 5. Enhance techniques and skills used in managing and producing FCD R&D outputs. | This is been promoted via the programme dissemination support officers and the provision of guidance on dissemination activities (e.g. R&D Route Map) and enhanced approaches to project management. |
| 6. Use new information and communications technology (ICT) to assist the uptake processes. | A Joint Programme website has been established to foster uptake and web-based publications have been published. It is believed that further innovation to enrich the understanding of science and its application would delivery significant benefits in uptake |
| 7. Develop improved links between software, models and tools and FCD R&D. | A strategic approach to the development of models for FCERM has been developed, particularly for risk assessment/modelling. This enables modelling of systems and assets at the necessary spatial scales, and the adoption of the appropriate software protocols/strategies will facilitate uptake within the Environment Agency and elsewhere. The Environment Agency flood risk management modelling strategy is also taking this forward. |
| 8. Use demonstration and pilot projects to enhance the R&D uptake process. | This has become more common within FCERM R&D and a number of demonstration activities and pilot studies are currently underway. |
| 9. Provide environment and incentives to encourage mainstream staff to keep up to date with current practice. | In implementing R&D through the delivery of flood risk management the Environment Agency actively promotes membership of CIWEM/ICE for its staff and does provide training on R&D outputs. |
| 10. Develop an improved image for DEFRA and Environment Agency R&D. | It is hoped that this has been achieved over the last 7 years – for example via "Research News", however, it is recognised that more can be achieved. |
| 11. Nurture centres of expertise to provide advice and support services in applying R&D knowledge. | Following a re-structure of FRM within the Environment Agency, the National Centres of Excellence referred to in this recommendation no longer exist. However, the programme continues to use project champions and business users to act as a focus for advice/support in applying knowledge. |

In addition to setting out a programme structure designed to foster engagement and uptake, a review was carried out to identify further actions that should be carried out to improve implementation and adoption of outputs (Leggett & Elliott, 2002). This study (commonly referred to as the "Uptake Study") included a detailed review of current practice/issues within FCERM R&D uptake, good practice in other relevant sectors of industry and developments in communications technology and theory. Key recommendations of the "Uptake Study", are listed in Table 1 alongside a brief assessment of the current situation with regard to each recommendation.

As can be seen from Table 1, a number of steps have been taken following the "uptake study" to improve dissemination (i.e. the passive, general circulation of information to a general audience) by setting up the Joint Programme website and newsletter. Specific support for the transfer of research findings and outputs through the appointment of staff dedicated to this work has been provided within both Defra and the Environment Agency. In addition an uptake "route map" was developed to provide Project Managers with assistance in planning and managing the communication process (Figure 1), (however access to this tool is limited at present and the guidance within it may require updating to reflect recent the current publishing processes).

The Joint Programme has also sought, with some success, to ensure that end users are engaged with projects throughout the research process and also to use dissemination activities and pilot studies where appropriate to introduce new methods to users in a proactive manner. The adoption of a more strategic approach to model development has also been beneficial. This issues faced are relatively common across the spectrum of R&D/Science and there is much we can learn from other industrially oriented research programmes. A key factor in this is that there must be commitment from both end-users and researchers to engage fully – successful uptake is a 2-way process and end-users need to have a culture of continuous improvement/learning (for example via CPD) seeking to use good practice based on the best available science. Alongside this it is also essential that R&D/Science Programme Management proactively manage programmes and engage with end-users to promote this partnership approach.

There are, however, some areas where further improvements could still be achieved.

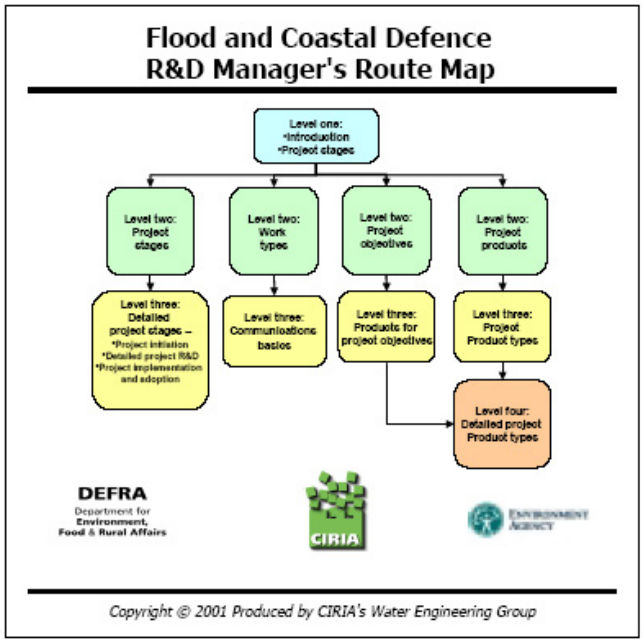


**Figure 1 R&D Route Map**

## Developments in Environment Agency science processes

The Environment Agency has developed and adopted a new approach to science project management designed to deliver improved project planning and delivery. This emphasises the proper identification of project risks, including in the delivery of outputs, and benefits as well as the development of appropriate end-user links from the outset. If a project is to gain approval to go ahead the project manager must:

- Have linked with the appropriate business user from outset as well as a Project Executive who champion the research from within the business
- Identify how the anticipated research benefits will be delivered – setting out the likely outcome of the research, how and where the benefit will accrue, the delivery plan and who owns it. This should be reviewed and developed as the project progresses and adjusted as appropriate

The project management process prompts for information on uptake and the project management structures required to support it. The final outputs are produced and reviewed prior to publication (see Figure 2) and a technical summary provided to guide the use of the report and a dissemination list. This process is designed to ensure that the reports are written to a consistent standard and are in the appropriate format.

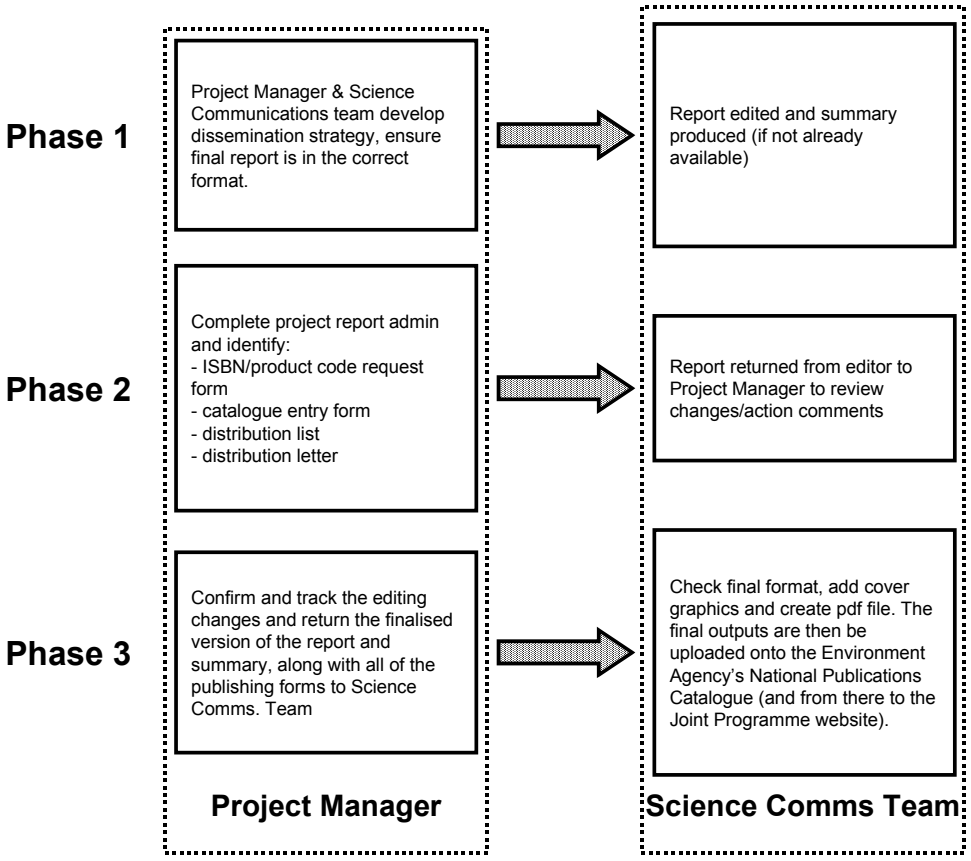


**Figure 2 Environment Agency – Science Publications process**

## Promoting Uptake (What works and what does not)

The increasing demands of flood risk management policy (eg Making Space for Water, Defra, 2004) and the associated appreciation of the improvements in capability needed to deliver this policy (Thorne et al, 2007) are strong drivers for improved tools and techniques. Although innovation and change are widely accepted as prerequisites to improved efficiency and effectiveness, achieving the widespread take-up of new methods and approaches, that appropriately take forward or challenge the status quo, can be fraught with difficulties.

Before new tools and techniques can be successfully delivered into practice a number of steps must be successfully negotiated and progress maintained; with a continued push from the researchers and a sustained pull from the users. Without the development of a long term and trusting partnership between the users and the developers innovations can quickly be dismissed by potential users or poorly focused by the researchers (failing to solve real problems). Central to the success of this process is the pivotal role of informed R&D or science management that

understands both the science and end-user groups.

Experience from a number of projects – from blue skies to applied research – highlights a number of common attributes associated with research projects that successfully pass from initial conception to use in practice as well as some of the barriers. It is important to recognise that the goals of individual projects will vary – and some will have a very limited audience and may not be intended for general uptake. The communications approach must always be tailored to the required outcome. However, some of key issues are discussed below.

***An understanding of the underlying challenge and research need*** - quick fixes rarely work and lead to continued problems and wasted time. This requires "quality time" from both the researchers and the end users if a full appreciation of the science question, its [1] methods and associated tools of NaFRA[2], MDSF[3] and PAMS[4]) provides an opportunity for research outputs to be rapidly and much more easily take up in practice; however for this to happen the researchers themselves must be aware of the form and format of outputs required – a requirement that is often not met or understood.

***An understanding of the research, development and use lifecycle*** - A multitude of funders have a role in bringing innovation into practice. There input may also be dependant on the type of research being carried out (e.g. "blue skies", development of "proof of concept", development of operational tools/good practice) and this also has implications for the uptake route. From underpinning science (for example funded by the research councils), to the more applied interests of the European Community (EC), Environment Agency/Defra programme and in-house programmes through to the operationalisation of the final output by the operating groups. Each funder has an important role; without the appropriate follow through of staff input alongside funding, the final outcomes can be sub-standard – within the conception or delivery. This presents difficult issues of joined up context and how the research will be delivered is to be achieved. This can be (and often is) supported through the use of a specific scoping phase to fully develop work.

***An understanding of the big picture*** - thinking globally but researching locally enable the outcomes to be focussed – there can be a tendency for projects to reinvent the wheel, or for problems to occur in gaining user acceptance, by focusing on broad topic areas rather that the specific issue at hand. Good practice examples include a recently completed project on toe scour where new insight into the process of toe scour. This was provided with a clear appreciation of the use of the new methods in provide better prediction and management of coastal flood risk and clear steps identified for the implementation of the outputs. The use of more structured risk based methods and tools are used (for example the RASP

development and the management of Intellectual Property Rights and the evolution of methods and associated software coding. To date it has been difficult to reconcile the different aims and procurement methods of the different funders and research has been delivered inefficiently, with either repetition or irrelevant research being undertaken. Recent consortia such as Flood*site* (lead by HR Wallingford with support from the EC and the Environment Agency/Defra programme) and FRMRC[5] (led by the University of Bristol with support from EPSRC[6], NERC[7], the Rivers Agency Northern Ireland, Environment Agency/Defra, Scottish Executive and UKWIR) show the willingness of funders and researchers to collaborate. Converting this willingness to synergetic action remains a challenge and probably cannot be delivered without a much stronger acceptance of the need for a central technical coordination and delivery process.

***Clarity of the uptake pathway and research recipient*** – Useful and useable innovation is seldom developed and delivered into practice in one project. Instead it relies on a succession of activities and often a succession of developers. Successful uptake

of research often includes more than one sequential "sub-project" - some underpinning research (where the academics remain true to the science and avoid making ill considered end user tools), development (where innovations are drawn together, extended and made practical, with due consideration to current policy/practice) and operationalisation (where guidance and training support the delivery). The on-going development of a new visual inspection methodology fir the assessment of asset condition provides a good example (see end of Case Study 1). This utilises underlying research from FRMRC I (by the University of Nottingham and HR Wallingford), development and user-trailing at pilot sites within the Environment Agency/Defra funded PAMS project, and implementation within formal Environment Agency AMS (Agency Management System) guidance for operations staff.

## CASE STUDY 1

***Thames Estuary 2100 – Applied research, development and practice – A marriage of convenience***

One of the best ways of promoting take-up is to demonstrate the utility of any new approach in the context of a real place with real issues. The Joint Programme has adopted this approach to assist the uptake of a wide range research across England and Wales including the development of good practice in beach management, managed realignment, and the use of demountable flood defences.

This case study provides an overview of the relationship between:

- the underpinning research within FRMRC I (by the University of Nottingham and HR Wallingford),
- the research and development within the EU FLOOD*site* programme, in particular fragility concepts and failure modes (a consortium lead by HR Wallingford),
- the PAMS project of the joint Defra/Environment Agency programme (led by HR Wallingford with inputs from Royal Haskoning),and
- the operational requirements of the TE2100 project (led by the Environment Agency TE 2100 Project team with inputs from HR Wallingford).

***The demonstration site***

The Environment Agency's TE2100 project team are developing a strategy for the Thames Estuary to take account of the increasing flood risk which could occur over the next century (Sayers et al, 2007, Ramsbottom et al, 2007). Climate change, rising sea levels, ageing of defence infrastructure and new development in the tidal flood plain can all increase flood risk. A strategy to manage the risk is being developed following the principles of flood risk management set out in Government's Making Space for Water strategy (2005) and the Environment Agency's related strategies.

The numbers are startling: initial estimates suggest that the next generation of estuary flood defences could cost £4 Billion, though this is protecting assets worth well in excess of £80 Billion. Good risk management decisions depend on the quality of information about the risks. A major study programme was initiated within TE2100 to collect data, to carry out monitoring and modelling, to predict changes in flood risk both temporally and spatially, and examine the benefits and costs of risk management options. This is being used to develop and appraise alternative strategies for managing risk over the next 30 - 100 years, and to provide a framework for use in further phases of the project and eventual design of management intervention (e.g. opening up space for flood storage, replacing existing defence structures, etc).

***Developing a close partnership between the research team and the user***

From early in the project a close working relationship has existed between the management staff on the Defra/Environment Agency R&D programme and the TE2100 project. This has benefited both with the researchers developing new tools and meeting their research objectives whilst working alongside the TE2100 team which used key research to achieve their own "user

objectives. The joint working is a key example of the benefits of adopting a pro-active management approach both within the R&D programme and the TE2100 team. This has meant that TE2100 has the advantage of new tools and information which have been key to the development of the strategy so far, while the R&D projects have had a ready customer with a clear need, and the opportunity to utilise best science and promising new techniques to meet this national need.

***Bringing together a range of research activities to support the decision makers***

The TE2100 has provided mechanisms to develop and demonstrate a range of improvements. The added value to both the research and practice is tremendous; ensuring that key research outputs from various organisations covering the various issues actually knit together in an integrated and practical way. Some selected elements of the integration of underpinning research, development and practice are discussed below.

- *Changing land levels - national and Thames measurements*

A fundamental factor in planning for the long term future is the rate of sea level rise relative to land levels in the estuary. This depends on two main factors: sea level rise, and changes in land levels. Global and regional climate models predict sea level rise but to get the full picture we also need to know the rate of land movements - and whether land is rising or sinking. We know from geological evidence that the south east of England is generally sinking but the TE2100 team wanted more detailed picture of land movements plus a geological interpretation of available measurements in order to make more informed predictions. Collaboration was therefore established between two projects - a national programme (FD2319) monitored land level changes at tide gauges throughout Britain, with a more detailed a regional study, centred on the Thames estuary, 'nested' within the national study to provide a higher level of detail to support TE2100. This helped to influence the TE2100 monitoring strategy, as well as providing a key piece of information for assessing extreme water levels.

- *Risk assessment for the Thames flooding system*

From early in TE2100 project it was clear that flood risk planning would need to be based on a sound understanding of the estuary and it's various flood risk management components acting as a *system.* Some of the main elements include: fresh water inflows, tide and surge levels, the channel itself, the Thames Barrier and other moveable barriers, fixed defences both upstream and downstream of the barrier, and numerous tide gates, pumps and other components. It is also necessary to consider the possible impacts of flooding including flood inundation, and the people, property and environmental assets at risk.

A comprehensive system model has been developed to be able to answer questions about levels of risk now and in the future, and to assess the benefits and costs of various risk management policies. The model uses Source-Pathway-Receptor approach and is a further refinement of the RASP methods developed under the joint programme (Sayers and Meadowcroft, 2005) and in particular a modification of the High Level Method*plus* used for the National Flood Risk Assessment (Gouldby *et al*, 2007). In practice, it also incorporates several of the advances proposed for the new Management and Decision Support Framework (MDSF2), such as improved flood spreading, developed under joint in-house, EC and Environment Agency funding. It also incorporates much of the thinking behind Performance-based asset management (PAMS). For example the reliability and deterioration of flood defences is modelled using 'fragility curves'. By identifying defences and failure modes responsible for most of the risk (so-called “risk attribution”), we can greatly improve our ability to identify priorities for maintenance and improvements, particularly to make best use of the existing defence infrastructure.

Early stages of this modelling suite were run with a preliminary and, as such, incomplete

or sub-standard data set. The purpose of these stages of the pilot were to demonstrate the concept and illustrate the types of output that could be generated, as well as learning about model performance. Initially, this model output was interpreted by some members of the TE2100 team to be results that could be used on the project. As some of the results were unsatisfactory this led to suggestions that the model was unsuitable and further work was needed to demonstrate that it was not the model but the interpretation of the particular application that was the cause of the problem. This highlights the need to manage the user uptake, demonstration or piloting of research outputs carefully. This is especially necessary when there is pressure for a rapid take-up into key national projects.

- *Condition assessment - improved guidance*

Finally, some research that has already been put to operational use is the development of the new Condition Assessment Manual (CAM) for flood defence assets. The CAM now includes better guidance on taking into account the performance of a defence as well as its apparent visual condition. This was produced as a specific deliverable under the PAMS project. The new guidance was trialled on defences in the Thames as part of the TE2100 project in checking the condition of the current defences. The concept of visual performance indicators, which has been used within the new CAM, was developed under an 'Infrastructure' research project carried out by the Flood Risk Management Research Consortium, led by EPSRC and supported by Defra and the Environment Agency (Long et al 2006 [(1) & (2)]).

## CASE STUDY 2

### The Conveyance Estimation System – translating tools into practice on a national basis

This second case study relates how a successful piece of research on the flood conveyance of channels has taken longer than anticipated to reach the full range of potential end users. The key issues behind this have been the need to make the Conveyance Estimation System available in the optimum manner for different users and the need to work with a range of partners to ensure UK-wide uptake. This has required flexibility in the dissemination process pending the successful testing of the final output and some changes in the approach to delivery that have resulted in changes and delays to the delivery of the tool to some end-users.

In 2000, a network of researchers and users was established by Defra/Environment Agency and EPSRC to examine the use of existing guidance on channel conveyance developed following a major national programme of research from the EPSRC Flood Channel Facility at HR Wallingford (WARK, 1994) and to consider the requirements and justification for further research. The Scoping Study (Escarameia et al 2001) carried out by the network identified little take up of the existing report-based guidance, due largely to the ready availability of software tools incorporating other less robust methods. It recommended a targeted programme for research to develop a new software-based Conveyance Estimation System (CES) to reduce the uncertainty associated with estimating flood levels. The main drivers were the advances in the understanding of flow phenomena in complex river and coastal flood systems; the benefits to users of improved flood level estimation; and the advent of computing power that enables more sophisticated solution techniques. Potential users ranged from strategic flood risk planning to channel managers from across all UK operating authorities, consultants and universities.

HRW led an excellent multi-disciplinary and collaborative research team in the development of the CES. Funding was led by the Joint Defra/Environment Agency FCERM R&D Programme with contributions from the Scottish Executive, Rivers Agency NI and NERC. User representation and trialling was carried out by consultants and operating authorities. The CES development programme started in 2002 and was completed in 2004. The final product was a user-friendly software module for estimating water levels, spatial velocities and boundary shear stresses at river sections as well as undertaking simple reach-based backwater

calculations. The CES incorporates a comprehensive database of river roughness, integrating diverse information from over 700 references (Escarameia et al 2003), including photographs and advice on vegetation cutting and re-growth. The CES formal launch was held in 2004, introducing the new research and associated tools. The system was well received, inluding the user-driven graphical user interface (GUI) based design and functionality, and the various potential users were all keen to have access to the software.

Under the CES contract, HR Wallingford had undertaken to incorporate theCES into the 1D river-modelling package, ISIS Flow which had been identified by the network as the main software tool used by UK users for flood level estimation. This was done in late 2004 and the updated version of ISIS incorporating the CES was provided to purchasers and existing users, including the Environment Agency. This availability fo the CES in ISIS software did not provide comprehensive uptake with a full training/roll out programme because of the identified need by the funders to:

- link the CES with the Afflux Estimation System (AES – for estimating water level difference across bridges and culverts) which was also under development and a national tool, and
- make the software widely available as a stand-alone executable alongside the Afflux Estimation System (AES) as well as open source to bona fide researchers and software houses (Bramley 2004).

It was deemed inappropriate to launch the stand-alone version of the CES nationally, only to replace this soon after with the linked CES/AES version. Unfortunately, the successful development of the AES took longer then planned and the linked CES/AES software has only recently (Dec 2006) cleared user and Environment Agency acceptance testing. The linked CES/AES is now available within ISIS and also accessible for standalone use within the ISIS package. The impetus to deliver this was maintained by the operational “user pull” created by the recent implementation of performance specification for channel management within the Environment Agency. A wide range of EA Flood Risk Management staff now have access to the stand-alone package via ISIS.

The delivery of the stand-alone package to other practitioners, researchers and universities has been more complex than initially anticipated due to their diverse interests. Despite the range of potential users, these were found to be too specialised for commercial software houses to accept the commercial risk of producing a simple stand-alone software package. It is now planned to release the CES/AES stand-alone in 2007 as freely-downloadable executable code from the CES website (www.river-conveyance.net/). The website will be linked with the AES website. A package of funding from users and science funders (including the Defra/Environment Agency Joint Programme) is being put together to support this.

This final stage of the CES/AES stand alone roll-out is now underway, with a clear delivery timetable. It includes a range of activities such as training, maintenance, website development as well as ongoing support and dissemination, including Frequently Asked Questions (FAQs) and provision to make the CES/AES software available as open source (under licence). The CES experience however highlights some of the difficulties in getting good research accepted and into practice whilst managing end-user expectations and meeting the needs of different audiences/organisations. In particular a better shared understanding of the issues faced in rolling out the full system across the UK would have been of use in managing expectations and helping end-users to better plan uptake. These complex issues will be better understood and explained with the publication of the *R&D Software Development Projects - Guidance for Research Contractors* (Defra/Environment Agency[1] 2007) and *Scoping the development and implementation of flood and coastal RASP models* (Defra/Environment Agency[2] 2007) reports.

## Conclusions

The two case studies highlight some of the benefits and risks of trying to promote rapid take-up of research outputs and the adoption of a partnership-based approach to research. On the one hand, application via pilot projects can help to promote collaboration between individual research projects to the benefit of all, and the focus provided by ongoing application by users can help shape the research endeavour. On the other hand, changes to the research being delivered, for example, to improve products and meet the needs of a wider range of stakeholders than initially anticipated can cause unforseen delays and frustration within end-users unless expectations are carefully managed. In addition early results can be misleading and there is a need for continual monitoring and assessment of the outputs, as well as critical review. This helps to ensure that the research outputs are valid, that the research is not being inappropriately used (particularly in the early applications when the researchers themselves may still be learning about and developing the range of applicability of a particular tool or model) and that the necessary checks and balances are in place. If this is to be achieved successfully it is essential that the end-users and researchers are working together properly committing the appropriate amount of time to ensuring the necessary links are developed and maintained.

The process also needs to include careful planning of the uptake process and the management of expectations of both the end user and the researcher. Again this needs to be done on an ongoing basis and not just to provide the information required to get project funding approval. It also helps to identify the appropriate implementation routes including training, support and dissemination and material needed for the different types of end user with their diverse learning styles. For example there may be users who actually work with the tools or models and there are those who have to make decisions based on the outputs, who need to know about applicability and implicit assumptions but do not need to know the operational details. Each group, or even individual, will need information in different formats and via different routes. Understanding the relevant approaches to end-user learning can be a significant part of the effective uptake of research and effective partnering can help to foster this awareness.

In all cases, good communication between the different parties is essential, and the need for good research managers in achieving this is pivotal.

## Acknowledgements

The views expressed in this paper are the personal views of the author and not necessarily those of HR Wallingford or the Environment Agency.

Further information on the Joint Programme and its outputs are available from the Joint Programme Website (www.defra.gov.uk/environ/fcd/research/default.htm) or by contacting Laurie Neal (Environment Agency) or Jule Harries (Defra)

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[1] Risk Assessment for System Planning
[2] National Flood Risk Assessment
[3] Management and Decision Support Framework
[4] Performance-based Asset Management System
[5] Flood Risk Management Research Consortium
[6] Engineering and Physical Sciences Research Council
[7] Natural Environment Research Council

## Fluid thinking...smart solutions

HR Wallingford provides world-leading analysis, advice and support in engineering and environmental hydraulics, and in the management of water and the water environment. Created as the Hydraulics Research Station of the UK Government in 1947, the Company became a private entity in 1982, and has since operated as a independent, non profit distributing firm committed to building knowledge and solving problems, expertly and appropriately.

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