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QUICKScan: a pragmatic approach to decision support

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Abstract: Decision Support Tools (DST) are a key instrument for preparing legislative proposals and policy initiatives. They provide insight about options, conflicts, synergies and trade-offs between issues, sectors and regions at multiple scales. DST range from integrated systems modelling to value-based knowledge systems resulting from expert groups. The results of the expert groups do not provide regional differentiation making it difficult to obtain useful insights for policy making. The 'black-box' complex tools are found not transparent by the decision makers that seek to understand the modelling behind the results to be able to cope with the scientific uncertainty and changing policy context. In addition, the policy questions need to be answered in a short period to fit the time horizon of policy making, e.g. a couple of months, which is possible with expert groups, but the complex models are often not ready to deal with this urgency.
The QUICKScan tool aims at filling the gap in the pallet of available tools by defining a methodology -supported by modelling software to visualize quantitative and value-based modelling in the decision process. The tool enables the creation of alternative storylines for policy questions by the stakeholders, and translates these in-situ into a model by combining tacit expert knowledge with available spatial explicit monitoring- and statistical-data. QUICKScan builds on concepts from Participatory Modelling and Participatory GIS and uses visualisation and interpretation tools which are essential to support the exploration of options allowing and facilitating the discussion and interaction on the definition of alternatives, analysing their consequences, determining trade-offs and synergies and compare the consequences of alternatives. The QUICKScan tool is designed to calculate fast, and therefor perform multiple iterations of a modelling exercise during a workshop. The results of each iteration feed the discussion among stakeholders and policy makers creating input for a next iteration.

Keywords*: Quick scan, decision support, policy assessment, participatory modelling, participatory GIS, impact assessment*

1 INTRODUCTION

1.1 The challenge

Understanding of the concept of ecosystem services (ES) by decision makers is a fundamental step towards their operationalization. However this understanding has proved to be rather challenging since it involves connecting and integrating the environmental and economic sciences with the decision-making process. Many potential conflicts/trade-offs or agreements/synergies between ES in multiple sectors and multiple scales make it difficult to get a comprehensive view on the impacts of a measure. In addition, decisions need to be based on facts and sound

evidence and the multifaceted questions need to be answered in a short period of time fitting the policy development time horizon. This high complexity demands support of tools.

1.2 Policy assessments

Policy assessments seek to analyse the potential effects of new policies before those policies are adopted (Owens et al., 2004) either to reduce costs of imposed regulations, increase transparency of policy making, coordinate/integrate cross cutting issues, or to engage in sustainable development. The trend towards evidence-based policy making draws policy assessment knowledge into the policy process and thereby improves the quality of decisions (Turnpenny et al, 2009). Policy makers have to use policy assessment tools (Nilsson et al, 2008) that have to be as compact and clear as possible, while clarifying where value judgements are included (Turnpenny, 2008). Many policy assessment tools exist ranging from complex computer models simulating real world processes; cost benefit and cost-effectiveness tools; multi-criteria analysis tools; scenario analysis tools; checklists and decision trees and; methods to structure group processes in which policy makers, tool developers and experts play an active role (Lipsett et al, 2011).
Cash et al (2003) found that an effective assessment process requires that all parties involved perceive the policy assessment knowledge as: 1) credible - meets scientific standards; 2) legitimate - produced by a fair process that reflects the interests of the stakeholders and 3) salient - answers questions that are relevant to users.
This paper focuses on computer based tools to perform the policy assessment.

1.3 Decision Support System

A Decision Support System (DSS) is an interactive, flexible, and adaptable computer based information system especially developed for supporting the recognition and solution of a complex, poorly structured or unstructured, strategic management problem for improved decision-making (BfG, 2000). It uses data and models, provides an easy, user-friendly interface, and can incorporate the decision-makers own insights (Matthies et.al., 2007).
DSS usage and development is shifting towards participatory approaches (Carberry et al, 2002, Nelson et al., 2002, McCown and Parton, 2006). Central to participatory processes is the principle of actively involving stakeholders instead of treating them as passive recipients of knowledge (Kloppenburg,1991; Massey et al., 2006).
In the participatory planning process a DSS is a central element facilitating stakeholders to engage in defining the input to the system (e.g. decision making options), evaluate the output (e.g. suggested improvements), and optionally setup/edit cause-effect relationships between them.
Jakku and Thorburn (2010) describe the potential social learning outcomes for participatory DSS development in which they treat the DSS as a boundary object – a common point of interest – through which stakeholders can collaborate and co-learn.
Vedung (1997) distinguishes between *Decision* and *Discussion* Support Systems depending on the policy phase in which the support system is applied. During the policy preparation phase a Discussion Support System is used to provoke policy discussions to generate a number of policy alternatives to cope with a problem. A Decision Support System is used in the policy development phase just before the actual policy implementation and aims at the optimization and/or evaluation of alternative policy proposals.
This paper describes the co-development of the QUICKScan framework and DSS by policy assessors, researchers and software engineers.

2 QUICKScan DEVELOPMENT

2.1 What is QUICKScan?

QUICKScan is both a framework (Figure 1) and a software tool to be applied in group-processes with policy makers and experts to develop and explore potential policy options and assess likely impacts of those options. The framework addresses five questions: 1) What aspects, in a policy context are relevant with respect to human and ecosystems well-being?; 2) What typical 'pictures' of the past and actual condition and trends exist?; 3) what elements and interactions are relevant for the persistence of these patterns, trends and impacts?; 4) Which strategies and options can be devised to preserve, restore, use, improve, mitigate, or adapt? and; 5) Which hotspot areas, services or land covers could be identified as targets for policy actions? (after Winograd, 2007).

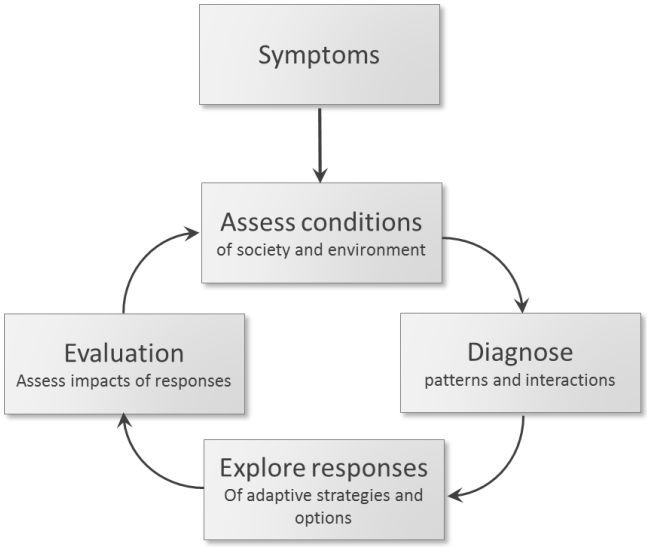

Figure 1 – QUICKScan framework (after Winograd, 2007).

The QUICKScan software (Figure 2) encompasses a modelling environment with functionalities to do the assessment of societal and environmental conditions, diagnose patterns and interactions, implement alternative responses and evaluate the impacts of those responses. The QUICKScan software comes as an empty shell and needs to be filled with spatial and statistical data on an application basis. The tool is not restricted to a specific geographic location or spatial resolution; similar to word processing software (e.g. Microsoft Word) which is not restricted to a specific document(type). The system enables the definition of if..then..else rules and link those to available data to create derived data. Typically the rules use quantitative classifications or qualitative typologies to help formulate the objective (Verweij et al, 2010). Rules may also be linked together to form a chain of rules. Alternative (chains of) rules are used to capture different options. Derived data from alternatives can be aggregated (e.g. by administrative units, or biophysical units such as catchments, or climatic zones) to be displayed in tables and charts for overviews.

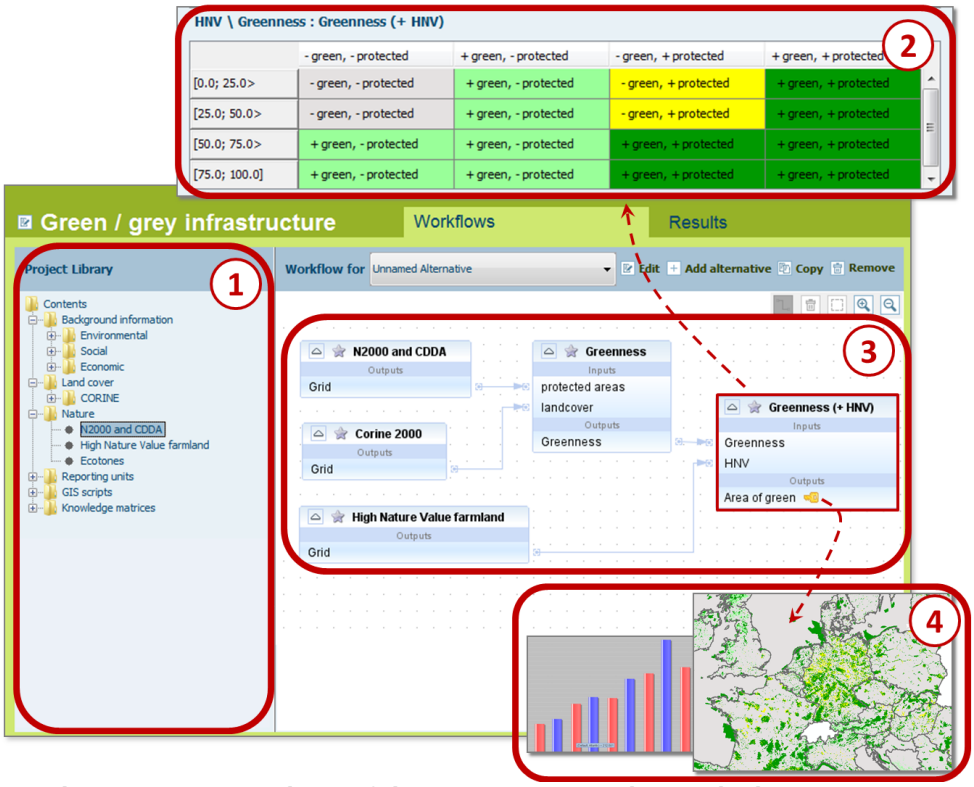

Figure 2 – screen shots of the QUICKScan tool. A typical QUICKScan exercise starts by populating the system's data and rule library '*1*' with spatial and statistical data relevant for the study (e.g. *protected nature areas* and *Corine landcover*). '*2*' is an example of an if..then..else rule defining *greenness* based on *nature protection status*, *land cover* and *High Nature Value* farmland (*HNV*). Rules are also placed in the library. Data and rules are dragged onto the canvas and linked together forming a chain (see '*3*'). Rules are applied to the data to create maps ('*4*'). Results of alternative chains may be compared in aggregated bar charts (e.g. *area of green* per Member State, or climatic zone).

2.2 Development process

During 9 workshops and 12 meetings with the donor, envisaged users, policy assessors, modellers, experts and software engineers we disseminated ideas and received feedback specifying requirements, both for the software tool to build as the policy assessment process in which it was to be used. 4 participants attended all workshops, while others varied (mostly modellers and experts).

To have a practical starting point for the kick-off workshop, we presented the QUICKScan framework, candidate concepts and excerpts from a range of existing software tools. A participatory form of paper prototyping (Sefelin et al, 2003) was used to visually capture initial Graphical User Interface concepts. Paper prototyping fits the User Centred Design approach (Raskin, 2000) that has been used throughout the project execution.

Following workshops were used to present progress on the technical implementation and on the understanding of the process; test with most recent proposed policies (they sometimes changed between workshops) to determine if QUICKScan was flexible enough to cope with the broadness of applications envisaged, or find its limitations and; adjust and reprioritize the planning. Most of the meetings were organized within the European context, while 5 were outside of Europe to test for applicability in the Americas, Africa and Asia.

In addition to the workshops and meetings weekly tele-meetings with a representative from the policy assessors and a representative from the scientific

software engineers were held. The tele-meetings were structured around implementation status, (changes in) upcoming policy proposals and data requirements for the next workshop. All communications and ongoing work was registered in a wiki available to all involved.

2.3 Test case: Green infrastructure

One of the workshops was exclusively used for the test of the QUICKScan process. The two-day workshop was divided into three parts: i) day one, morning - delineate the policy context and brainstorm on alternatives and how to measure the success of the alternatives. The EU Biodiversity Strategy (EC, 2011) was chosen to set the policy target: "*By 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15% of degraded ecosystems*". Area of Green infrastructure should be the key output to compare alternatives. The morning session was attended by policy assessors, domain and technical experts and a process facilitator;
ii) day one, afternoon – implement alternatives in workflows in the QUICKScan tool by linking available GIS and statistical data with knowledge rules created by the experts. Rules expressed both explicit and tacit knowledge. Four alternatives were created:1) protected nature areas; 2) exclude non-nature land use from protected nature areas and include nature areas outside of the protected zones (e.g. include city parks and forest and exclude roads and buildings); 3) additionally include all European areas that have farmland with 'High Nature Value' (HNV) (Doxa et al, 2012); 4) additionally include natural ecotones, transition areas between two adjacent but different plant communities. For the afternoon session the policy assessors were excused to continue with their busy agenda;
iii) day two – present the results to the policy assessors by using the QUICKScan tool. Initially a summary chart of the area of green was presented in which each alternative was visualised as a bar (resp. an average of 22, 24, 38 and 42% of GI components) feeding the discussion on the impact of changing the definition of Green and where to put focus for policy development. Then the area was summed per Member State to identify Member state outliers and similarities. Finally pan European maps were shown to find spatial patterns within– and crossing Member State borders. The display of maps triggered the inquiry after the rules that were used when a (cluster of) locations came out differently than expected. The trace functionality was used to visualize the causal relationships and to highlight the decision path in the rules (see Figure 2). Some rules were changed after tracing. The changed rules were used in another calculation and those results were compared with the previous run. See the EEA (2011) report on Green infrastructure and territorial cohesion for a more elaborate discussion of the case.

3 DISCUSSION AND CONCLUSIONS

3.1 Participatory modelling

Despite political pressure, complex models are hardly used. Recommendations to improve their usage include the provision of training, communication material and advancement of the usability requiring additional resources. Still, complex computer models are found not transparent enough by the decision makers that seek to understand the modelling behind the results to be able to cope with the (scientific) uncertainty.
In addition, the multifaceted policy questions need to be answered in a short period of time. The complex tools and models are not ready to deal with this urgency as often new policy questions require careful model-adaptation, -expansion, -linking to other models (Knapen et al, submitted) and -calibration. Modelling results are often send to policy makers in a report, or policy brief and might be exemplified

during a short presentation. Incorporation of feedback to the modelling results necessitates another time consuming iteration of the complex modelling and model validation at the modeller's office after which another workshop may be used to present the new findings. A gap between workshops leads to a loss of engagement and interest (Kok et al, 2011), but more importantly it may take longer than the time horizon of policy development. Kok et al (2011) also recommend to use a story-and-simulation type of scenario method that excludes the use of mathematical models.

Expert groups meetings are common for doing policy assessments in a short period of time. Expert groups are essentially a forum for discussion with policy makers, providing high-level input from a wide range of sources and stakeholders in the form of opinions and recommendations both from scientific origin as derived from practical experience (EC, 2010) while explicating the causal relationship between policy and impact. However, expert groups do not provide evidence based localized quantifications in contrast to many computer models.

Visualisation and interpretation tools are essential to support the discussion and interaction between stakeholders, experts/modellers and policymakers and are capable of speeding up the decision making process (secretary general of the Dutch ministry of agriculture, nature and fisheries, Wouters, 2008; Brown Gaddis et.al., 2007).

QUICKScan is capable of developing storylines, select indicators for measuring the objective achievement, gaining and processing of stakeholder knowledge and jointly create new model(s) as is done in participatory modelling (Voinov and Brown Gaddis, 2008). QUICKScan offers access to spatially distributed phenomena and provides interactive zooming, overlaying, temporal comparisons and many visualization options as used in participatory GIS (McCall, 2003; Jankowski, 2009, Cutts et al, 2011). And QUICKScan can do so within the time frame of a two-day workshop. However, such a workshop needs careful preparation. Experts for the topic at stake must be found and data gathered and made available to the QUICKScan tool. Preparation also means running through likely scenarios and thinking of proxies to use for unavailable, or non-existing data.

QUICKScan is applicable in situations that Becker (1989) calls explorative; a situation with high uncertainty and high causality. Guiding directions can be found for many policy shaping cases. However, sometimes a more in depth study is required which may be solved by using a (set of) complex model(s). QUICKScan can be used to identify those cases.

Assessments tend to be performed at a late stage in the policy process. As of the late timing such assessments tend to have little or no effect on the policy shaping. The QUICKScan project is a co-production between researchers and policy assessors from an agency of the European Union with a given role to advice on proposed policies. Their role automatically involves them (and the project) early in the policy creation process making it possible to influence the policy. It is crucial to be part in the early policy development.

3.2 Participatory development

Following the terminology of Vedung (1997) the QUICKScan software classifies as Discussion Support System rather than a Decision Support System as it mostly fits the policy preparation phase. However, Verweij et al (2010) describe a similar software tool which is used for participatory modelling to find water and nature-management measures to secure the habitat of migratory birds in a wetland. The management measures in this study relate to the policy development phase. There is no intrinsic nature to the tool classifying it as discussion or decision support system. It depends on the application at hand.

QUICKScan development has been taken place in close cooperation with the policy assessors who formerly used either reports with results from complex models and GIS analysis, or oral dialogue for doing policy assessments. They are

very much aware of the urgency in doing policy assessments and time constraints policy makers have to participate in workshops.
Initially exercising the tool seemed like playing with an interesting toy which combined concepts from technical tools they knew, but especially the design of the QUICKScan process was hard to get right. It became clear we had to be able to do the modelling in two days and only have contact for max a few hours per day with the policy makers due to their full agenda's.
In the end some of the policy assessors continue to use the QUICKScan, some understand the advantages of it but stick to practise assessments as they did previously and some reject it as not applicable to their specific assessment types.

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