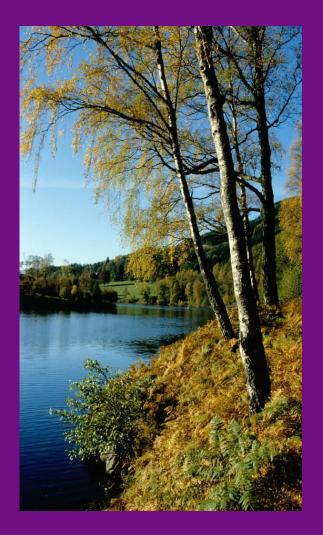**Forest Research**

Uptake of Decision Support Systems in the Forestry Sector in Great Britain

Scoping Report

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Acknowledgements

1. Introduction

1.1 Background

Over the last decade, Forest Research (FR) has been involved in numerous projects to develop Decision Support Systems (DSS) for the forestry and land use sectors in Great Britain and Europe. Many of these have been adopted by the Forestry Commission (FC) and other parts of the forestry sector, and are now integral to the systems of forest management planning and decision making applied throughout Great Britain. However, for some DSS, the level of adoption by potential end users has been lower than expected, which has raised concerns and questions about how this situation arose and how it might be improved.

Within Forest Research, the expectations of some researchers regarding the uptake and use of tools have rarely been met. In an interview conducted for this study, one DSS developer stated that: 'all our models in FR I suppose have had variable uptake… all of them have been disappointing in their uptake' (Interviewee 1). One perspective among those within FC responsible for centrally commissioning DSS is that FC has invested heavily in DSS development in the last 10 years, as have most state forestry departments, yet the 'apparent return on that investment has been patchy… real return, the <u>impact</u> of using DSS on management decisions is not known. We need to improve' (FC 2009). This situation has emerged often in spite of a shared perception among researchers and end users during commissioning and development of a tool that it would provide useful knowledge for decision support.

Such perceptions are not restricted to FC. A growing body of academic literature has identified and analysed reasons behind perceived gaps between DSS design and use, or between modellers and end users, across a range of software and tool applications within and beyond the environmental sectors (Diez and McIntosh, 2009; Jakeman et al., 2006; McIntosh et al., 2005, 2009; Nilsson et al., 2008; Stephens and Middleton, 2002). The causes of the problem have often been analysed primarily in terms of the quality of stakeholder engagement during DSS development. Thus, based on experiences of several projects and a literature review, McIntosh et al. (2009: 41-43) propose the following good practice guidelines for involving users in development:
1. know the capabilities and limitations of DSS;
2. focus on the process of DSS development rather than the product;
3. understand the identity, roles, responsibilities and requirements of end users;
4. work collaboratively with key stakeholders, and
5. build and maintain trust and credibility

In February 2008 a meeting was held at FR to discuss the production and implementation of a range of DSS that had been developed by FR or were then under

development. The meeting involved representatives from relevant sections of the Forestry Commission operating at GB level: FR; Corporate and Forestry Support, Operational Support Unit, GB Planners Group, the Forest Management Officers Group, and Learning and Development.

The following key points emerged from the discussion:

1. Clarity was sought regarding **strategy and process** by which DSS are conceived, commissioned, developed, implemented and maintained, including the role of user groups, steering groups and champions.
2. Clarity was sought regarding **product type**, in particular whether the DSS was to be implemented as a stand-alone product, a product that could be embedded in existing corporate systems (e.g. Forest GIS), or retained by FR to run as a bespoke consultancy service.
3. The **potential new uses** for individual DSS needed to be explored in discussions of FR teams and users, perhaps by user/steering groups.
4. **Data dependencies** needed to be resolved, due to the mismatch between data availability and requirements to run assorted DSS.
5. While most DSS had been developed with input from a range of users (through formal user/steering groups and/or testing), and their use supported by training, **linkages between developers and the user community** needed to be maintained after development, not least because of staff transfers and organisational change.
6. There is a need to provide ongoing maintenance and servicing of products after they have been made widely available.
7. A shared understanding of the **culture and terminology** of developers and users was required and could be achieved partly through greater frequency of contact (FR 2009).

After the meeting, a working group was formed to focus on the first of these points, i.e. the strategy and process for the commissioning of DSS development, implementation and maintenance by the Forestry Commission, a task which is currently in progress.

In mid-2009, a social research project was initiated which seeks to address key governance issues identified during the February 2008 discussions, and the broader question of how to enhance uptake and usefulness of DSS developed by FR. The research is being conducted by the Social and Economic Research Group (SERG) of the Centre for Human and Ecological Sciences (CHES) of FR. This document reports on the scoping stage as a basis for more focused and in-depth social research. A workshop will be organised in 2011, which will act as a follow-up to the one held in 2008 and will report on and discuss research findings as well as identify next steps.

1.2 Objectives

The aim of the study is to support and enhance the development, uptake and usefulness of existing and new DSS for UK forestry by carrying out social research with end-users and other stakeholders, and identifying areas of potential improvement, with particular focus on DSS developed by FR and commissioned by the Forestry Commission.

Specific objectives are to:
- Improve understanding of the factors affecting DSS uptake, especially those relating to the institutional/governance/policy context in which DSS are developed and applied.
- Use this understanding to learn from both positive and less satisfactory experiences, to inform the future development and implementation of DSS tools.
- Advise on the strategies and processes whereby DSS are conceived, commissioned, developed, implemented and maintained by FC and other forestry sector stakeholders.

1.3 Scoping work

The scoping stage involved semi-structured interviews and email correspondence with nine key stakeholders within the Forestry Commission, supplemented by a brief literature review. Interviewees were selected on a purposive basis, and included: one forestry DSS commissioner/customer/funder at the GB policy level; six DSS developers within Forest Research, and two Forestry Commission users/customers – one at country level and one at district level. These interactions took place between August and October 2009. The interviewees are all referenced anonymously in this report as agreed at the time of interviewing, which ensured more candid responses were gained.

It was decided to focus the scoping study on the Forestry Commission to try to understand key issues for this important customer in sufficient detail before attempting to broaden the research agenda to include non-governmental agencies.

The structure of this report is as follows. First we discuss our findings relating to the potential future value and application of DSS to the forestry sector in Great Britain. Second, we examine the barriers to uptake of DSS identified through the scoping interviews. Third, we consider the proposition that only by making the use of DSS mandatory can high uptake be ensured. Finally, we conclude by identifying key steps for the remainder of the project, including a protocol for selecting DSS (Appendix 1), a list of proposed interviewees (Appendix 2) and a proposed interview schedule to be used during subsequent case study research (Appendix 3).

2. The potential future value of DSS to the forestry sector

There are many context-specific ways in which DSS enhance, or could potentially enhance, the forestry sector in Great Britain. This section focuses on overarching issues raised by interviewees regarding the current and future role of DSS. Overall, they indicate that the potential application for DSS is growing, due to changing policy agendas which incorporate multi-purpose forestry objectives, adaptive forest management strategies and climate change concerns. However, these same agendas may also pose threats to the applicability and value of DSS.

Increasing demand for DSS to support evidence-based policy

With the prevailing focus on sustainable, multi-purpose forest management since the Rio Earth Summit in 1992, forest management decision-making has become increasingly complex since it engenders the integration of environmental, social and economic concerns and places greater emphasis on the need to involve a range of stakeholders, taking into account competing views and demands and incorporating public participation (Lawrence and Stewart, 2010; Sheppard, 2005: 1515).

As a result of this, there has been a growing call for evidence-based policy, and for DSS to help provide this evidence in a user-friendly format. A number of interview respondents felt that DSS could prove useful in this respect. One DSS developer (Interviewee 1) argued that, 'Just giving… people's best advice based on experience is no longer good enough… we need to have systems which use evidence-based science to provide the answers they need'. One DSS country-level customer (Interviewee 2) concurred, stating that DSS can help at the strategic level when diverse groups are being consulted with 'because it helps manage complexity'. He added that:

> '… you've got really competing, conflicting, dynamic situations happening on a big estate and you need to be able to react… in a way that you can get as much evidence-based information [as possible]… the arguments move quickly but we don't make the changes on the ground quickly so what we need is the ability to sensibly start discussions and debates without feeling we are forced… you need tools that can respond to that dynamic so you can plug in scenarios… That's the kind of decision support tools that are really, really helpful.'

Greater uptake of DSS by the private sector

However, one developer (Interviewee 3) suggested that the private sector have perhaps been quicker on the uptake of DSS for this purpose: 'the private sector… seem to be more willing to use the tools to fight their cases' and provide some evidence basis for their decision-making. Another DSS developer (Interviewee 5) observed that the private

sector has taken on board DSS tools to a much greater extent than the Forestry Commission, and added: 'and yet the Commission was supposedly leading sustainable forestry… how can you be leading sustainable forestry if you're not using the best available evidence?... how can you be claiming to be making the best decisions if you're not using the best available tools.'

DSS development may not keep up with rapid changes in policy and business
As mentioned above, the context in which sustainable, multi-purpose forestry occurs is dynamic and policy agendas can change quickly. While DSS can help provide an evidence-base for decisions, changes in policy can also render DSS redundant or out-of-date. For example, one developer (Interviewee 3) stated that 'Sometimes business practices overtake decision support tools… this is something that is going to become an issue with decision support systems and models in general… the business changes its mind quicker than we can respond'. One of the examples he gave was that 'We are just getting to grips with [modelling] homogenous, even-aged stands' but demands are being made for modelling mixed species stands with different age structures. 'There is always a feeling that systems are slightly out of date… We are always on catch up' (Interviewee 3).

There are new demands for DSS to help managers respond to climate change
One of the competing demands that foresters have to deal with is a result of the growing perception that forests need to play an essential role in climate change mitigation and adaptation (Lawrence and Stewart 2010). Ogden and Innes (2007: 728) argue that the uncertainties associated with climate change may have discouraged managers from incorporating climate change into forest management plans, but that DSS may be able to help with these efforts if they can build into them an acceptance of uncertainty and integrate forest management models with climate change models. However, one developer (Interviewee 6) suggested that 'trying to climate proof' existing DSS was an 'intellectual challenge' because 'they are based on field experiments in current or past climate scenarios' and would either have to be incorporated with 'very broad assumptions' about climate changes or be based on 'proper process based modelling' of which the capacity is low at present.

DSS can support certification
Beyond dealing with various competing demands on forests, it was also noted that DSS can prove useful in terms of providing an evidence basis for certification: 'It's there to back you up for an UKWAS [UK Woodland Assurance Scheme] audit' and help justify your decision-making (Interviewee 4). Similarly, a DSS developer (Interviewee 6) stated that 'I think probably as we go towards certification and having carbon standards and these kinds of things, there is much less scope for what you might call a sort of intuitive forester… I think the climate is that there is going to be much more requirement to justify how you arrived at a decision' and DSS could help provide this justification.

3. Barriers to uptake

We have heard how the demand for DSS within the GB forestry sector may be on the increase. However, on the whole, their uptake to date is lower than has been hoped or expected. This section explores some of the reasons for this, including cultural and historical factors, communication shortcomings, the corporate delivery context within the Forestry Commission, problems relating to meeting business demands and requirements, poor consolidation of DSS and a lack or adequate training and ongoing support.

3.1 Cultural resistance to DSS: foresters vs. scientists

DSS may challenge values that underpin decision making
A possible cultural barrier to the implementation of certain DSS was put forward during one interview. It was suggested that some foresters may find it difficult to accept particular DSS because they encourage or force decision makers to consider non-market aspects, whereas in reality forestry decision making is primarily about financial returns: 'no matter what people say about multifunctional forestry and sustainable forestry, at the heart of what happens on the ground is how much money it's going to bring in, how much volume you're going to get, whether you're going to meet your volume targets, that drives everything'. Of relevance here, Borchers (2005) argued that 'infusion of a technological innovation into organisations is determined largely by a trade-off between its compatibility with existing values, past experiences and needs, and the relative advantage of the innovation over that which it replaces'. It appears that some DSS can challenge the value that underpin decision making.

Lack of trust and understanding between forest managers and scientists
Another important barrier, raised by various respondents, was the perception of a persistent state of distrust between different types of 'experts', in particular between scientists and foresters, brought about largely by a lack of understanding of mathematical models by foresters, and of user needs by modellers.

DSS may be seen to impose solutions and suppress creativity
A DSS user at the forest district level (Interviewee 4) maintained that, 'foresters who have probably been in the job for a long time think that they know more than the system can tell them'. He added that a lot of planning foresters see design planning 'as being a creative process… and… they see themselves being pinned down by decision support systems'. The effect is that 'it's taking their creative edge off'. This 'creative edge' is similar to what another interviewee (6) described as a characteristic of 'the intuitive forester'.

One developer (Interviewee 1) argued that the problem was not specific to the Forestry Commission and that the wider public also 'mistrust' models and the DSS based on them

because they have a 'lack of understanding… about what models are' and prefer to 'trust experience'.

Foresters may dislike the uncertainty associated with certain DSS

This relates to the inherent uncertainty built into DSS, the models they are based on and the decisions which they may point the user towards. According to the same interviewee (1) this uncertainty causes 'a problem within FC because foresters… like to know exactly what to do, when and where and they don't like these sort of fuzzy edges around decisions… If you put uncertainty into there it makes it uncomfortable'. Put simply, 'Foresters… like absolutes' (Interviewee 1).

Other foresters see DSS as providing absolutes which threatens professional judgement; DSS need to be better understood as decision support

Conversely, another concern raised was that some foresters may feel threatened by DSS and feel that their expertise is being rendered redundant by their use because of a belief that they do provide absolutes and that they run counter to professional, site-specific decision-making. As one developer, (Interviewee 5) stated, 'people do feel threatened by [decision] support, the number of times we've had to emphasise these are decision support, so it's helping you make the decision and not decision making'. Similarly, a country-level customer (Interviewee 2) maintained that 'I think perhaps there was a presentational issue in the past and maybe the decision part of the DSS is the bit that made some forest managers uncomfortable. People are very wary of computer systems that make a decision on the ground, but of course they are not designed to do that'.

3.2 Communication and FR/FC linkages

Improved communication is needed on how DSS fit into decision making

The issue of presentation raised by Interviewee 2, above, is part of a wider 'communication' problem that cuts across the themes discussed in this report. For example, one case was reported where a scientist repeatedly used an unnecessarily high level of detail when presenting a DSS to customers, and discussing its capabilities. Indeed, according to one Interviewee (5) 'there was a key point where the whole programme nearly got closed down because that level of detail had entered into some people's perception and they just decided it was unworkable'. A DSS customer at the country-level (Interviewee 2) argued that people need to be able to 'actually understand how it can help in their job' and perhaps 'an education process' is needed. Similarly, one developer (Interviewee 3) noted that people 'need to know how it fits into the business process' for uptake to be successful. These aspects relating to how the DSS would fit into the decision making process may prove to be more important in discussions with potential end users than seeking to communicate every aspect of the science behind the models.

There is uncertainty over who is responsible for DSS delivery

Another barrier to higher levels of DSS uptake appears to be an uncertainty over whose responsibility it is to make sure that DSS become embedded in corporate structures. As one developer reported (Interviewee 1):

> 'Its always been one of the problems at FR that we have a bunch of scientists here developing systems to help forestry but scientists aren't very good at the next stage of how to embed their things in other people's systems and a lot of them don't really see it as being their job or something they know how to do or have the skills in. It's the next step, it's critical actually to getting things adopted but we don't always actually do that.'

Likewise, another developer (Interviewee 7) stated that while he had driven the DSS through development, 'I have often felt that somebody else ought to be working with me to deliver that to the [forest] enterprise'. Similarly, another FR developer (Interviewee 6,) reported that 'Within my centre we have a kind of rule of thumb that FR's role is up to the point of doing a pilot project but it's not FR's role to do the operationalisation of a product, but that's not universally agreed, it's not written down.'

Developers may not feel comfortable with the role of publicising DSS

A related issue is that there is no clear system for communicating with FC business about new and existing DSS, and developers can find identifying and compiling a suitable means of communication difficult because it isn't necessarily their area of expertise or something they feel comfortable with. For example, one developer (Interviewee 1) stated that 'publicity within FC I find quite difficult'. Upgrades of existing DSS are produced but there is no obvious or accepted best practice way to communicate this to potential users. One option is to utilise the various electronic newsletters which exist. However, there is a problem of information overload and as one developer (Interviewee 1) put it, 'we don't want to inundate people with bits of information about our different decision support systems' within FR. As a solution, it was suggested to this developer that rather than use electronic newsletters to communicate news about just the DSS he was working on, something should be compiled which described all the DSS available: 'At which point I just get stuck, I just can't do that so it doesn't necessarily happen… It would have to be regular as well because… a lot of people won't read [a one off article and]… the staff change is quite fast… somebody would actually have to think about this every year maybe.'

Informal communication links between FC and FR have declined in recent years

Respondents also raised concerns about the historical decline in linkages and communication between FC and FR which make it more difficult for FR to 'sell' DSS to the FC. In the past foresters undertook a five year 'tour of duty', in which they were

encouraged to spend time in a specialism such as research. This helped to build connections between FR and FC. As one respondent (Interviewee 2) explained:

> '… you would basically have foresters going into FR for five years and coming out. So they would bring all that contact and all that knowledge of what was going on [in FR back into FC] but you don't get that same flow going anymore. So you have to work at the communication thing an awful lot more because it doesn't happen naturally in the way it once did. I still think there is the same willingness and I think there is the same desire for research. I just think... it used to communicate very naturally whereas now it has be to much more formally done, but that means you have to then be clear about what it is you want the tools to do.'

The last sentence in the quote above links to the discussion below on the need to identify the full range of potential users for a DSS and its full range of application to ensure uptake and use.

According to one interviewee (2) the decline in the tour of duty, and the links it engendered between FR and FC, was compounded by the historical decision to make FR a 'stand alone entity… encouraged to try and generate revenue', rather than a department within FC as it had previously been, a move which 'created this disconnect' between the FC who were traditionally the 'principle customer' and FR. From a different perspective, another interviewee (5) described the problem thus:

> '…we've had devolution, breaking up structures and prior to that it was also the agency construction where the Forestry Commission got split into FE, FA and FR… for a while that really was a case of "if it's not invented here, we're not interested" and definitely between FE and everybody else, so… some of that legacy is lurking'.

While communication and linkages are reported by some respondents to be improving again, this discussion indicates that considerable attention needs to be given to formal, structured communication between FR and the FC around DSS if they are to achieve high uptake within FC, since the informal communication networks and methods of the past have changed and arguably no longer function as effectively (Interviewee 2).

DSS uptake can be enhanced through the activities of 'champions'
One mechanism that has been used in the past to communicate to the sector about DSS, and raised by some respondents as a potential means of improving DSS uptake, was the use of 'champions' whose role it is to promote a particular DSS within the forest industry. One developer (Interviewee 6) observed of one DSS that developers had recently established dialogue with some of the 'influential cross-country groups, like GB planners [and]… the HMOs' which had helped establish 'a sort of champion who is taking ownership of rolling it out' which other DSS had not benefited from.

Another developer (Interviewee 9) argued that another DSS referred to by Interviewee 6 had had a high-level steering group on which 'there were the kind of people who could take on the responsibility of directing the role of [the DSS]... within the business of the Forestry Commission' as well as the private sector (the steering group included one senior director from one of the largest private forest management companies). In this case, the use of champions failed to increase uptake. One developer (interviewee 5) surmised that this was probably partly because some staff had moved into different roles. Another reason relates to the discussion above about devolution. The Steering Group included senior managers at GB level, yet, as one interviewee (5) reported, with devolution, 'any structure that would allow [them] to say this is the tool we are going to use in Forest Enterprise across the country... and... we'll embed it in the software, just disappeared'.

Another developer (Interviewee 7) maintained that champions were a good way to ensure that feedback from the industry to the developers could take place in a structured way: '*There has to be feedback from the industry to those champions and a way to channel that information back to the people developing the system... it seems to me that a small group of champions that have links to organisations that are trying to develop the system would be very advantageous*.'

3.3 Corporate delivery context

Another reported barrier to uptake is associated with tensions within the corporate delivery context in FC, in particular relating to the linkages between DSS developers and the FC's centralised Information Services (IS), previously known as Business Services Division (BSD) and Inventory, Forecasting and Operational Support (IFOS).

3.3.1 Information Services

Integration of DSS into corporate systems is seen by some developers to be hindered by resistance, software incompatibility and lack of expertise within IS
In terms of the context in relation to IS, one developer (Interviewee 3) said that there were 'a whole host of hoops to jump through' for IS to consider integrating any DSS into corporate systems, even though the DSS were not usually 'systems of significant scale'. A DSS commissioner (Interviewee 8) suggested that in one case there had been difficulties and time delays in development because IS had not been able to provide a platform for the DSS and were not able to support it.

Similarly, referring to a different DSS developed by FR, another developer (Interviewee 5) maintained that it had not been possible to integrate it into the corporate systems because of resistance from 'the gatekeepers of those corporate systems' and because 'the software versions they were running' were incompatible. Discussing the same DSS,

another developer (Interviewee 9) felt that IS had not wanted to integrate it into the corporate system because they did not have the expertise to maintain it, fix any problems with it, and provide advise on its use 'because it's a very complex system, set of programmes and routines'. Interviewee 5 summarised the situation by asserting that: 'there is definitely a tension between this drive to be innovative and package knowledge in new ways and then the ability of the corporate systems to then accommodate that knowledge'.

There has been a failure to include those responsible for delivery in early stages of DSS development
Another developer (Interviewee 6) suggested that part of the practical solution should be to consult with IS earlier in the process of DSS development: 'where we have gone wrong in the past is… what I don't think we have done is include the people who would be responsible for delivering the products. So we haven't included information services like BSD… sufficiently early.' The respondent added that 'it's not just the users we need to engage with, it's the delivery mechanisms' because we need to understand the corporate context.

3.3.2 Inventory, Forecasting and Operational Support (IFOS)

There is disagreement and uncertainty over whether DSS should be incorporated into 'Forester'
Another issue is whether or not DSS developed by FR should be integrated into 'Forester GIS' (or 'Forester'), the main forest management information system used by the FC, and developed and supported by IFOS. Members of both IFOS and the wider FC have suggested that inclusion of FRs DSS in Forester GIS would help to improve uptake but some FR DSS developers would prefer DSS to remain under the control of FR and be delivered from FR. It has been suggested that the legitimacy of IFOS, as a unit with a GB-wide remit operating within the wider context of devolution, may be strengthened by further integration of DSS into Forester GIS. Conversely, it could also be argued that developers at FR may wish to deliver DSS directly to help bolster their own position and profile, and that of FR as an organisation.

Regardless of these suppositions, when Forester GIS was first developed there was some indication by members of IFOS that although its main function was to run the production forecast, there was an aspiration for it to include a range of models, including some DSS created by FR. It was later decided at a strategic level that the organisation couldn't afford to include these additional models. One developer (Interviewee 5) suggested that a 'real squeamishness about big investment' in this kind of technology was probably a factor in this decision and ultimately this 'constrained investment in Forester' has 'as much as anything, constrained their [IFOS's] ability to pay for embedding other systems' into Forester such as the DSS developed by FR.

However, the interviewee (5) also argued that, regardless of financial constraints, the way in which Forester GIS was designed has limited the potential for the inclusion of other models and systems in the future: 'what they never did in producing Forester was scope where they might be needing to go [in the future] so it was done just to deliver' the production forecast. The interviewee also gave the example of Windthrow Hazard Classification (WHC), a DSS which had been incorporated into Forester, and noted that FR had only found out that it was to be included at a very late stage: 'we knew that [WHC] didn't work and we were replacing it' with ForestGALES but 'they [IFOS] were hard-wiring it [WHC] into Forester and… they were… not building in any kind of architecture that would allow changes into the future' without significant costs attached.

Developers may find it difficult to keep up with the latest demands from users
This also links to the fact that technology moves on quickly and sometimes DSS developers struggle to keep up. One DSS developer (Interviewee 1) noted that when ForestGALES was first developed, the developers had established through the user group that 'the user-face that people wanted was a simple Windows screen' but with the introduction of Forester 'almost immediately we found that… people started working on GIS systems… so immediately we are battling against change'. He continued: 'the industry moved on fast and the FC moved on fast' and the ForestGALES developers were left 'trying to catch-up' because they had not been informed that this change was coming and that, certainly within the FC, there was a preference among forest planners for DSS to show results spatially, using GIS.

The points raised above indicate how problems with communication, in this case on the part of both FR and IFOS, have hindered development and implementation of DSS and their incorporation into corporate systems.

One developer (Interviewee 3) confirmed that 'there are moves afoot' to remedy the situation and incorporate a spatial component into DSS, although the main problem lies with the availability of data: 'if they want spatial landscape scale analysis, it's not really a decision support system issue, it's a data collection and management issue […] people have got to appreciate the costs, not only in software terms but in the fact of the amount of data that is going to have to be collected.' Furthermore, he suggested that further down the line, 'there will be a revolution and a lot of these tools that we are using at the moment like Forester… will become more web-based, and my question is, is it worth investing now for something that in two or three years time we will do again?'

Separate governance structures for development of 'Forester' and commissioning of DSS
Another related problem that was highlighted during the interviews was that there is now also an organisational or structural barrier to the integration of DSS into Forester, because at the moment there are two separate governance structures for the

management and development of Forester and the commissioning of DSS. One the one hand, most forestry-focused DSS are commissioned and funded through Programme Advisory Groups (PAG) and, on the other hand, IFOS and therefore Forester are governed by a Service Board. If FR were 'to design and implement a decision support system' that was integrated into Forester it 'would require those governance structures to in some way have some handover, handshake or some consistency of prioritisation' but 'it's not at all clear there's any mechanism in the countries for doing that'. The 'PAG reps are often [from] a very different part of the organisation from the IFOS Service Board'.

Reasons for not incorporating DSS into 'Forester' include its dependence on the sub-compartment database and its minimal use by the private sector

As previously mentioned, many DSS developers within FR are not keen on the idea of all DSS being delivered through Forester although it is conceded that 'it's useful if a lot of them do work with Forester' (Interviewee 1). In other words, most DSS developers recognise the need for their systems to be compatible with Forester but not necessarily the need for them to be delivered through Forester. The reasons given for this include the fact that they do not want to loose control over making changes to the systems (Interviewee 7). Secondly, 'Forester depends on the sub-compartment database' which is 'deeply flawed' and 'you can't rely on the data that's in it […] plus there are a lot of complexities about forest stands which can't be reflected in the sub-compartment database (Interviewee 1). The same interviewee (1) added that 'FR is here to support the whole forest industry and not just FC' and that Forester is 'not a system which is widely used in the private sector'. On this last point, one developer (Interviewee 6, 2009) argued that:

> '…the remit [of IFOS] has changed and I'm not sure they have actually taken on board the fact that they are also responsible now for delivering to the wider sector. They are not just delivering it back to Forest Enterprise, although a portion of their funding comes from Forest Enterprise. They now are truly responsible for roll outs to wider sector. So I think their role in delivering decision support systems should have changed subtly.'

3.4 Meeting business demands and user requirements

Uptake of DSS depends upon the extent to which they satisfy a business need

Alongside concerns regarding the corporate context through which DSS may be delivered, one of the obvious factors behind DSS uptake it's the extent to which there is a business demand for them and they meet business and user requirements, and don't just exist as a means for researchers to gain more funding. As one developer (Interviewee 5) noted, 'decision support tools and expert systems and decision support systems were in a way the rage' at one stage and 'if you looked at what the EU were

asking for in their projects, decision support was one of the kind of buzz-words of the era.'

A DSS customer and commissioner at GB-level (Interviewee 8) suggested that 'the critical thing is there has to be a demand for them'. This interviewee (8) added that sometimes meeting business needs can be about ensuring a DSS is delivered in a timely manner when the industry needs it most. Furthermore, this interviewee also noted that there has to be an 'ease of understanding' when using them and they must not become 'too complex' or 'over-developed and therefore unwieldy'. Similarly, a developer (Interviewee 7) suggested that 'the most important thing is the practicality of the system in terms of its importance to the industry in general'.

3.4.1 User groups

User groups can help ensure DSS are developed to meet customer needs
One of the main mechanisms that has been employed to help integrate DSS into the FC business and ensure they meet user requirements has been the establishment of user groups. All the DSS developed within FR appear to have involved the establishment of user groups in some form, which is encouraging from the perspective of ensuring the product is fit for purpose, meets customer needs, is applicable to the real-world jobs being undertaken in the industry, is easy to use and in terms of providing 'champions' of some sort to take the DSS back into the business and explain its benefits, show others how to use it and so on. However, some criticisms and concerns have been levelled at these groups.

User groups need to be able to communicate effectively with scientists, and have a stable composition
One such criticism was that users may not always feel able to openly criticise or discuss perceived flaws in the DSS because they feel intimidated by the scientists who are developing the tools (Interviewee 3). Another concern was that if the user groups are relied upon as a fundamental vehicle for embedding the DSS in the forestry sector, and in particular within the FC, then this may prove unsuccessful because of staff turnover and the fact that members of user groups will often change posts (Interviewee 3).

User group membership needs to reflect the full range of users and stakeholders
Another issue raised was their representativeness in terms of the potential user base and 'that user groups in the past might not have had the right people' in them (Interviewee 3). For example, while user groups have to remain limited in size to some degree or they become unwieldy, one interviewee (3) suggested that perhaps user groups in the past had been 'overly skewed to the FC' with usually only one private sector participant on the user group for each DSS, even though the private sector seem to be using DSS far more than the FC. A DSS user at the district level (Interviewee 4) also noted the

differences between districts and their needs: 'if you take Scotland quite simply as a country and look at the districts there are very big variations in the challenges that each district faces'.

One respondent (Interviewee 3) argued that the way in which user group members were chosen was also often problematic with not enough consideration being given to who should be involved. Rather than having 'a certain specification of user' identified for involvement, the process was often far more abstract and left to certain individuals within the FC to suggest possible candidates. This respondent (Interviewee 3) also suggested that perhaps there were four groups of users which should be represented on DSS user groups: 'FE planners, the FC [operational] staff on the ground, academia and [the] private sector'.

This matter is up for debate but it is significant in the fact that DSS developers have sometimes not initially foreseen the full range of applications for their DSS and therefore not included all potential users in their user groups. For example, one developer reported that in the case of one DSS, 'initially we probably had quite a simple view that it would be forest district managers' using it but 'different roles have developed in district offices so… perhaps now it can do a variety of things for a variety of people' and forest district managers are 'probably sitting at too high a level' to use it much (Interviewee 6). Indeed, a member of the user group identified that DSS could be used as a useful 'means of auditing the decision-making process for the purposes of certification' and 'Planners are now using it as a means of, or beginning to think of using it as a means of defining species choice and plant type' (Interviewee 6).

Identity of end users is not always clear, and needs to be explored carefully
One respondent (Interviewee 3) also argued that forest planners 'were neglected in a lot of things', including user groups because developers often saw their tool's application as being purely at the operational level but they were later revealed to also have application at the strategic level (although not all tools have a strategic element): 'part of the problem we've had is that a lot of the representatives tend to come from the tactical user base as opposed to the strategic'.

Indeed, one developer (Interviewee 7) admitted that when the user group was formed for the DSS he worked on it only had operational staff on it, but 'over time it has become more and more apparent that it's actually [also] a planning tool rather than just an operational tool because the planners, when they can see that kind of spatial information, have the opportunity to alter the way the forest is felled'. Similarly, a DSS customer at the country-level (Interviewee 2) explained that in his experience with this same DSS:

'[It] was rolled out to operational staff because it's an operational problem, but the operational staff realised that planners were controlling a lot of what they were doing so there wasn't great uptake. There needs to be more done to understand where one person starts using it and another picks it up.'

This respondent (Interviewee 2) maintained that DSS need to be presented as being applicable from the strategic policy making level right down to the implementation level: 'if we can cascade right through to the guys on the ground so that the policy has been set using good evidence-based science then the guys on the ground can use the same tools to actually get the best result at that level'.

Developers need to understand how use of DSS may affect operations on the ground
One DSS developer (Interviewee 3) raised a related concern, claiming that DSS may be used at a strategic or forest planning level to formulate policy and plans but that there can be a problem if operational staff then follow these plans without refining them based on site specific knowledge. As the interviewee (3) put it, 'operational staff do as they are told even if they know from experience that what they are doing is far from optimal'. A DSS customer (Interviewee, 2) at the country-level described the situation thus: 'you have got Ops people saying well you just give me the plan and I'll implement it… culturally you can't afford that to happen because… decisions that are made at a strategic level can get interpreted literally without being refined at micro-level'. This further emphasises the need for clarity over how a specific DSS can be used at different levels.

3.4.2 Volume testing and feedback
Volume testing and feedback mechanisms from users are often not put in place
Respondents also suggested that in the GB context there has often been a DSS development stage that has failed to be implemented or which has remained too informal, namely volume testing and feedback after the launch of a DSS. One country-level customer (Interviewee 2) argued that even when a user group is employed, when a DSS 'goes en masse all the problems come out' and there needs to be a clearer process for feedback from the whole industry which should be seen as part of the development process. He added that feedback and volume testing 'plays a role in terms of strategic direction but [also] in terms of practicality, applicability and in terms of just testing it properly' and that the majority of dialogue should 'be at the user level' with 'more field-based communications' and 'a lighter touch at the top'. Likewise, a developer (Interviewee 6) admitted that 'there needs to be some kind of mechanism for feeding comments back and improving the system and maintaining the system and to be honest I am not sure we have actually addressed that yet'.

3.5 Training, ongoing support and consolidation

Better delivery strategies may help the industry absorb new and improved DSS

Another issue that was raised and which reportedly acts as a barrier to uptake is the limits of 'the industry to absorb' new DSS developments (Interviewee 3). As another interviewee (6) put it, the industry needs time 'for consolidation before the next one is delivered' and it should fit 'in to a process of delivery so that it doesn't matter whether the tool is being delivered from FE [Forest Enterprise] itself or FR' because it is 'being rolled out to a user community according to a time table', something which has perhaps not happened in the past with DSS being launched in a more haphazard manner.

There may be long term training needs, partly because of staff turnover

Consolidation takes time because individuals have to learn how to use new systems and how to apply them to their job. Some things that can aid this process are training and support but a criticism that has been levelled against some existing DSS is that training and support for users have been lacking or have not been maintained. For example, one developer (Interviewee 9) noted that, in the case of one DSS, a series of training courses were run initially for perhaps five years but for some reason 'the whole thing collapsed and, because there's a big turnover of staff at the operational level in the organisation, the skill-base… suddenly disappeared, so there was nobody on the ground to run the thing'. Another developer (Interviewee 1) reported a similar story with a different DSS whereby training was provided to accompany the initial roll-out, but no subsequent training was provided. Likewise, regarding another DSS, one DSS customer at the country-level (Interviewee 2) maintained that, along with a minor technical issue, the problems which had hindered the uptake of the DSS were to do with a 'lack or training'. A developer (Interviewee 3) conceded that FR 'have been very poor at developing any supporting documentation' such as user manuals for the DSS it has developed. However, this same respondent also reported that, with a DSS he had been involved with, there had been training courses but that these 'didn't help uptake much because people went away from the training course knowing [the DSS]… existed' but there was no compulsion to use it.

4. Compulsion: the only way to ensure high uptake?

Examples where compulsion to use a DSS ensured high uptake
As well as considering strategies to overcome the barriers discussed above and improve upon the ways in which DSS are developed and implemented, we must take into account arguments that the only way to ensure high uptake of DSS is to make their use mandatory, possibly to ensure compliance with requirements for certification, and/or because official best-practice manuals stipulate their usage. An example which backs up this argument is the *Hylobius Management Support System* (HMSS). When this was originally designed and rolled-out there was reasonably slow uptake, but as explained by one DSS developer:

> *'then the FSC [Forest Stewardship Council]… picked up on the system and its potential to reduce the amount of insecticide that is being used in the industry and [they]… put out a derogation essentially saying that the industry, not just the FE but the industry as a whole, needed to be seen to be reducing its chemical usage and essentially saying that they should use the management support system (Interviewee 7).'*

As a result, representatives from the FCS Planning Team held meetings with the developers and decided to roll the system out across Scotland, compelling district-level staff to use it where appropriate.

Making DSS use compulsory, e.g. to support certification, would certainly increase uptake, but there are risks that this would lead to inappropriate use
This led one developer (Interviewee 3) to conclude that 'the biggest element in the model to decide usage would be FSC [certification standard] compliance or some sort of mandatory element' to usage and 'being more engaged with UKWAS and FSC to let them know what we have got' would help with uptake. However, he also suggested that compulsion would not ultimately serve the DSS cause well because in some cases it would mean certain DSS could end up being used inappropriately with a lack of cost-benefit return and that, ultimately, forcing people to use them 'will just get people's backs up'.

The case for compulsion needs to be accepted by users for it to work
A DSS user at the district-level (Interviewee 4) agreed with this assertion when he stated that:

> *'Some of them [the DSS] are getting used because we are told we must use them… I think a lot of the planning foresters… are probably quite set in their ways*

so they don't like being told to use these systems… there are probably certain things that are pushed down from above without properly consulting the people that are doing the job. It just gets rolled out and you get told you are doing it this way and that's it… sometimes the communication between senior management and district-level staff needs to be improved.'

This statement suggests that once again communication is an issue, this time in relation to communications between senior management and district-level staff within the FC. Interviewee 4's statement above also perhaps points to a cultural resistance to change which may possibly be related to the mistrust many foresters have of science and mathematical models, which was discussed previously.

Inclusion of DSS within operational guidance would enhance uptake
Linked to this discussion of mandatory usage is debate over whether the inclusion of DSS in Forestry Commission Operational Guidance Booklets (OGBs) (which cover cross-GB operational policy and guidance) would dramatically enhance their uptake.

Interviewees revealed very mixed opinions over this matter with one developer (Interviewee 1) declaring that 'unless you tell people to use a tool or decision support system in one of the OGBs, they won't use it because foresters follow the OGBs, or are supposed to follow the OGBs. So if they are doing anything which isn't in the OGBs they are kind of going off their job a little bit so it's hard for them to justify doing that'. Similarly, another developer (Interviewee 5) argued that 'there is no attempt to build in the professional standard' to forest design planning that 'would force people to make use of' a DSS.

It is argued that uptake depends primarily on its ability to meet demands
However, a customer at the country-level (Interviewee 2) argued conversely that a DSS will appear in an OGB only once its business relevance, need and usage has been established:

'I think it [inclusion in OGBs] would come naturally but it comes back to specking out what you are wanting, why you want it, where you see the use might be…and then properly embedding that…through training [and] senior management support to make it work. The one thing it has to do is that it has to be practical and you have to be prepared to change things that annoy people…'

Thus, while making DSS mandatory will undoubtedly improve uptake, the only way this is likely to happen is if the DSS fulfil business and user requirements and needs, their implementation and consolidation are adequately supported, and feedback about required improvements to DSS design are responded to adequately.

5. Conclusions

5.1 Key findings

The scoping research presented in this report reveals a range of factors that influence the uptake of DSS. The main points are outlined below. Overall, they support the view expressed in the introduction that the factors can be expressed largely in terms of the quality of stakeholder engagement during DSS development, and point to a need to focus on the process rather than the product, to identify and understand end user needs, and work with them collaboratively to build trust and credibility.

It should be remembered that 'high uptake' or 'successful uptake' cannot simply be defined by the number of people using a DSS because, as one interviewee put it, 'it could be a specialist thing that is helping a few people out with a very real problem' (Interviewee 8). Also, as demonstrated in the discussion above, the successful uptake of DSS relies on numerous factors or criteria (whether compulsion is one of these or not) and it is not a simple matter of meeting one or two of these; uptake will only be successful if a DSS meets a range of criteria. Interviewee 6 put it as follows, by showing the importance of meeting several key criteria, in addition to those relating to communication:

> *'it needs to be addressing a business need, it needs to be user friendly, it needs to be rolled out in a manageable time frame for users, it needs to have training and then it needs to have consolidation. This pre-supposes it is actually technically correct and it's not giving advice that is just so counter to people's experience that they think it's misleading or not worth following… it has to be all of them… it can be absolutely fantastic in a couple of these categories but if [it doesn't]… also meet the requirements [of the full range of criteria] it's likely to be poorly used.'*

The potential future value of DSS to the forestry sector
The perception among respondents was that the value of DSS appears to be increasing, partly because they are seen to support the growing demand for evidence based policy, and also as a means to help policymakers and managers respond to climate change, and demonstrate that they are doing so with the latest evidence and tools. The role of DSS may also increase in the future if they can support certification. The private sector is seen to have been more favourable to the uptake of DSS, and this situation may continue into the future unless issues raised in this report are adequately addressed.

Cultural resistance to DSS
The barriers to uptake are diverse, and as mentioned above may need to be addressed together for significant impact to be made. Barriers include cultural resistance among intended users, and a lack of trust and understanding between foresters and scientists.

There is also a sense that DSS may challenge values that underpin the practice of decision making, impose solutions, suppress creativity, or threaten professional judgement. Some users did not welcome the uncertainty associated with use of DSS while others felt DSS provided users with misleadingly accurate results that were stripped of uncertainty.

Communication and FR/FC linkages

Improved discussion and communication is needed between developers and other key stakeholders on how new DSS would fit into decision making processes, and this is arguably more important than detailed discussions around the science that underpins models. There is also a need for discussion to clarify roles and responsibilities regarding DSS delivery, a role that developers may not feel comfortable with. Part of the problem with uptake within FC is seen to lie in a reduction in tours of duty whereby foresters spent periods in research, which has helped to reduce informal links between FC and FR. It was noted that champions within and beyond FC can be particularly valuable in enhancing uptake.

Corporate delivery context

Integration of DSS into corporate systems is seen by some developers to be hindered by resistance, software incompatibility and lack of expertise within Information Services. Part of the problem lies with developers where there has been a failure to include those responsible for delivery in early stages of DSS development. Regarding the role of IFOS (Inventory, Forecasting and Operational Support) there has been disagreement and uncertainty over whether DSS should be incorporated into 'Forester', the GIS tool used for production forecasting within FC. It can be hard for DSS developers to keep up with latest demands from users, partly due to insufficient resources, for example the recent shift towards DSS that are spatially explicit. One barrier to dialogue and clarity over roles within FC has been the separate governance structures for development of 'Forester' and commissioning of DSS. Reasons for not incorporating DSS into 'Forester' include its dependence on the sub-compartment database, which is seen to be flawed, and the fact that it is rarely used by the private sector.

Meeting business demands and user requirements

Uptake of DSS depends largely upon the extent to which they satisfy a business need. User groups can help ensure DSS are developed to meet customer needs, but they need to be able to communicate effectively with scientists, and have a stable composition over the course of DSS development. User group membership also needs reflect the full range of users and stakeholders, but this is hindered by the difficulties in identifying all potential end users. Use of DSS, for example by planners, may affect operations on the ground in unforeseen ways. Another concern is that volume testing and feedback mechanisms from users are often not put in place, with negative consequences on the usefulness of DSS being delivered. Better delivery strategies may help the industry

absorb new and improved DSS, including attention to training, which needs to be sufficiently long term to address problems with staff turnover and loss of expertise among intended users.

Compulsion: the only way to ensure high uptake?
It is clear that making DSS use compulsory, e.g. to support certification, would certainly increase uptake, but there are risks this would lead to inappropriate use. The case for compulsion needs to be accepted by users for it to work. Inclusion of DSS within operational guidance would enhance uptake. However, it is argued that uptake depends primarily on its ability to meet demands: use of a DSS is only likely to be made compulsory, and even if its use is compulsory it is only likely to be used, if it is perceived on several levels to respond effectively to a business need.

5.2 Next steps

In this section, the next stages in the project and expected outputs are outlined.

Social research

From August 2010 to March 2011, semi-structured interviews will be conducted with key stakeholders from across the forestry sector (both public and private) using the interview schedule given in Appendix 3. The schedule may be refined during the course of the interviews according to the information being received.

Respondents will include those who have been involved in different aspects of the conception, commissioning, development, implementation, consolidation, maintenance and use of the selected case study DSS, as well as individuals who could potentially use them and other stakeholders who could be influential in terms of their uptake (such as members of IFOS, BSD, country-level planners, and champions in other parts of the forest industry). An initial stakeholder analysis of potential interviewees is given in Appendix 2.

A list of potential DSS that will become case studies in the final report is given in Appendix 1. During the course of the interviews, this list is likely to be shortened according to the value of the information being received.

Outputs

By June 2011 it is anticipated that a final report of the findings of this study will have been completed and will then be disseminated to interested parties.

A journal paper focusing on best practice for DSS development and implementation, and the challenges that must be faced in this process, is expected to be ready for submission by September 2011.

In mid/late 2011 a dissemination workshop will be held as a follow-up to the February 2008 meeting on DSS held at FR. The workshop will have a dual purpose: first, it will be used to disseminate the findings of this research project and, second, it will be used to identify a way forward and the next steps needed, both in terms of research (if deemed necessary) and in terms of DSS development and implementation.

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Interviews

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Interviewee 2. Forestry Commission country-level decision support system customer: September 3, 2009

Interviewee 3. Forest Research decision support system developer: September 16, 2009

Interviewee 4. Forestry Commission district-level decision support system user: September 8, 2009

Interviewee 5. Forest Research decision support system developer: October 8, 2009

Interviewee 6. Forest Research decision support system developer: September 21, 2009

Interviewee 7. Forest Research decision support system developer: September 15, 2009

Interviewee 8. Forestry Commission GB-level decision support system commissioner/customer: September 8, 2009

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Appendix 1: Selection of case studies

The scoping study revealed five DSS to be priorities for further social research: Forest Gales, Ecological Site Classification (ESC), Establishment Management Information System (EMIS), Hylobius Management Support System (Hylobius MSS) and Habitats and Rare and Protected Species (HaRPS). In addition five other potential case studies were identified, including DSS being developed by the two EU funded projects 'MOTIVE' and 'Northern ToSIA'.

The priority list of case studies to be included in the final report is likely to be refined during the research process once we have a greater understanding of which DSS we can learn most from. While some are included as full case studies, others may be included only as illustrative examples of specific issues.

Since the focus of this project is on the uptake of DSS developed by FR, it is intended that case studies will reflect the broad range of DSS on offer from FR and the different narratives, contexts, applications and experiences associated with them. Across different DSS, there is a continuum in the level of expertise required to operate them. Some tools can be rolled out to users with no need for training or specialist knowledge like HARPPS or the Deer Population Dynamics model. Other tools such as ESC and Hylobius MSS require training. At the other end of the scale, BEETLE may only ever be operated by researchers as part of a bespoke consultancy service because of their complex nature or because it is deemed to difficult to embed them into existing systems. Another continuum is the scale at which different DSS are applied, from Forest Gales and EMIS, which operate at the stand or site level, to BEETLE which operates at the landscape level, and ToSIA which can operate at a range of scales including the national or even EU level.

Priority case studies

Forest Gales

Provides wind hazard assessments for GB conifer plantations based on stand (soil, drainage, location) and species (top height, average dbh) information. Forest Gales is targeted at both foresters and planners and was developed with a user group. However, uptake across the industry has been patchy. Initially there was training to accompany the product but this has now ceased. The system works at the stand level and was developed before GIS became a major tool in the forest industry in GB. To try and meet the demand for spatial systems, FR are now providing wind risk maps in GIS for requested areas since Forest Gales cannot provide this function.

Ecological Site Classification (ESC)

This tool determines species and woodland suitability based on site location and optional assessments of indicator plants, soil and humus form. Like Forest Gales, ESC has had a patchy history of uptake. In many locations the old version of ESC is being used, which has problems associated with it, but because of communication difficulties and a lack of training many people in the sector are not aware of newer versions of the system where these problems have been resolved.

Establishment Management Information System (EMIS)

EMIS comprises simplified tools to assist with species selection, site/species management options, and planting guidance. Its use requires the OS six figure grid reference of the site and knowledge of site conditions (e.g. soil type). EMIS was developed with a user group but it has been suggested that there is not much buy-in from the industry at large. It has not yet been officially launched but it is believed that the national planning team for FCS will be rolling it out to district planning teams across the country.

Hylobius Management Support System

Assists with site-specific monitoring of pine weevil (*Hylobius abietis)* populations in advance of conifer clearfell restocking to predict and reduce transplant damage, insecticide use and costs of establishment. A user group was involved in the later stages of the development process which largely involved people in operational roles. However, it was later realised that it is essentially a planning tool because planners drive what happens on the ground. The system is now being used by many within the private sector and FCS and this is in large part because in June 2009 the Forest Stewardship Council put out a derogation which stated that the forest industry needed to reduce its chemical usage and that the Hylobius MSS should be used to support moves towards this.

Habitats and Rare and Protected Species (HaRPPS)

An information and decision support system providing quick and easy access to information about a range of Priority and protected woodland species and habitat management. It allows users to enter site specific queries to assess the entire range of consequences of woodland management on species. This system was reportedly in high demand within the industry at the time the scoping work for this report was undertaken but it had not yet been launched. Although it was initiated before the change in legislation on European Protected Species (EPS) in 2008, the demand for this system was in large part down to this legislation change which increased the legal protection given to protected species.

Other potential case studies

Other potential case studies are listed below. The value of their inclusion will become evident after further interview work is undertaken.

Biological Environmental Evaluation Tools for Landscape Ecology (BEETLE)

A suite of tools developed to model and analyse fragmentation and connectivity using GIS. BEETLE analyses landcover habitat requirement and species movement data.

Deer Population Dynamics

To set appropriate cull targets deer managers need to predict the effect of culling on future deer populations. To do this they need firstly to have an estimate of current deer numbers. To predict the population in the following year they need to add the number of young deer likely to be recruited to the population and subtract the number likely to die. The Deer Population Dynamics model was developed to help with this process and runs in Microsoft Excel.

Herbicide Advisor

A web-based expert system developed to advise on the relative efficacy of different herbicides for scenarios with a mix of weed and crop species, at varying times of the year. To use the herbicide advisor problem weeds must be already identified. Optionally the user can input on-site tree species to determine the impact of operations on current stock.

MOdels for AdapTIVE Forest Management (MOTIVE)

The EU funded project 'MOTIVE' is developing DSS to assess adaptive management strategies in the context of climate and land use change. It also examines the impacts of these strategies with respect to a broad range of forest goods and services. The project focuses on a wide range of European forest types under different intensities of forest management. Specific attention is to be given to uncertainties and risks and how they can be considered in improved decision support tools.

Tool for Sustainability Impact Assessment (ToSIA)

ToSIA was first developed by the EU funded project EFORWOOD, and is currently being operationalised in case study regions in Scotland, Norway, Sweden and Finland as part of 'Northern ToSIA', a project funded under the EU Northern Periphery Programme. The tool can be used to assess the impacts of changes in forest management on a range of environmental, social and economic indicators. Work with the Cairngorms National Park Authority is seeking to make the tool spatially explicit so that it can be used by forest and land use planners for optimisation of forest landscapes.

Appendix 2: Potential interviewee list

Interviewee selection will be done purposively to reflect respondents' roles in different aspects of DSS conception, commissioning, development, implementation, consolidation maintenance and use. Selection will also be based partly upon who is willing to be interviewed for the project. Interviewees will include potential end users and other stakeholders who could be influential in terms of their uptake. This should ensure that a broad range of perspectives is gained, and a through understanding of the issues pertaining to each stage in the process from conception to use.

However, ensuring that this broad representation is included will have to be balanced with the budget and time constraints of the project. For example, one interviewee (4) reported that views and perspectives within FC can vary greatly within a country, let alone between the different countries: 'if you take Scotland as a country and look at the districts, there are very big variations in the challenges that each district faces', for example due to variations between highly urbanised populations in the central belt, and a dispersed rural population in the highlands. It would be impossible, given the time and budget constraints, to talk to individuals in every forest district in GB and instead only one or two districts will be selected from each country. The sample will therefore not be representative per say, but will endeavour to be as inclusive as possible and should hopefully still uncover the key issues affecting the uptake of DSS in the forestry sector.

Potential interviewee respondents include the following:

- Commissioners:
    - CFS Specialist Advisors
    - Country-level Planners

- Developers:
    - FR Research Scientists
    - FR Research Liaison Officers

- FC Corporate Delivery Context:
    - IFOS
    - BSD

- FC Users (Actual and Potential):
    - Country-level planners
    - Forest Management Officers
    - District Planners
    - Operational District Staff
    - Forest District Managers

- Private sector (potential users and other stakeholders):
    - CONFOR
    - Forest Management Companies
    - Private estates
    - UKWAS
    - Other

- Government agencies and multi-stakeholder forums:
    - Local Authorities
    - National Park Authorities
    - Enterprise Agencies
    - Regional Forest Forums
    - Green Network Partnerships

- NGOs and community groups:
    - The Woodland Trust
    - Central Scotland Forest Trust
    - Community associations

Appendix 3: Interview schedule for case studies

A generic schedule is given below, comprising a full list of questions. Not all f these will be relevant to all interviewees. Subheadings are used to indicate sets of questions that are likely to be appropriate for different groups of interviewee. The list is not exhaustive and additional questions, or modifications to questions, are likely to be needed for specific groups.

The schedule begins by providing background information that will be used to introduce the interview. This will be tailored for different interviewee groups. In line with SERG's Ethical Statement, interviewees will be informed that their identity will remain confidential, and how the data will be analysed, stored and used, before they are asked to give their consent to participate.

Background

Over the last decade, Forest Research (FR) has been involved in numerous projects to develop Decision Support Systems (DSS) for the forestry and land use sectors in Great Britain and Europe. Many of these have been adopted by the Forestry Commission (FC) and other parts of the forestry sector, and are now integral to the systems of forest management planning and decision making applied throughout Great Britain. However, for some DSS, the level of adoption by potential end users has been lower than expected, which has raised concerns and questions about how this situation arose and how it might be improved.

As a result of these concerns, in February 2008 a meeting was held at FR to discuss the production and implementation of a range of DSS that had been developed by FR or were then under development. The meeting involved representatives from relevant sections of the Forestry Commission operating at GB level: FR; Corporate and Forestry Support, Operational Support Unit, GB Planners Group, the Forest Management Officers Group, and Learning and Development.

This research project seeks to build on these discussions to support and enhance the development, uptake and usefulness of existing and new DSS for UK forestry by carrying out social research with end-users and other stakeholders, and identifying areas of potential improvement.

Specific objectives are to:
• Improve understanding of the factors affecting DSS uptake, especially those relating to the institutional/governance/policy context in which DSS are developed and applied.

- Use this understanding to learn from both positive and less satisfactory experiences, to inform the future development and implementation of DSS tools.
- Advise on the strategies and processes whereby DSS are conceived, commissioned, developed, implemented and maintained by FC and other forestry sector stakeholders.

1.   Does that sound like a useful piece of work to you?

A. Introduction

2.   How are DSS important to the forest industry?

3.   How are DSS important to your job?

4.   How would you define a successful DSS?

5.   Can you tell me about the DSS that you are aware of in your role and your experience with them?

Ask relevant questions from B-F about specific DSS they have knowledge of:

B. Conception and development

6.   What's the background to it?

7.   How was it conceived?

8.   Was it commissioned or developed out of a research project?

9.   Is it an 'on-the-ground' tool or a strategic tool?

10.   How was it developed? – what was the process?

11.   Who was consulted through the conception and development phase?

12.   Were users or potential users involved in any way in its development? [*probe in what ways, did they test it? etc.*]

13.   Who was it targeted at?

14. Do you think it was targeted at the right level? [*probe –i.e. should it have be targeted at planner not forester?*]

15. Was there a user group to oversee its development? [*If so, ask additional questions below*]

Additional questions if there was a user group

16. Do you think this mechanism worked effectively?

17. Are there any ways you think the user group process could have been improved?

18. Do you think members of the user group also acted as a communication method to tell the industry about the DSS and champion it?

19. Do you think there was good representation of all potential users on the group? [*probe – not only in terms of from across the three countries and industry but also whether they were the 'right' people', e.g. planners and foresters*]

Additional questions if the interviewee was a member of the user group

20. Can you give me a bit of background of how you came to be involved in the user group? [*probe – how were they selected to join?*]

21. How often did you meet? [*probe - was this enough, too much etc.*]

22. Who else was on the group?

23. Do you think there was a good representation of all potential users on the group? [*probe - not only in terms of from across the three countries and industry but also whether they were the 'right' people e.g. planners and foresters*]

24. How did you feedback your views?

25. Did you feel able to openly say what you thought about the system, even if it was negative?

26. Did you feel that your views were taken on board?

27. Do you think members also acted as a communication method to tell the industry about the DSS and champion it?

28. Do you think the user group mechanism worked effectively?

29.   Are there any ways you think the user group process could have been improved?

30.   At what stage was the group disbanded and was this the right time?

C. Implementation and consolidation

31.   Once it was launched was there a process of feedback for users to comment on it and if so was it effective?

32.   If not, do you think this would have been useful?

33.   Do you think it has met user requirements? [*prompt – i.e. easy to use, does the job they need it to? etc.*]

34.   Do you think the DSS fits easily into existing planning or decision-making procedures? Does its adoption depend upon significant changes to these procedures?

35.   Is there any training offered on its use? [*probe – has training ceased, been sufficient or not been effective?*]

36.   Does it have effective supporting documentation such as a user manual?

37.   Was there buy-in from the industry and potential users?

38.   Were there high level champions in the FC and industry? If so were they effective?

39.   Is it included in official guidance such as an OGB?

40.   If not, do you think it should be? [*probe – would this help with uptake?*]

D. Maintenance and corporate delivery systems

41.   Is it supported by BSD and delivered through the corporate information system?

42.   How is it maintained?

43.   Are there any issues/problems around maintenance?

44.   Should it be delivered centrally, through Forester for example, or by FR?

45.   Are there any drawbacks to this approach from your perspective?

E. Uptake and usefulness

46.   What do you think are the factors that have affected whether the DSS is adopted or not?

47.   Do you think that it has met a business need? / How useful do you think it has been to the business?

48.   How well used is it and why?

49.   Who uses it?

50.   Are there other potential users – if so why aren't they using it?

51.   What could make it better?

52.   Do you think a DSS was the right way of communicating the information?

53.   Was it cost effective?

54.   Do you think that there is cause for concern that it is used in such a manner as to make decisions rather than to inform decisions?

F. Specific questions for IFOS and BSD

55.   Why do you think that many of the DSS produced by FR have not been as successful in terms of uptake as anticipated? [*probe*]

56.   What do you think needs to change to improve uptake?

57.   Why aren't FR DSS delivered to the FC through the standard corporate delivery platforms?

58.   Should DSS be delivered centrally, through Forester for example, or by FR?

59.   Are there any drawbacks to this approach from your perspective?

60.   Would this even be possible?

61. If you do think they should be delivered through Forester who should pick up the cost of this?

62. Do you think that we are likely to see tools like Forester becoming more web-based in the future?

63. Do you think FR DSS should be built on web-based platforms in the future?

G. General questions

64. What areas of forestry do you think will see the greatest demand for DSS in the future and why? [*probe – where will they add most value?]*

65. What are the biggest challenges to their potential and this demand being met?

66. Do you think that in the future their role will diminish, that they will be as important as they are now or that they will become more important, and why?

67. Do you think that shifting demands on forest management arising from issues like climate change will change the demands on DSSs?

68. Do you think that forestry is going to have to become more adaptive and therefore will require different kinds of decision-making, meaning that new kinds of DSS will be needed or that new ways of developing them will be needed?

69. Do you think that the forestry sector has the capacity to absorb and consolidate new DSS?

70. What are the key factors you think affect whether a DSS is adopted or not?

H. Concluding questions

71. Is there anything you think is important that I should have asked you about?

72. Is there anybody else you think I should talk to about this?

73. Is there anything else you would like to add or that you want to ask me about?

Thank you for participating.