Impact assessment as a design tool

Experiences and effects in the case of R&D programmes

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Abstract

Research and development (R&D) programmes constitute a pivotal arena for shaping technologies of the future. In order to make qualified decisions, R&D programmes ought to be subject to impact assessment (IA). It seems, however, that only a few countries have developed a systematic practice. One reason for the limited practice might be that IA of R&D policy is said to be particularly difficult. This paper reports on experiences from a voluntary IA application in Danish with point of departure in the question: How does IA work as a design tool in terms of R&D programmes?

1. Introduction

With some notable exceptions (e.g. Kuhlmann, 2003; Commission of the European Communities, 2005), a huge amount of resources are allocated to R&D activities globally without substantial ex-ante considerations to environmental and social impacts. From a governance perspective as well as a sustainability perspective, there is thus a need to increase attention to impact assessment of R&D programmes. Otherwise, we might continue facing late lessons on the downsides of technological development (EEA, 2001).

The key question raised in this paper is “How does IA work as a design tool in terms of R&D programmes?” To explore this question, the paper documents how IA directly and indirectly plays a role as a proactive design tool in the R&D programme process. Generally, research has shown how IA serves to alter projects and plans (Christensen et al., 2005), but little research has focused on how ex ante impact assessment may influence the design R&D programmes in practice. To investigate this influence, this paper applies a case study approach in which reviews of R&D applications, observations and interviews are carried out. Based on this investigation, IA's potentials as a design tool for R&D programmes are discussed.

The case is the environmental impact assessment of the Danish publicly funded R&D programme within the energy sector titled “ForskEL”. Since 2011, a specific type of IA has been applied at this programme; an ex-ante environmental assessment inspired by the EU Directive 2001/42/EC on environmental assessment of plans and programmes, although EA is not legally required for this programme; rather EA is seen as an advantage by the organization that administers the programme, Energinet.dk, in the sense that it is argued to enhance the basis for selecting the best projects and that it adds to the requirements on documenting the (expected) effects of their R&D funding activity.

2. IA as a design tool in R&D

Ex-ante IAs are made on a range of choices in R&D processes. Among these choices are choices of materials in eco-design processes (e.g. Bovea & Gallardo, 2006) and broader technology assessments (e.g. Hirtz et al., 1993). The literature show elements of how IA can work as a design tool, but the variety of methodologies and experiences are yet to be documented.

A dilemma that is pronounced in the field of R&D is related to uncertainty: "policy making require information on the potential consequences of the introduction of new technologies before they are widely implemented, i.e. at early stages of their development when the direction of the innovation process already can be influenced but its implication can hardly be foreseen" (Fleischer et al., 2005 p. 1113). More generally, the ex-ante assessment of R&D policy is described as "particularly difficult" (Commission of the European Communities, 2005, p.1) and as posing "formidable conceptual and methodological challenges" (Feller, 2007). In the US, the National Research Council concluded that "no theory exists that can reliably predict which research activities are most likely to lead to scientific advances or to societal benefit" (National Research Council, 2007). These methodological challenges may be part of the reason for the scarce practices and literature on IA of R&D.

In other types of decision-making processes IA has proved to influence designs and developments, although often only to a modest extend (Jay et al., 2007; Cashmore et al., 2010). Research also shows that IA functions as a design tool throughout the decision-making process (Christensen et al., 2005). This paper explores whether this is the case for IA of R&D programmes as well.

Facts about the ForskEL programme

- 20 mil Euro annually
- Scope: R&D on environmentally-friendly energy technologies
- A public service obligation administered by the Danish TSO Energinet.dk
- Funded by fees on electricity
- Applicants: Private enterprises and universities
- Evaluation of applications by technology experts

2.1 IA of the Danish ForskEL R&D programme

The impact assessment of the Danish ForskEL R&D programme is based on an environmental assessment (EA) methodology in which the funding applicants play a prominent role in the assessment. The applicants are asked to describe and assess the significance of the expected effects of their R&D activities in the project period as well as the potential of the project contribution at a societal scale. These descriptions are then validated by experts in the general evaluation of the applications. The environmental assessment reports then summarise the description and analyse the environmental performance of the R&D programme. This approach has notable challenges especially in terms of validity of the information, but it is the pragmatic solution to framing conditions, hereunder costs, information accessibility, and uncertainties in applications (Lyhne & Byriel, 2013).

EA of the ForskEL programme has been conducted since 2011 and during the years, requirements on environmental information from the applicants has been strengthened. Applicants are required to describe milestones related to environmental performance and contribution to selected environmental policy targets. In 2014, programme level targets were established on these requirements as well as on the handling on significant negative effects in the R&D applications.

Figure 1 outline the R&D programme development process as well as the impact assessment in the case of the Danish ForskEL programme. In short, the previous EA report feeds into the programme formation (A) that determines what types of R&D are prioritised and defines the requirements to the applications. The incoming applications (B) are then subject to a preliminary EA that serves as an input to the evaluation and

selection process (C) as well as to the negotiation process (D). After contracts are signed, the final EA report is produced and the cycle is closed by feeding into the programme formation of the upcoming tender process. As part of the EA process, a follow-up on the implementation of the R&D projects (E) is taking place through the annual reporting system. Figure 1 outline these ways in which IA may work as a design tool. Indicators of influence in the R&D phases are outlined in table 1.

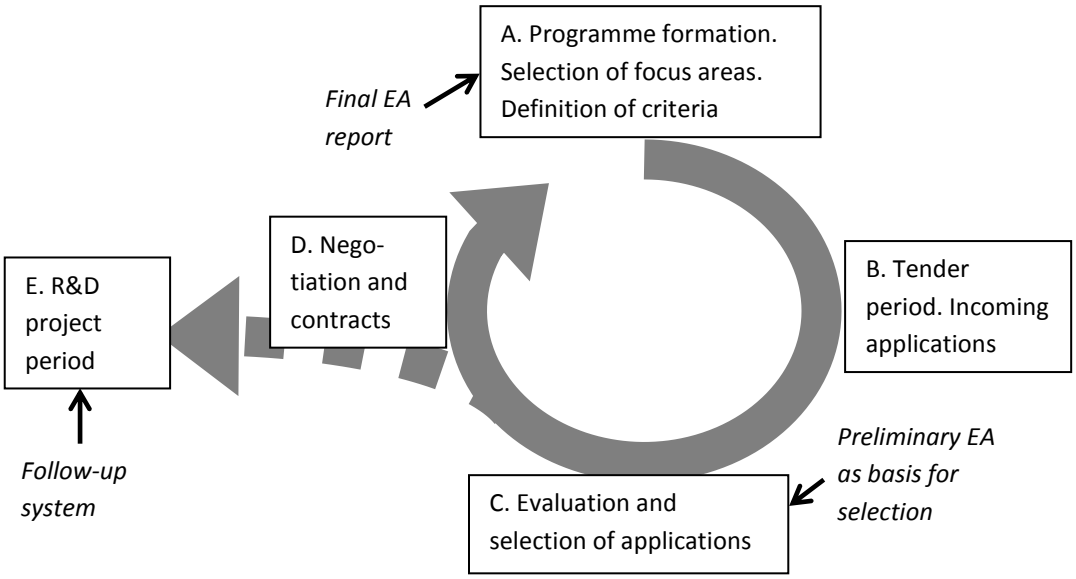

Figure 1: The R&D programme cycle including the EA reports.

3. Methods

The documentation of how EA works as a design tool in the ForskEL R&D programme is based on A) surveys and interview with core actors to identify ways in which IA influence, B) review of applications throughout a longer period in order to identify actual changes in how environmental issues are prioritised and described subsequent to changes in programme requirements and targets, and C) observations at evaluation meetings. An overview of how the methods are applied to document influences is provided in table 1.

Phase	**Indicator**	**Method**
A. Programme formation	Influence on programme focus area	Interviews
B. Incoming applications	Milestones in applications	Quantitative review of applications
	Handling negative effects in applications	
	Fulfilment of policy targets in applications	
C. Selection of application	Change in selection due to environmental performance	Observation, interviews and short survey to evaluators.
D. Negotiation and contracts	Influence on negotiation due to environmental aspects	
E. R&D project period	Change in implementation of the project	Short survey to applicants

Table 1: Phases, indicators of influence, and data collection methods applied.

A short survey to applicants was conducted in 2013 *after* the applicants had received support and involved 96 respondents. They were asked about their capability to describe environmental effects, about the relevancy of the required information, and whether completing the template leads to useful considerations for their further work on the project. Another survey to evaluators was conducted in 2014 asking into their

experiences with the environmental descriptions in the evaluation process. Interviews were made with one of the core administers of the programme in 2015. Observations were made of evaluation meetings in terms of how environmental aspects were articulated in the evaluation.

4. Results – tendencies:

A. Programme formation

In terms of the programme formation, the EA is a design tool in the sense that it provides a platform for deciding on ambitions for the programme's environmental performance as well as for designing the application templates related to environment. The administrator of the programmes outlines the influence of EA as: "The work on EA has provided a platform for setting up targets for environmental performance of the programme. The experiences gained in the work on EA have also meant that we have been able to make detailed requirements on environmental descriptions in the tender material". The intension is that the EA is also used as a design tool to focus the programme on strategic technologies or needs, however, this role is not yet established.

B. Incoming applications

Through the influence on application templates, the EA has had a considerable influence on the content of the applications. This influence is visualised in figure 2. Changes from 2014 to 2015 may be due to the establishment of performance targets on programme level for the three elements in the figure.

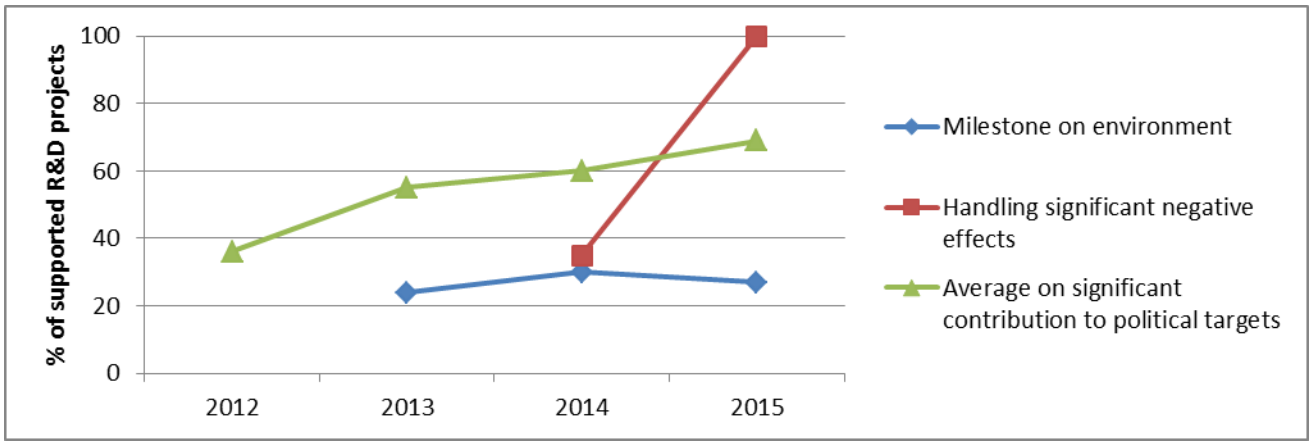

Figure 2: Development in the R&D applications measured as the percentage of supported R&D projects with milestones on environment, handling of significant negative effects, and contributions to political targets.

Whereas the requirements on environmental descriptions in the tender material have made applicants consider environmental aspects, the actual effect may not be as prominent as the figure indicates; it may be a tendency of making existing implicit environmental performance explicit. This seems to be supported by the fact that the applicants seem reluctant to include binding milestone on environmental aspects in the application. The administrator of the programme states: "We generally see more attention towards environmental issues in the R&D projects. This is in part due to a general increasing attention to environmental issues in society, however, our requirements play an important role in systematising environmental considerations in terms of the design of the project".

C. Selection of application

The preliminary environmental assessment is part of the information basis in the evaluation and selection process. In this process, evaluators assess and prioritise the applications. The survey to evaluators reveals that 20% of the evaluators regard the environmental descriptions as important or of critical importance in their evaluations, whereas almost 60% regard these descriptions as background knowledge. 20% state that they do not directly use the environmental descriptions.

The administrator of the programme explains this distribution: "We ask evaluators to concentrate on different elements of the applications, for instance reliability of the technical designs and the predictions of market potential. Therefore, a considerable percentage of the evaluators are not supposed to be concerned with environmental issues. That 20% of the evaluators assign importance or critical importance shows that environmental aspects are an important priority in the selection of applicants".

D. Negotiation and contracts

Inexpedient elements in the applications process is sought removed in the negotiation phase. This could for instance be that the progression is not adequately measured through milestones, which impede the administrators' control of the development. According to the administrator, environmental aspects can be part of this process, but often as an indirect element of milestones: "Often our negotiations of milestones indirectly relate to environment. As an example, the effectiveness of a new wave energy technology is a technical measure, but it also defines the environmental potential."

E. R&D project period

In the 2013 survey, 36 % of applicants stated that completing information about environmental effects to a considerable or high extent provided useful considerations for their further work in their project. Besides these considerations, applicants are required to report on the development in their R&D project, including environmental elements. The administrator of the program states that in this period, "environment is given more attention, if it is defined as a milestone or it is a significant problem".

5. Conclusion: IA as design tool?

This paper aimed at exploring how IA works as a design tool in terms of R&D programmes. The empirical findings show that EA influences the R&D programme cycle in several arenas with varying effects. Although the influence may partly be a matter of making implicit characteristics explicit, EA is highlighted for its ability to systematise environmental considerations in the R&D programme development.

The current EA methodology has limitations in terms of the quality of the data retrieved from the applicants, and the full potential as a design tool may therefore be significantly bigger given a more solid methodology. The identified influences are, however, far better than no systematic environmental considerations, so methodological challenges should not discourage R&D administrators and decision-makers from applying IA as a design tool and create more sustainable R&D activities.

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