InnoDemo Survey Report

Aims and results of demonstration projects in renewable energy and transport

Dorothy Sutherland Olsen

NIFU

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Preface

This report summarises the findings of a survey of demonstration projects related to energy and transport. The survey was designed to develop an overview of the aims of these projects and the results they have achieved. The projects were carried out in Norway, Sweden and Denmark in the period between 2002 and 2012 and all of them received public funding.

This report is part of the InnoDemo project funded by the Research Council of Norway as part of the FORFI programme. The survey and the analysis of the results was carried out in 2014.

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Summary

This report documents part of the work carried out in work package 3 of the InnoDemo research project funded by the Research Council of Norway. The partners in the project are The Nordic Institute for Studies in Innovation, Research and Education (NIFU) (project leader), DTU Management Engineering at Technical University of Denmark, and CIRCLE at Lund's University.

This work builds on the state of the art study carried out in work package one (Klitkou et al.2013) and uses the data registered in work package two, in the Inventory of Demonstration and Trial Projects in Sustainable Energy and Transport in Scandinavia (Dannemand Andersen et al., 2014).

The survey was designed to gather data on the aims and results of demonstration projects within energy and transport in the Nordic countries. We expected demonstration projects to have learning as one of their main aims or their central activities; learning how technology is built, how production is scaled up and how it is used. Therefore, we have included questions designed to give us a better understanding of how these projects are functioning as learning environments.

The survey was carried out online and was sent to 370 project leaders in Norway, Sweden and Denmark. The response rate was 22%. The findings were analysed in terms of the various themes: aims, results, effects, then in terms of learning and lastly some national comparisons were carried out.

The main findings of the survey were:

- Most projects had technical aims.
- Most reported a positive outcome from the demonstration project.
- Most say they are working on radical innovations and rate the novelty value as high.
- Respondents thought that all participants had learned from their participation, except policy makers.
- Changes which occurred in the project indicating learning:
  - New designs and concepts
  - Changed and better aligned expectations
- Projects emphasised fault fixing and adaptation, rather than purely verification, suggesting that the technologies were still under development and not yet ripe for market introduction.

Comments from respondents suggest that networking and getting to know and understand new partners was more time consuming than estimated, but also more valuable.

1   Introduction

In recent years, various attempts have been made by politicians, researchers and industry in the Scandinavian countries to move towards sustainable energy production. There are many factors which have influenced this gradual process, such as the oil crisis in the 1970s, concerns about decreasing biodiversity, depleted natural resources, pollution from road transport emissions and climate changes caused by greenhouse gas emissions. Different types of political instruments have been developed to facilitate the move towards greater sustainability. However, we are still learning about the possible effects of these instruments and the optimum design and mix of instruments. Some of the instruments which we are still learning about are *demonstration projects and programmes.*

The InnoDemo research group understand demonstration projects as "experiments to overcome uncertainties, while uncertainties can be of different character, such as technological, economic, environmental, social, political, etc. Such projects exist on different scales, including a variety of types of actors, and they have different objectives and different types of outcomes. A comparative analysis of demonstration projects and trials has to ensure that projects are comparable according to objectives, organisational solutions, and technologies" (Klitkou et al., 2013:22).

The project has already analysed recent literature on technological transitions to sustainable transport and has compiled a database of all demonstration projects in Norway, Sweden and Denmark, which received public funding in the period from 2002 to 2012. In this work package, the main aim is to gain an understanding of the aims and effects of these demonstration projects. In addition to this we have included some questions which help us to understand the role of collaboration and of expectations in demonstration projects.

The report is structured in the following way: firstly, the methodology used is described, this is followed by survey results on aims, results and effects, learning outcomes, improved understanding of consumers and markets, project organisation and management, national comparisons. This is followed by a discussion of the findings and lastly some reflections on the validity and reliability of the data.

2   Methodology

The survey questions were developed in a series of iterations with InnoDemo national groups. A survey was then constructed using Opinio, for online surveys. The survey questionnaire is given in the Appendix. The survey was carried out online, by recipients following a link in an email. The questions were mainly multiple choice and in most cases, there was a free text field for comments.

The recipients of the survey were the project leaders we have registered in the project database (see separate report: Dannemand Andersen et al., 2014), i.e. those who led projects in Norway, Sweden and Denmark in the period between 2002 and 2012. The survey was sent out to 370 email addresses of the registered project managers. Respondents were sent two reminders. 80 of these have responded to the survey (21.6%) and of these 58 have completed the survey. Due to the low response rate, the applicability of the findings is limited; however, the responses have provided interesting and useful information on individual projects.

The findings were analysed in terms of the various themes: aims, results, effects, then in terms of learning and lastly some national comparisons were carried out. The percentages referred to in this report refer to the percentage of respondents answering each question. In most cases, we have not included numbers who did not respond to a particular question, wherever these are included they are indicated in the descriptions. Many questions have provided the opportunity for those who could not find a relevant answer i.e. "other, please describe". These results have been included in the analyses. In cases where comments help to explain results or provide examples, they have been included.

The results are aggregated and anonymised. In some cases, we have quoted comments, but the identity of the respondent has not been revealed. The collection, storage and reporting of data in this project is in compliance with European guidelines on the confidentiality of personal data and has been approved by the Norwegian centre for social science data (NSD).

Some of the questions arising from the findings of this survey were followed up in interviews and in focus group meetings.

3   Aims of the Demonstration Projects

The aim of the demonstration projects often tells us something about the phase of the development the technology is in at the time of analysis. We would typically expect most demonstration projects to have an emphasis on technological development, but those who have a technology, which is soon to be marketed, will typically use the project to explore or test the market. Of course, the technology/market emphasis of a project is not simply indicative of a linear progression, there may be some technologies which will come to market as components within other technologies, or technologies which will not be delivered directly to consumers. In both these cases, we would expect less emphasis on developing or testing markets. The survey included several questions relating to the aims of the project, both directly and indirectly. The main question was question 4, which attempts to dig deeper into the various technology/market aims of a demonstration project.
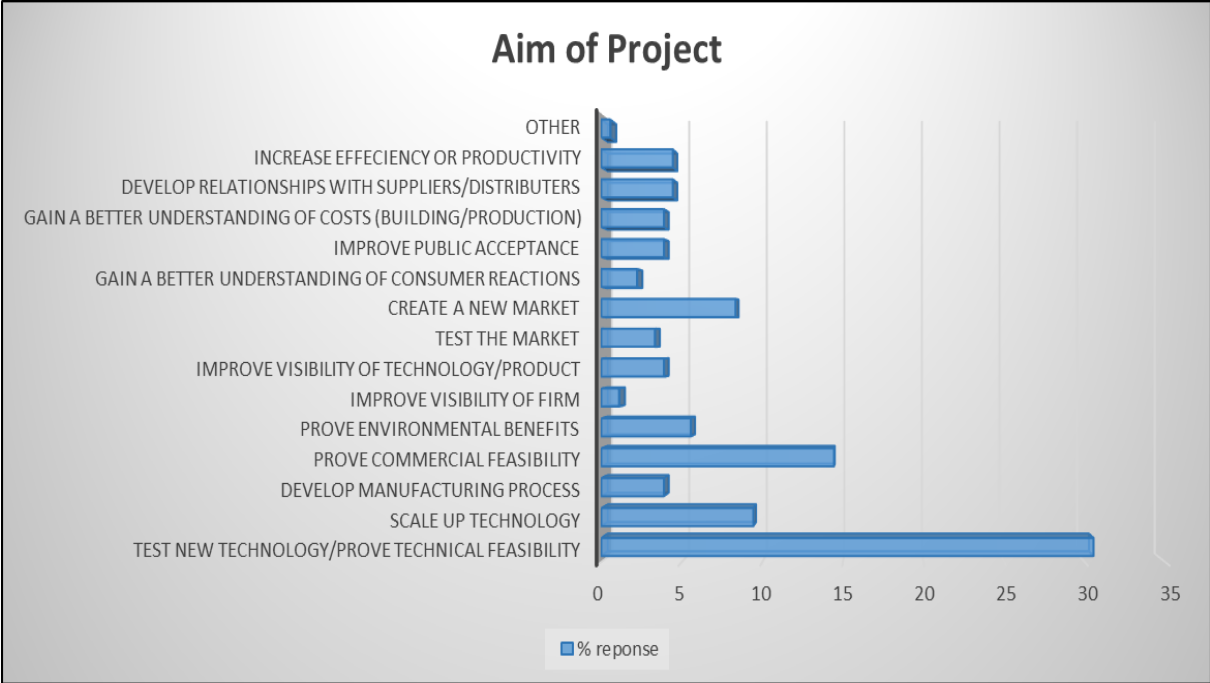

Figure 3.1 Question 4 Choose the 3 most important aims of the project from the following list (N=64)

The main aims of the projects in this study were technological and economic, with 32% rating *demonstrating technological feasibility* highest and 15% aiming to prove commercial feasibility (Fig 3.1).

In addition to their main aims, 28% reported that they also attempted to develop a new infrastructure (q29) and 58% reported that they also attempted to develop supporting technologies (q27).

We also included a couple of questions on themes, which would not necessarily be expressed as explicit aims of a project, they may however have been underlying aims, guiding activities and influencing decision-making in the project. The responses to these questions are thus dependent upon the project leaders ability to reflect on this and also that the project has been running long enough for there to be something to reflect upon.

- In your opinion was the project mainly a project to develop technology or was it more focused on social changes? Choose on the scale where 1 is mostly technological and 5 is mostly social. (q39)
- Were the project activities mostly related to verifying something, which already existed, or to creating something new? Choose on the scale where 1 is mostly verification and 5 is mostly novelty. (q41)

When asked to say if the project was mainly aimed at producing social change or mainly technological development, (q39), the majority – 48% (N=58) – were on the side of technological development, while only 5% stated mostly social aimed at social change. In total 73% responded that it was more technical than social.[1]

69% (N=58) report that their projects were aimed more at novelty than at verification (q41), while only 12% reported that verification was the main aim. This is supported by question 40, which asks if the product or technology being developed is radically new, and 78% responded that it was. This tells us that our projects contain a significant element of new development, suggesting also that the level of uncertainty was high.

When asked about the extent to which the project had resulted in an increased understanding of consumers (q10) and market (q11), 27% (N=59) and 20% (N=59) respectively said this was not applicable. This suggests that 20% of the projects had no intention of gaining a better understanding of the market

Several of the comments related to the aims suggest that some projects were more focused on getting existing technologies to work together in new ways and some were reproducing foreign pilots in a national setting or that the aim was calculating feasibility rather than actually building a demo.

In conclusion, we can say that the aims were very varied, but the main emphasis on demonstrating working technologies and proving commercial feasibility. Few projects stated that their aims were related to learning or about consumers or the market, nor did they appear to be aimed at profiling new technology. This pattern of focus on the technology rather than on the consumers, might indicate a more supplier oriented attitude, as opposed to a conscious attempt to meet the demands of a new market or indeed to create a new market. Only 6% stated that their aim was to prove environmental benefits, suggesting that environmental benefit was not the main motivator for these projects.

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[1] Sum of Mostly technical and Quite technical

4 Results and Effects of Demonstration projects

One of the main aims of the InnoDemo project was to gather new data on the results and effects of demonstration projects. To this effect, we included questions relating to the results of the demonstration projects (q5, q40). Often it may take time for discernible or measurable results to be registered, so we have attempted to include results, which might be evident at an early stage. In question five we asked respondents to indicate the type of results, which their projects had achieved.
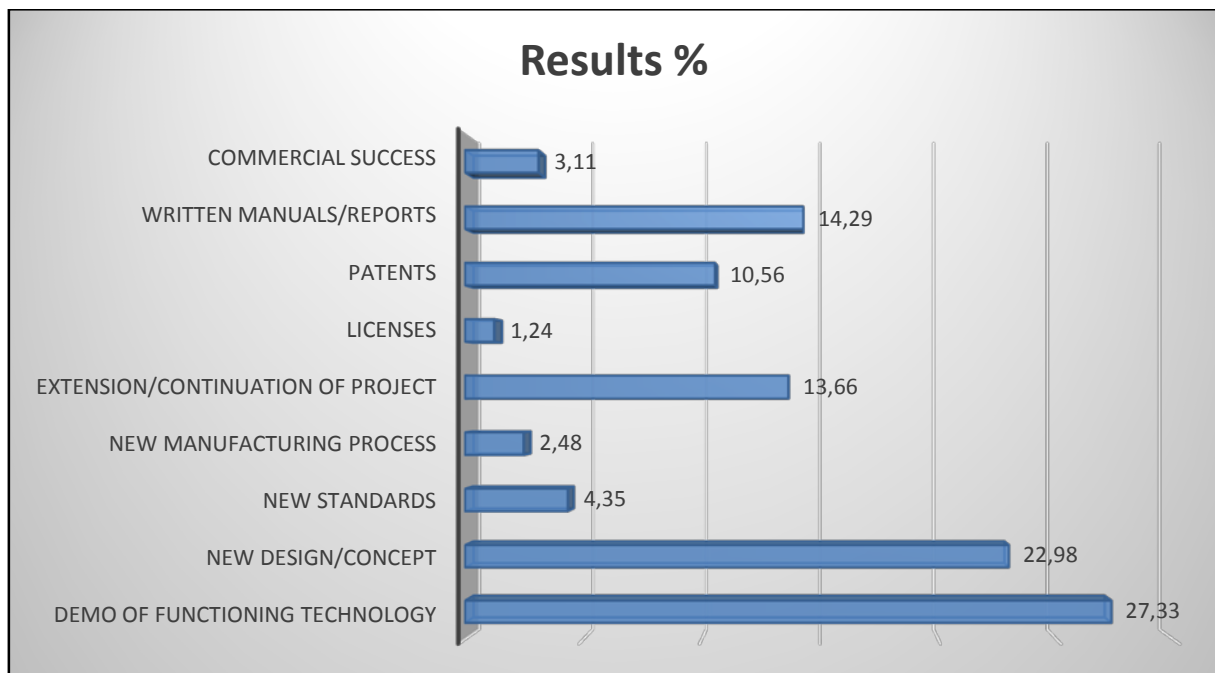

Figure 4.1 Question 5 Has the project resulted in any of the following? (N=62)

As shown in figure 4.1, 27% of the projects resulted in a successful demonstration of working technology and 14% reported that their work had resulted in an extension of the existing project or the establishment of a new project, suggesting that the project was promising, but incomplete. In terms of other measurable outcomes, 23% reported that they had produced a new design or concept and 14% reported that new manuals or reports had been produced.

We did not provide a Not Applicable (N/A) option to this question, but 20% declined to answer and the comments indicate that many projects are unfinished, some have patents pending, others have products on the market, but would not yet classify themselves as commercial successes. Some projects were stopped before completion and others had successfully demonstrated their technologies, but had handed over to others for upscaling. This suggests that results are even more nuanced than our analysis gives room for.

We included a question (q40) which would give us some information on the novelty value of the project. 78% reported that the technology or product being tested/demonstrated was radically new, confirming ideas that demonstration projects are potentially important contributors to innovation.

As well as the direct results of the projects, we were also interested in finding out if the project leaders thought that the project might have produced other effects. In question 20, we asked if the project had contributed to increased public awareness, changes in public opinions or to changes in transport habits. We assumed that it might be difficult for project leaders to identify direct outcomes relating to users and therefore asked if they thought the project had *contributed to* increased public awareness. 67% were of the opinion that the project had increased user awareness, 32% changes in public opinions, while only 2% thought that transport habits have been changed. This is perhaps not very surprising given the fact that the main aims of these projects were related to technology and commercial feasibility.

When asked if the behaviour of firms might have been affected by the project (q21), 59% were of the opinion that the project had not produced any change in this respect. The comments to this question indicate that some projects leaders think that behavioural changes emerge over a much longer period of time, some suggest that other firms in the value chain have improved their understanding, but not necessarily changed their behaviour.

When asked if the project had resulted in environmental improvements (q23), 74% said yes, however the comments suggest that some of these improvements may not be measurable, e.g.:

- "awareness of decentralised biogas"
- "we believe more fast chargers have resulted in more EVs being sold and used though there's no fixed relation"

and some point towards potential improvements such as:

- "more energy can be extracted from the water".

However, there are some good examples of measurable results such as reduced emissions, replacement of diesel generators and measurable reductions in electricity use.

We also asked which business sectors benefit from the projects (q24). The sector, which benefits the most, is electricity generation with 35%, the next is personal transport at 11% (Figure 4.2).
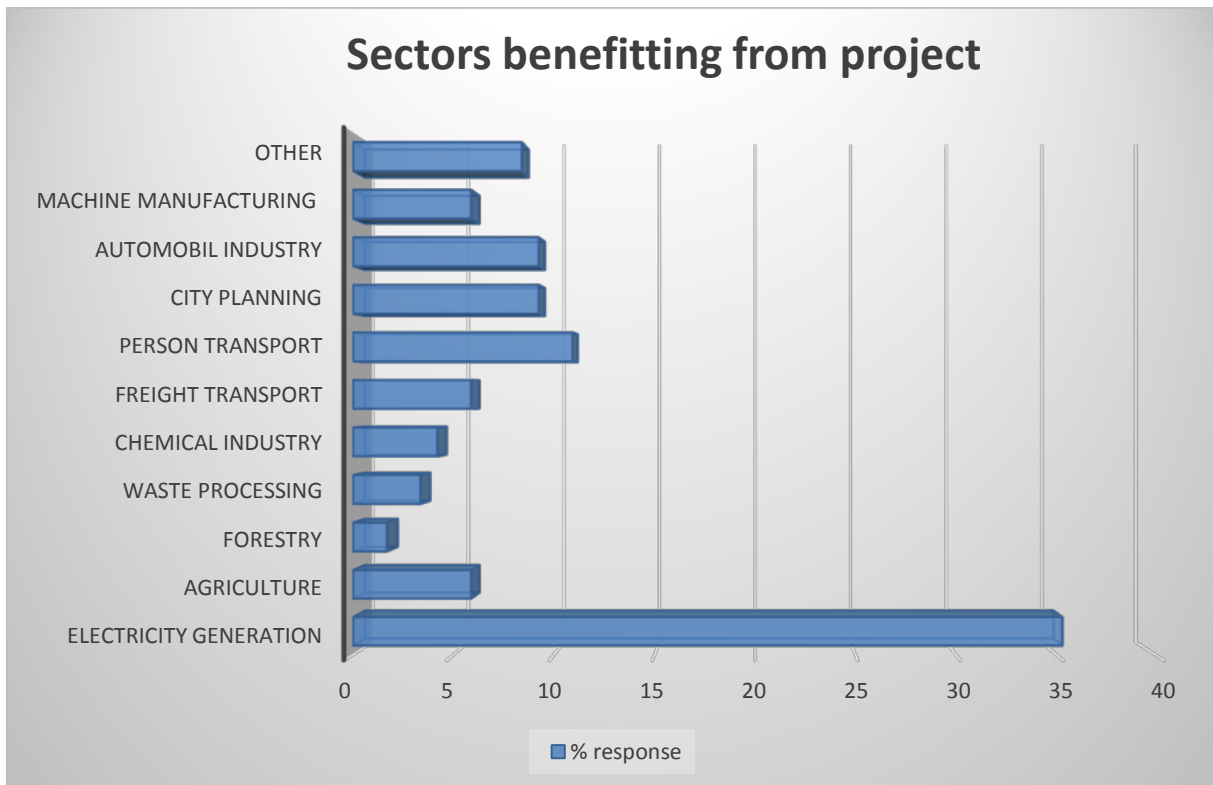
Sectors benefitting from project

Figure 4.2 Question 24 Which business sector(s) benefit from this project? (N=56)

It is interesting that only 2% thought that transport habits had changed, while 74% said their projects had resulted in environmental improvements. This suggests that the improvements are perhaps potential improvements, which have not yet been realised. Out of the sectors benefitting from the project, it becomes evident that electricity generation is the dominant sector and this might explain why project leaders do not view their achievements in terms of changed transport habits.

Since many of these projects find it artificial to impose a cut over time at the end of the demonstration project and many continue well beyond the planned demonstration time and budget, we also asked about the future potential of the technology being demonstrated.

- Do you think the technology could be used in other sectors in the future, perhaps with some adaptation? (q25)
- Is there a potential for the use of this technology to increase? (q26)
- Has the technology been used in new projects? (q28)

66% thought that the technology developed could be used in other sectors in the future, perhaps with some adaptation. There were a large number of comments to this question, indicating where respondents thought it might be used. These include automotive, shipping, pulp, solar power, desalination, heat pumps, public transport, marine applications, aviation, bioethanol production, waste treatment, enhanced oil recovery, water treatment, and propulsion.

65% of respondents thought that there was potential for their technology to be used more internationally, while only 34% identified a potential increase in use nationally.

In addition to these questions, question 5 also has an option to report the initiation of new projects as an effect of the demonstration project:

- "Extension of the project/new project to continue testing or demonstration of this technology".

When asked about the results or the outcome of the project, 14% reported that their work had resulted in an extension of the existing project or the establishment of a new project.

In summarising the findings on results and effects, it becomes evident that our sample does not cover all aspects of renewable energy and that some of the choices in the survey were not relevant for many of the projects. The findings show that the majority of respondents achieved working demonstrations of their technologies and were generally satisfied with the results. Few were willing to say that they had achieved commercial success however 14 % of the projects have spawned new projects or will be continued in some form (See Figure 4.1). Further research might be able to discover whether the projects are not reaching commercialisation because limitations in funding criteria, or are perhaps experiencing unexpected challenges in making new technologies work. Either way this might have implications for funding bodies. Lastly, it is evident that these demonstration projects are creating novel technological solutions, both in terms of working technologies, but also in terms of new designs and concepts as well as patents.

5 The Learning Outcomes of the Demonstration Projects

One of the expected outcomes of demonstration projects is learning in some form. This may be easily identifiable when respondents are asked if they know or understand something, which they did not know or understand previously. Some forms of learning are less obvious and may be defined as an increased awareness. The questions relating to learning outcomes were q6, q7, q8, q9, q10, q11, q12, q30, q31 and q32 (See Appendix 1) . Most of the responses to questions on learning are positive, particularly those referring to a better understanding of the technology and the costs. The details below refer to those at the upper end of the Likert scale of 1 to 5, where 1 is to a lesser extent and 5 is to greater extent, i.e. it is the sum of those reporting "to a greater extent" and "to a considerable extent".

- 85% reported that they now have a better understanding of how the technology functions (q6).
- 46% reported improvements in their understanding of manufacturing processes (q7).
- 69% reported that they now have a better understanding of the practical use of the technology by users (q8).
- Almost all participants gained a better understanding of the costs – (spread between "somewhat better" and "to a great extent") 82% (q9).
- 41% reported a better understanding of consumer behaviour and preferences (q10).
- 46% reported a better understanding of the market (q11).
- 52% reported a better understanding of how to work with suppliers and customers (q12).

As expected, the greatest learning was in how the technology functions. This matches well with the original aims of the project. In spite of the low number of projects aiming to improve market awareness and gain a better understanding of consumers, many projects appear to have made progress in these areas. However, the surprises were in how many of them stated that they learned more about the costs and more than half had developed a better understanding of how to work with suppliers and customers. This latter point was confirmed by some of the comments, which suggest that project leaders were also surprised at how much effort this collaboration required.

We included some reflective questions relating to increased awareness, as we consider this an important learning outcome of a demo project.
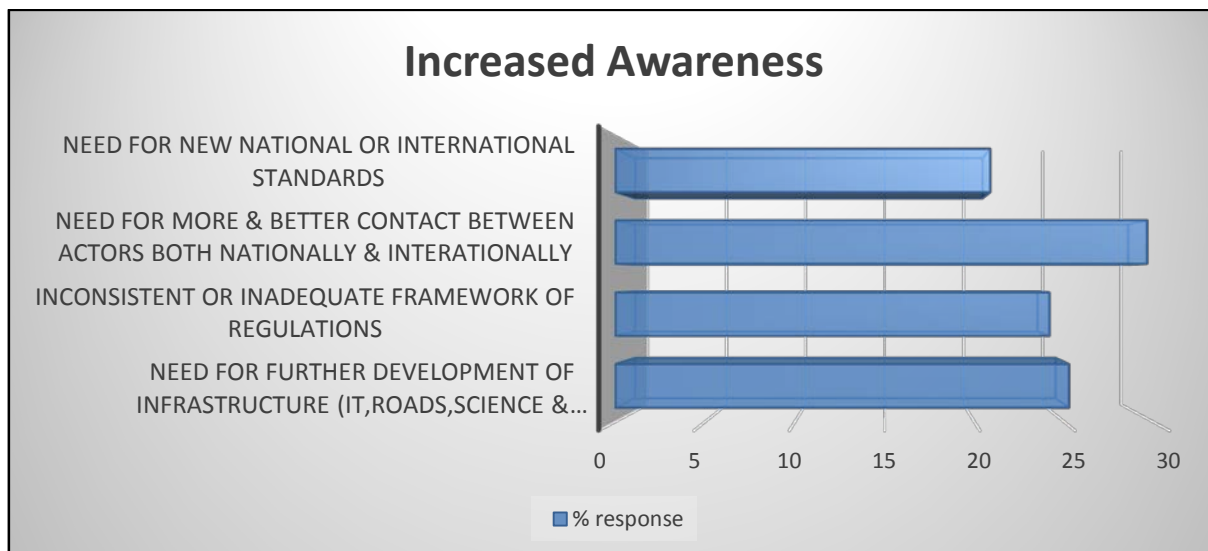
Figure 5.1 Question 30 Has the project made you more aware of a need for any of the following (N=46)

As shown in Figure 5.1, respondents reported that the project had resulted in an increased awareness of all the issues we had included. 29% reported better awareness of the need for more contact with other actors both nationally and internationally (q30).

In question 31 we asked project leaders if they had become more aware of weaknesses in the public funding system. 47% said yes. The comments suggest that there is wide range of reasons for this. These range from the cash-flow challenges of SMEs to the lack of funding for basic research. The comments also provide examples of a severe lack of knowledge among public service employees, bureaucratic constraints and lack of alignment of national policies in international projects. A recurring issue in the comments is the length of time it takes to develop robust technologies within this field and how the public funding system does not make the necessary allowances for this.

We also asked if the project leaders had become aware of limitations in the national economy, which might hinder the transition to sustainable transport. In spite of all the weaknesses identified in the public funding system, 84% of respondents answered no. One of the comments from Norwegian respondents was that the largest proportion of the energy research budget goes to research on fossil-based fuel. There were also comments to the effect that money is there, but the consumers are not yet asking for the products. There was also a comment that Sweden lacked the political will for a transition to sustainable transport systems.

Learning environments (q38, q13, q14, q15)

Due to the importance of learning in demonstration projects we wanted to find out if anything was being done to create a learning environment; either a physical or a virtual environment where participants can interact with each other and with their technology. Learning might be expected to occur in discussions between participants, or it might be the result of a trial and error process, or the result of comparative processes. Project participants are not always aware that learning has taken place. It is also common to find learning environments have emerged, regardless of the intentions of the project leaders. The survey included some indirect questions, which might provide an indication of whether the project environment was conducive to learning or not.

66% of the projects allowed for new or unplanned development of the technology to take place (i.e. in addition to fault fixing(q38)). For example, some mention switching design, or developing new designs for integration, a simulation model was improved to analyse some losses not originally considered

relevant. Parameters were optimised etc. New solutions to charging infrastructure were developed and new standards were developed.

When asked about the extent to which the project provided the opportunity to find faults and fix them, 43% said either to a considerable or to a greater extent (q13).

Not only was there room for fault fixing in the projects, but the participants also had the opportunity to test alternative solutions, as shown in Figure 5.2 (q14):
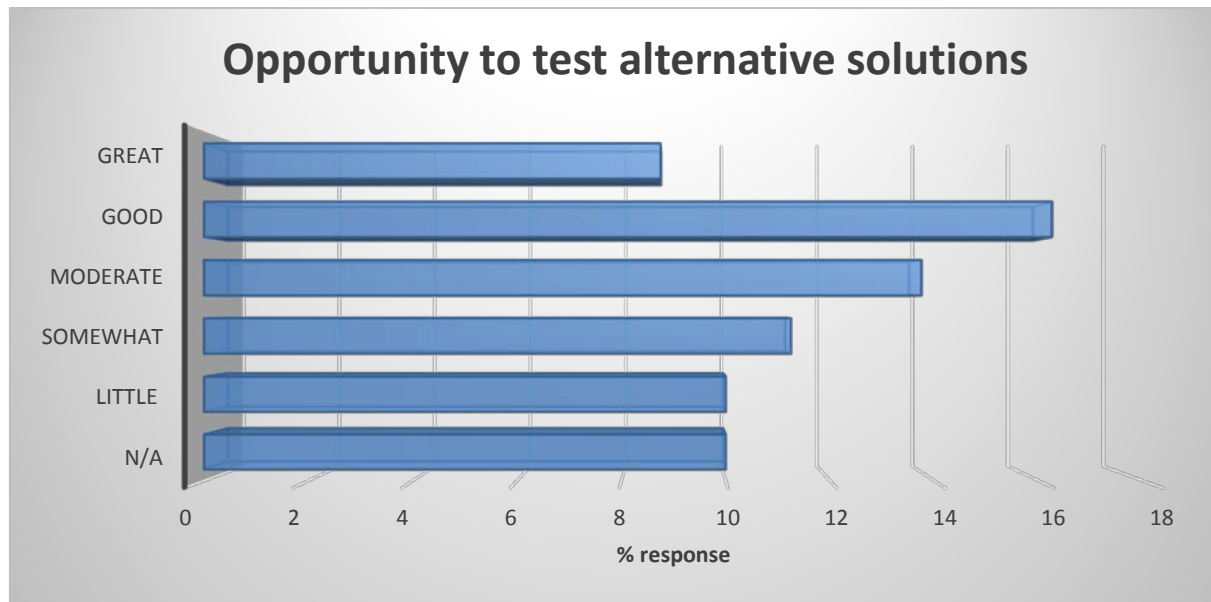

Figure 5.2 Question 14 To what extent did the project provide the opportunity to test alternative solutions? (N=56)

The opportunity to obtain feedback from users is also considered as an important prerequisite for a learning environment. It appears as if the projects in the survey have managed to get access to this valuable feedback (q15). 26% report "to a greater extent" and 10% to a considerable extent.

In summary we can say that the project managers reported a positive learning experience. Most of this learning was related to gaining a better understanding of how the technology worked in practice. Fewer were able to say that they had learned much about consumer preferences and consumer behaviour. This matches quite well with the reported aims of the projects. Findings also suggest that there were good opportunities to learn by testing alternatives and by using trial and fail methods as we would expect in demonstration projects. Some of the more interesting finds were that project managers reported becoming aware of the need for closer contact with project partners both nationally and internationally and comments suggest that the project managers were surprised at how much time it took to develop close working relationships and to understand each other (this finding has been confirmed in interviews). Most project managers also reported that they had developed a better understanding of the costs involved in developing the technology. While it was surprising that so many in planned and budgeted projects highlight this issue, this finding must be counted as one of the positive contributions of demonstration projects and we would expect that future developments will be based on a more robust economic estimates.

6 Improved understanding of consumers and markets

Here we discuss the findings related specifically to consumers and markets. Some of the results showing the extent to which respondents thought they had learned more about consumer behaviour etc. are also mentioned above under the "Learning".

A typical aim of a demonstration project is to be able to have a product to show potential clients or users of the product. Depending on the type of product, they may be able to try it out, to touch it or just to see that it actually works. This contact between consumers and the technology can give valuable feedback to designers and developers and help to identify potential problems at an early stage. The literature reviewed in work package one (Hoogma et al., 2002) suggested that, within sustainable transport, few of the demonstrations were aimed at engaging consumers and even fewer succeeded in changing users habits. Hoogma's cases were concentrated on the development of alternative forms of personal transport, where one might expect a high degree of end-user participation. Our study includes demonstrations of new forms of personal transport, however we also include demonstrations of new ways of producing sustainable energy. In the latter examples it is not so relevant to include end-users therefore our results are not directly comparable with Hoogma's.

The survey included some questions designed to obtain data on the issue of user involvement:

- a better understanding of the practical use of the technology by users (q8)
- a better understanding of how to work with suppliers and customers (q12)
- a better understanding of consumer behaviour and preferences (q10)
- a better understanding of the market (q11)

In response to the first two questions above, over 50% reported positive results[2] 69% and 52% respectively. While the latter two questions received, lower scores (See figure 6.1):

41% reported a better understanding of consumer behaviour and preferences (q10).

46% reported a better understanding of the market (q11).

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[2] These figures are the sum of two categories on the Likert scale "To a great extent" and "somewhat better".

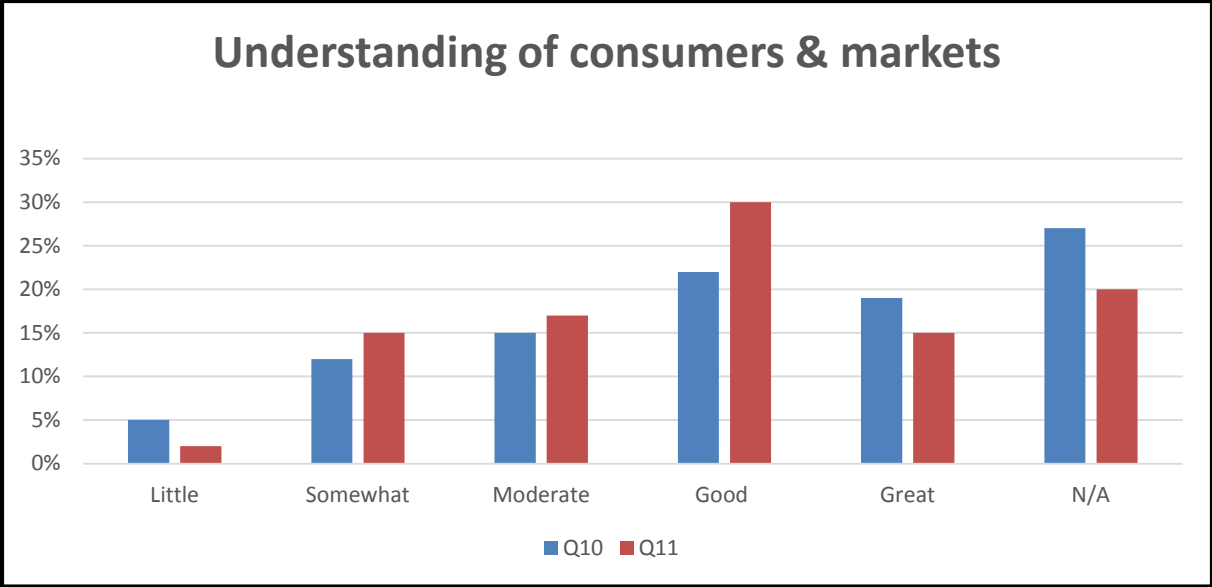**Understanding of consumers & markets**

Figure 6.1 Better understanding of consumers (q10), better understanding of markets (q11) N=59.

To summarise, one can say that the majority of our sample did not aim to learn much more about consumers or markets, our sample projects were obviously very technologically oriented, one indication of this is the high number who reported that this question was not applicable to them. It is interesting that there was such a positive response to question 8, i.e. if the project managers thought the project had resulted in a better understanding of the practical use of technology by users. There are no comments to illuminate these results and it could indicate that the users of the technology are not consumers, but are other technologists in another part of the supply chain. As indicated in section 4, the sector benefitting from most of our sample projects was "Electricity generation", where we might expect important improvements based on new technologies, without consumer use of the technology being changed.

7 Project organisation and management

The organisation and management of all projects is an important factor in their success. Earlier literature on demonstration projects has suggested that they face a particular challenge with regard to the expectations of participants and how projects manage to align these expectations (Borup et *al.* 2006; Bakker et *al.* 2012)

We included a few questions designed to pick up some information on these issues and also to gain a better understanding of some of the more common challenges of collaborative projects such as risk sharing etc.

Internal issues in the project and the project context (q33, q34, q35, q36 + comments to evidence of learning processes in projects i.e. q 13 – 18)

- Did the project find good ways of resolving conflicts? (q33)
- Do you think that the different participants had different expectations of the project? (q34)
- Do you think that expectations became better aligned during the project? (q35)
- Was the economic risk spread evenly between partners? (q36)

30% of respondents managed to find good ways of resolving conflicts, but 32% stated that the question was not relevant; therefore, we can assume that they had few or no conflicts. Some of the comments are more revealing here:

- We addressed risk assessment
- There was a continuous need to support cooperation between many types of stakeholders
- We had a good dialogue at an early stage
- An external steering group was installed
- Project governance was clarified
- We had weekly web-meetings to keep key information flowing
- We listed up mistakes and conflicts

These comments are very short; however, they suggest that project leaders have deliberately included activities and mechanisms in order to reduce the risk of conflicts.

38% of respondents stated that participants had different expectations of the project; however, 42% stated that they were able to align their expectations during the project.

44% stated the economic risk was unevenly spread between participants. Based on this result we might have expected more conflict, however it is not unusual that one business partner bears the brunt of the risk and presumable derives the largest part of the profits.

Our findings suggest that some time is being spent on resolving conflicts and aligning expectations and the comments suggest that many of the tasks being carried out are related to communication and clarification. While the comments registered give us some useful information, interview data is necessary to gain a better understanding of conflict alignment.

8   National Comparisons

The theoretical basis for our project is the concept of technological transitions[3] (Kemp et *al.* 2007, Harborne et *al.* 2007) and these transitions must be viewed, not only at the level of the project, but also at the national level. We would expect national differences due to different policy decisions and differences in national industrial structures. Therefore, we have included some national comparisons. The number of projects is very low and with a low response rate there is a risk that the results do not give a realistic picture of national differences. We have, however analysed the differences revealed in our sample.
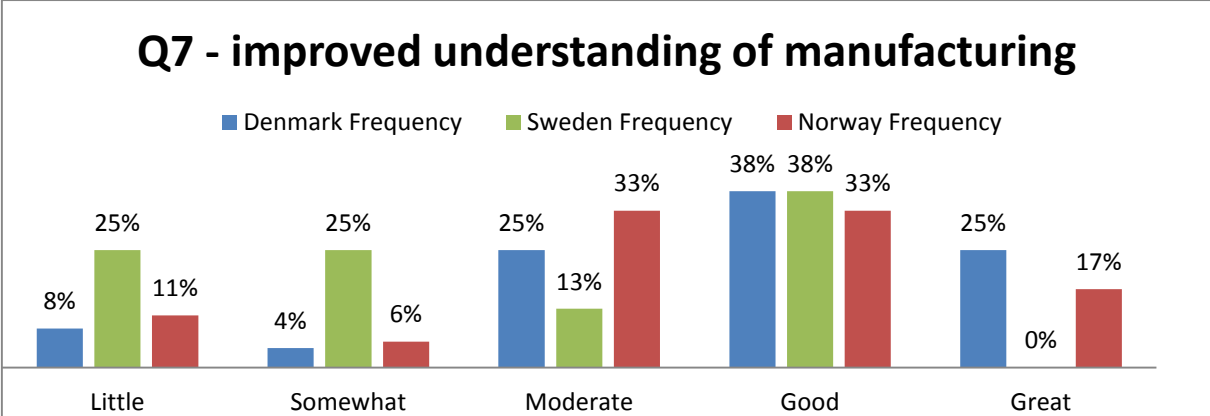
Figure 8.1 Q7 Improved understanding of manufacturing (N=59)

DK N=25, SE N=12, NO N=22

Most projects reported an improvement in their understanding of manufacturing; however, Swedish projects reported this less frequently than Norway and Denmark as shown in Figure 8.1.

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[3] Technological Transitions (TT) are defined as major technological transformations in the way societal functions such as transportation, communication, housing, feeding, are fulfilled. TT do not only involve technological changes, but also changes in elements such as user practices, regulation, industrial networks, infrastructure, and symbolic meaning. An example is the transition in offices from punched card technology and small office technology to digital computers, 1930–1960 (Van den Ende and Kemp, 1999). See also Geels 2002.
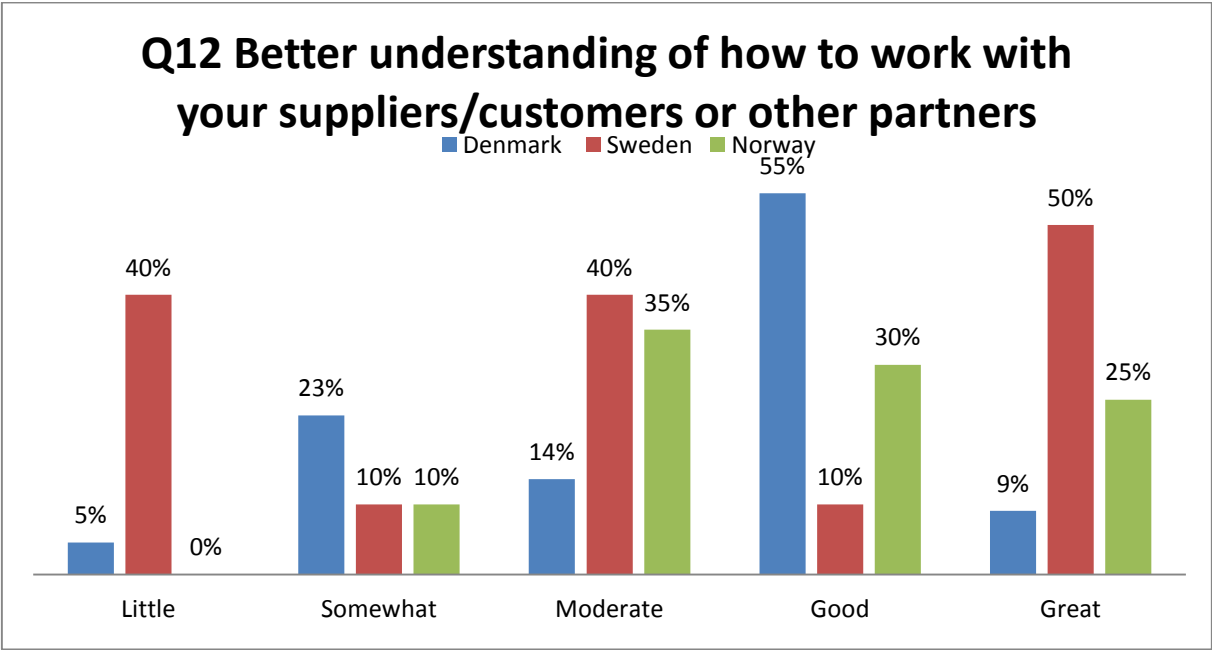
Figure 8.2 Q12 Better understanding of how to work with your suppliers/customers or other partners (N=58)

DK N=24, SE N=12, NO N=22

Norwegian projects reported better improvement in understanding of how to work with suppliers/customers or other partners, while Swedish projects reported the lowest improvement. (See Figure 8.2).

The question about the opportunity to remedy faults was designed to find out how much development was actually going on in the projects.
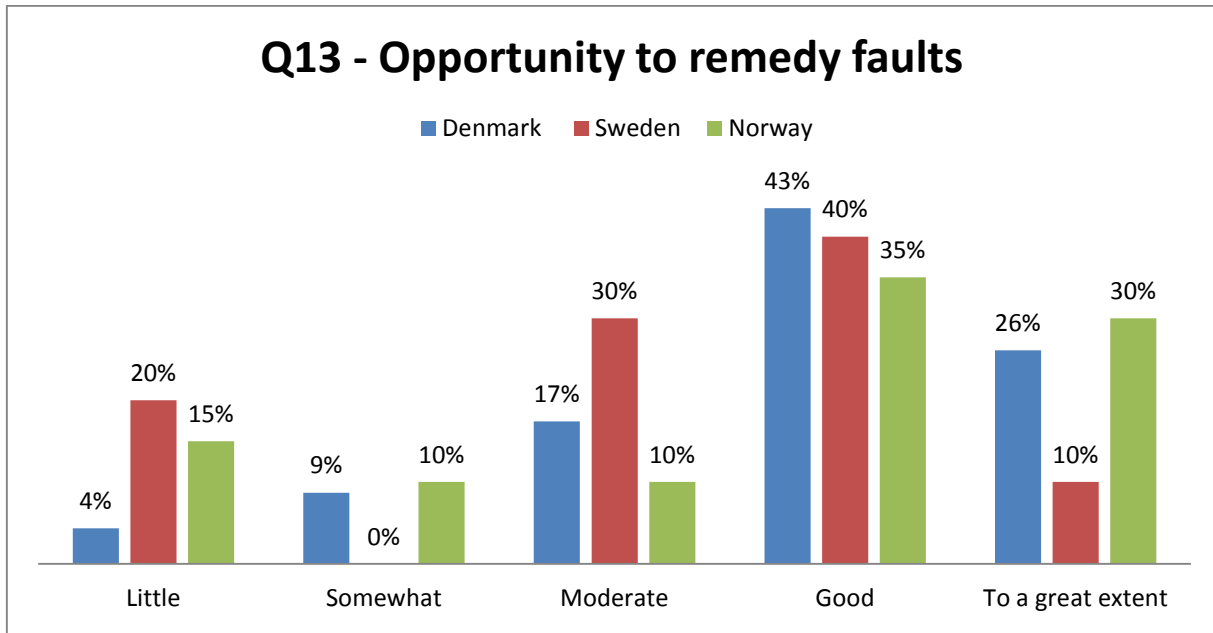
Figure 8.3 Q13 Opportunity to remedy faults (N=59)

DK N=25, SE N=12, NO N=22

The results suggest that fewer of the Swedish project leaders felt that they had this opportunity to a great extent (Figure 8.3). This result might be because the Swedish projects have fewer faults to remedy, suggesting that they have come further in their development and that there is less new development occurring in these projects. This is supported by Q14 about the opportunity to test alternative solutions; in this case, Sweden reported a greater opportunity for this than the other countries. The limited opportunity to remedy faults might mean that there are just as many faults to be remedied as in the other countries, but that for some reason, they are not remedied. In the latter case, this might be due to stringent project management or less emphasis on time on time for fault-finding in the planning and budgeting stage.

In question 15 we asked about the opportunity to get feedback from users (Figure 8.4). In this case, we have included the numbers who answered that it was not applicable and those who did not respond at all to the question.
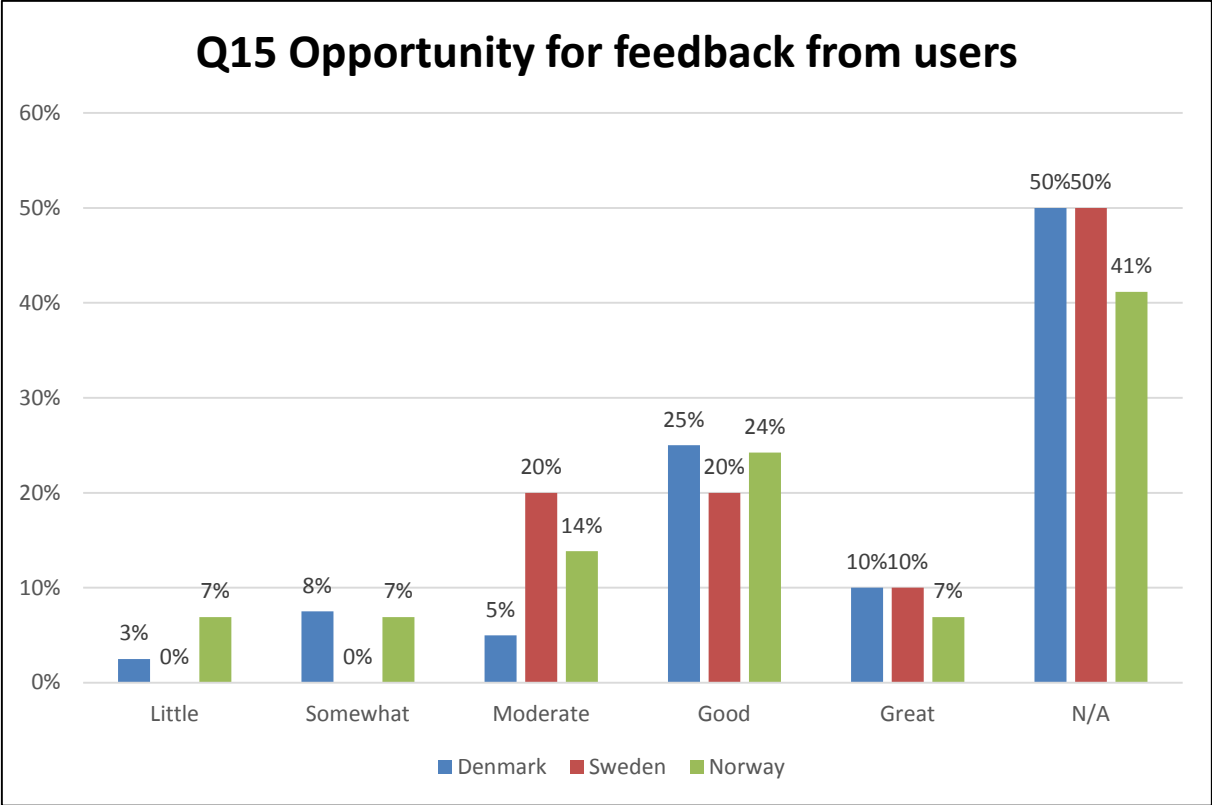
Figure 8.4 Q15 Opportunity for feedback from users (N=58)

DK N=25, SE N=12, NO N=21

If we assume that those who answered N/A (not applicable) do not see their demonstration projects as providing an opportunity for feedback from users, then we must conclude that there is very little opportunity for user feedback in our sample. Some of this may be due to the nature of some of the technologies and some may be because many projects are still at an early stage in their development and thus not yet ready to be given to users. In this case the Norwegian projects provided less opportunity for feedback than those in the other countries.
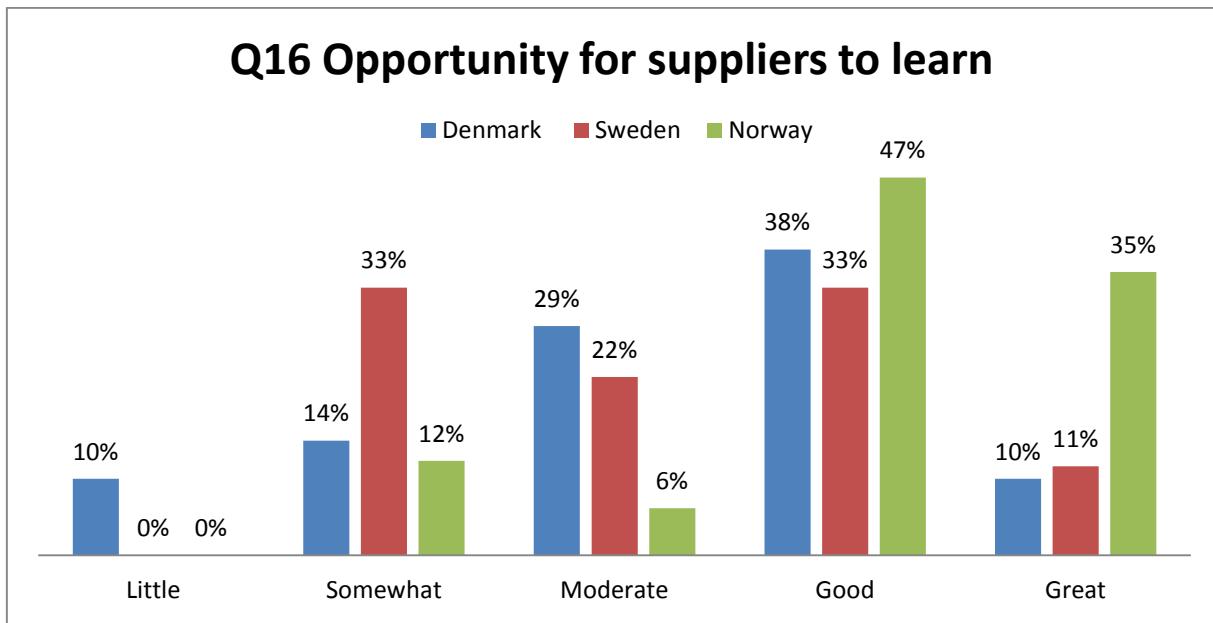
Figure 8.5 Q16 Opportunity for suppliers to learn (N=58)

DK N=24, SE N=12, NO N=22

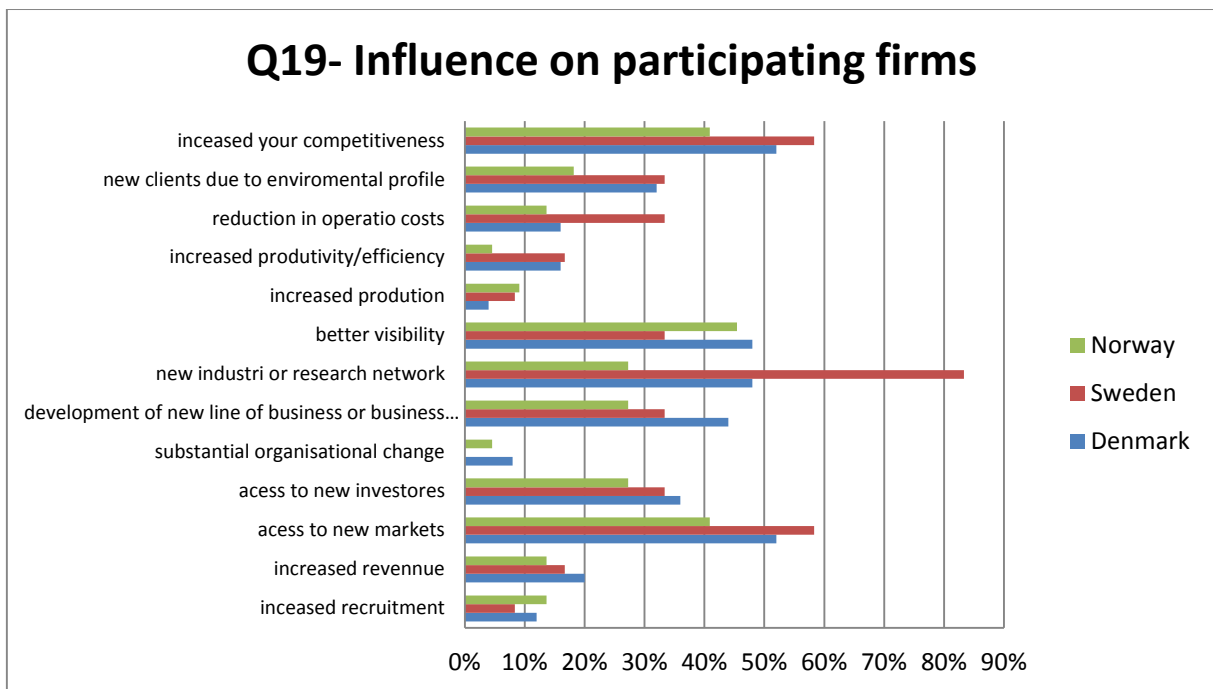Stakeholder learning was higher in Norway than in the other countries (Figure 8.5).

Figure 8.6 Q19 Influence on participating firms (N=54)

Respondents were free to choose multiple answers.

Answers to question 19 suggest that the Swedish projects had a greater influence on the creation of industrial or research networks, as shown in Figure 8.6.

The business sectors benefitting from the projects were largely electricity generation in all three countries, however in Sweden there were also benefits for public transport, urban planning and the automobile industry (Figure 8.7).
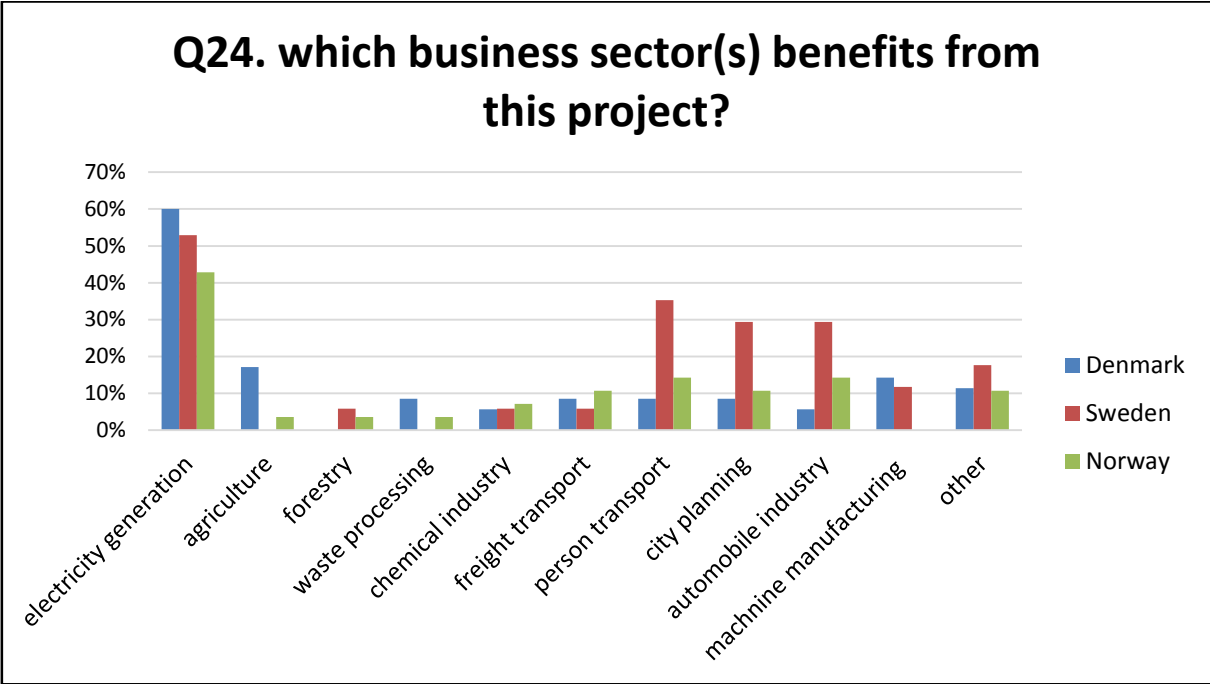

Q24. which business sector(s) benefits from this project?

Figure 8.7 Q24 Business sectors benefitting from the project (N=58)

Respondents were free to choose multiple answers.

Few obvious patterns have emerged from the analysis of the international comparisons, however we can see some indications which support some of the findings of the network analysis (Klitkou et *al.* 2014). In response to questions relating to cooperation with other parties such as industrial partners or users, Sweden gained less from this than Norway or Denmark. With regard to the opportunity to learn in these demonstration projects, the differences between the countries were small. The firms participating in the Swedish projects gained better access to markets, improved competitive position and new networks (80%). This suggests that the landscape of industrial collaboration in Sweden is different from the two other countries, something which is examined more closely in Klitkou et *al.* (2014). Another difference between Sweden and the other countries becomes obvious when we look more closely at the sectors benefitting from the technology. We find that automobile manufacture, personal transport and urban planning are more prevalent in Sweden than in Denmark and Norway.

9   Discussion

The results of a survey of this kind can be influenced by the type of projects included. We already know from our analysis of data from the funding authorities that there are projects relating to various aspects of hydrogen and hydrogen vehicle technology, technology related to electricity production and usage and to the production of biofuels (Dannemand Andersen et *al.* 2014). As well as all the different technologies, these projects are also in different phases of their development. Some of the projects in our sample have been completed, while others are ongoing. Some projects build on previous ones, while others see the potential for further development. We also know that there is a mix of firms stretching from small newly established firms to large multinational companies. These features of our sample should be borne in mind while analysing the data.

The largest group of projects in our sample aimed at demonstrating *technical feasibility (q4)*, combined with the results of question 39, where the largest group stated that their project was mainly *technical* (Figure 9.1), we can conclude that the projects in our sample were more taken up with technological than social issues. This is supported by the limited effects on consumer opinions and changed transport habits. If we look at the placing of projects on the technological – social scale (q39), we find that projects with the greatest focus on social change also aimed to create a new market (q4).
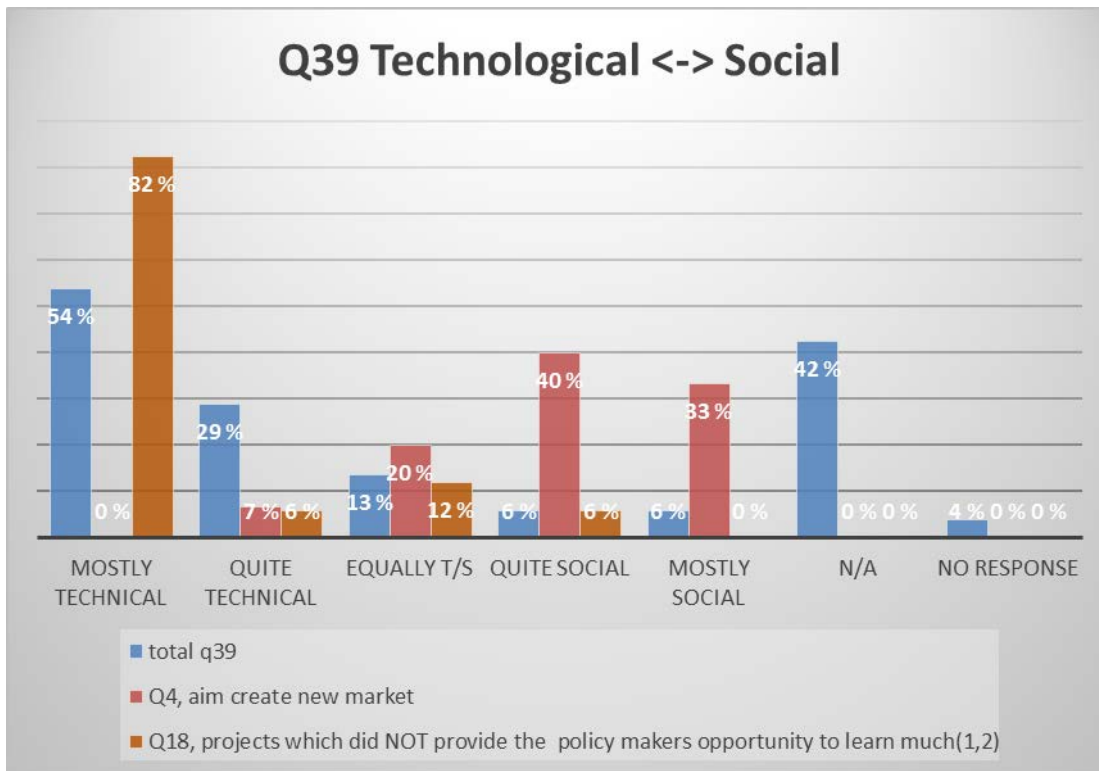
Figure 9.1 Technological, social, markets and policy learning (N=58)

We also note that those with the strongest technical focus where those which did not provide policy makers much opportunity to learn. This finding supports our conclusion that our sample contained mostly projects which were designed to develop technological knowledge, rather than change consumer behaviour or consumer perspectives.

There might be a number of reasons for this. One being that the projects in the survey were perhaps at an early phase in the development of a technology, when it is too early to test in a market. Another reason for this could be that some of the technologies being developed were components in larger technological systems, and as such might not require direct knowledge of the market or the consumer. If we then look at who benefitted from these demonstrations, the largest group is "electricity generation". This suggests technologies, which the end consumer might not come into direct contact with.

We have compared some of the responses to different questions and found, for example, that there is a relationship between the projects, which have had commercial success and those who developed a better understanding of cost as shown in Figure 9.2). [4] This is perhaps not surprising, however it highlights the contribution of the demonstration phase of a new technology, when calculating the future development and commercialisation of the technology.

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[4] Responses to q5 were broken down and matched against q9 responses, so that of the 30% who said that they had a good improvement on their understanding of costs, 40% reported commercial success as one of the outcomes of their project.
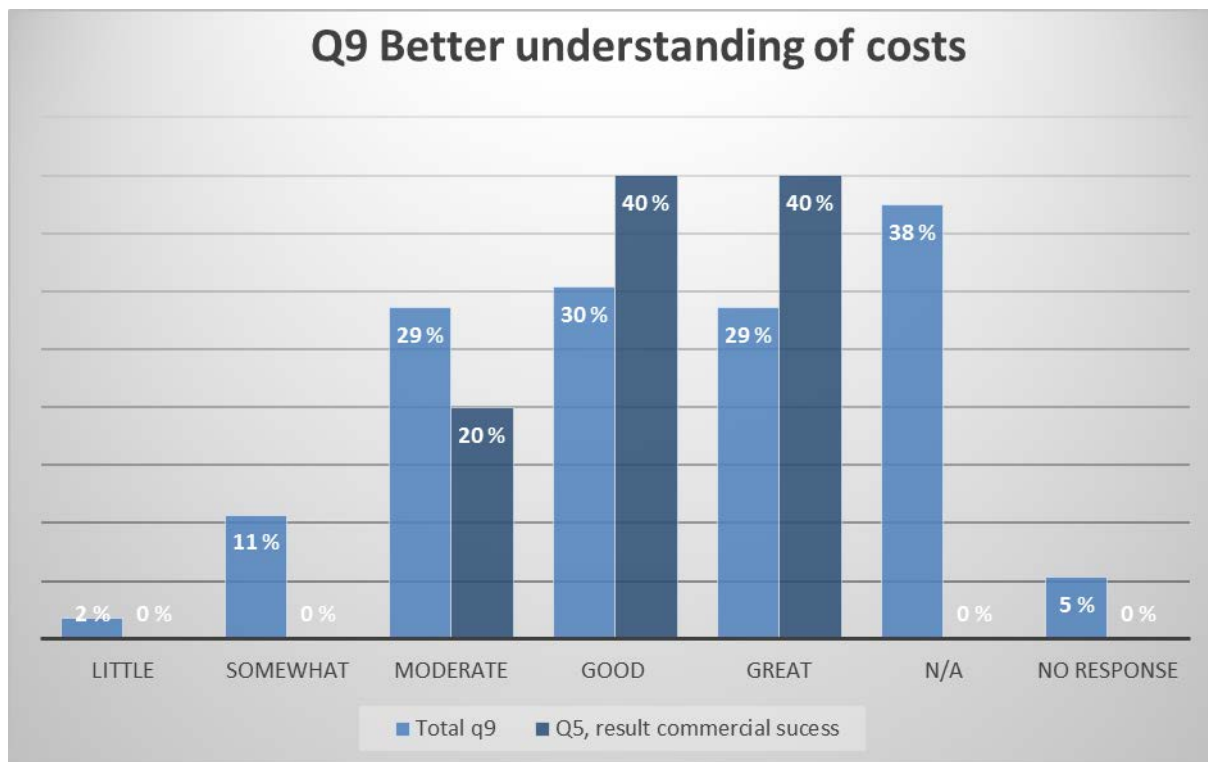
Figure 9.2 Commercial success and better understanding of costs (N=59)

Learning in various forms and by various groups of participants was a central part of all these projects. The findings suggest that some of the learning occurred in the process of solving problems (q13), testing alternatives (q14) and by gaining feedback from partners. Learning was high among all groups except policy makers. In spite of all these claims, we also observe that 59% of firms reported that the behaviour of firms was not affected by the projects. From the comments and the responses, it appears that the firms were aware of the need for learning among the public and some respondents did include this as one of their intentions. When we compare this intention (q4) with the actual results (q5) of the projects, we find that very few report that the public learned much and certainly not that they had changed their habits. With little change in firm behaviour or consumer behaviour, we must assume that a lot of the learning occurred within the more limited frame of technology learning i.e. an improved understanding of the technologies, the way they work or how they are produced.

With regard to collaboration, we see that access to an industrial research network was reported as an effect (q19) and that gaining a better understanding of how to work with partners was the most common response. Respondents also became more aware of the need for better contact between actors, both nationally and internationally (q30). However, some of the comments suggest that this collaboration was more time consuming than originally estimated. This might be an indication that project managers lack experience in networked projects with multiple participants. However most projects appeared to find ways of resolving their problems and they managed to align their expectations, suggesting that project managers were quite capable in this respect.

The responses suggest that projects are functioning as learning environments with room for trial and error, testing of alternative solutions and indeed the freedom to develop new solutions in most of the projects. There are indications that the projects had a degree of unpredictability and 78% classified their projects as developing something radically new. These responses indicate that these demonstration projects include research activities, where the outcome is uncertain; they expect to deal with uncertainties and expect to solve problems in order to reach their goals. This confirms theories of demonstration projects as an important part of the research that goes into developing a new

technology and making it work. It also means that there is potentially a high degree of unplanned work. This has implications for the expectations of investors and for the businesses contributing resources to the project.

With regard to the national comparisons, there are indications that the Norwegian projects are in an earlier stage of their development than the other countries. This may be due to differences in the systems for funding of research and innovation in the different countries; however, it might also be due to predominance of different technologies in the sample. The electricity sector seems to benefit from most of the projects in all three countries, however in Sweden we see that personal transport, city planning and the automobile industry also benefit, sectors which are largely absent from the other countries. This latter point might be because Sweden is the only country in the survey with a tradition for vehicle production.

In conclusion we can say that this survey provides some interesting information, but due to the small sample size, broader conclusions cannot be drawn without supporting data from other sources.

10 Reflections on the Validity and Reliability of the Survey

The methods used in this survey were appropriate for gathering data on aims, results and effects of these projects and developing a comparative analysis of the Nordic countries. However, with such a low response rate (22%), we cannot use the results of this survey to demonstrate causality. We can however use the data as examples of demonstration projects and use the analysis to support other findings and as an indication of factors, which should be studied in more depth in interviews and case studies.

As with all surveys, there is a risk that questions will be misunderstood or interpreted differently. In order to reduce the risk of this, we circulated the proposed questions to all InnoDemo project partners and gained feedback in several iterations. As well as testing the survey internally, we also tested it on two potential respondents. We included a field for comments, so that participants who feel their answers did not fit into the framework could explain. We chose to send this survey to the project managers and not to all participants, so there is a risk that their view of events will be just that, *their* view. In other words, the results will not necessarily represent other participants, than the project managers. Otherwise, many of the questions are based on the opinions of the project managers and as such are open to the interpretation of the individuals involved.

Appendix 1 Questionnaire

1. **Confirmation of participation**

2. **Confirm project name**

3. **Confirm project start dates**

4. **Aim of the project:**
   - To test new technology & prove technical feasibility
   - To scale up technology
   - To build a manufacturing facility
   - To develop manufacturing processes
   - To prove commercial feasibility
   - To prove environmental benefits
   - To improve the visibility of the firm
   - To improve the visibility of the technology/product
   - To test the market
   - To create a new market
   - To gain a better understanding of consumer reactions
   - To improve public acceptance
   - To gain a better understanding of costs (building, production)
   - To develop relationships with supplier and/or distributers
   - Other
     - Please describe

5. **Has the project resulted in any of the following?**
   - A demonstration of functioning technology
   - A new design/concept
   - New standards
   - A new manufacturing process
   - Extension of the project /new project to continue testing or demonstration of this technology
   - Licenses
   - Patents
   - Written manuals or reports
   - Commercial success

6. To what extent did the project result in a better understanding of how the technology functioned? (Please choose on a scale of 1 – 5, where 1 is to a lesser extent and 5 is to greater extent).

7. To what extent did the project result in a better understanding of manufacturing? (Please choose on a scale of 1 – 5, where 1 is to a lesser extent and 5 is to greater extent).

8. To what extent did the project result in a better understanding of the practical use of technology by users? (Please choose on a scale of 1 – 5, where 1 is to a lesser extent and 5 is to greater extent).
9. To what extent did the project result in a better understanding of the costs? (Please choose on a scale of 1 – 5, where 1 is to a lesser extent and 5 is to greater extent).

10. To what extent did the project result in a better understanding of consumer behaviour and preferences? (Please choose on a scale of 1 – 5, where 1 is to a lesser extent and 5 is to greater extent).

11. To what extent did the project result in a better understanding of the market? (Please choose on a scale of 1 – 5, where 1 is to a lesser extent and 5 is to greater extent).

12. To what extent did the project result in a better understanding of how to work with your suppliers/customers or other partners? (Please choose on a scale of 1 – 5, where 1 is to a lesser extent and 5 is to greater extent).

13. To what extent did the project provide the opportunity to find faults and remedy them? (Please choose on a scale of 1-5, where 1 is to a lesser extent and 5 is to a greater extent).

14. To what extent did the project provide the opportunity to test alternative solutions? (Please choose on a scale of 1-5, where 1 is to a lesser extent and 5 is to a greater extent).

15. To what extent did the project provide the opportunity to obtain feedback from users? (Please choose on a scale of 1-5, where 1 is to a lesser extent and 5 is to a greater extent).

16. To what extent did the project provide the opportunity for suppliers & distributors to learn? (Please choose on a scale of 1-5, where 1 is to a lesser extent and 5 is to a greater extent).

17. To what extent did the project provide the opportunity for stakeholders to learn? (Please choose on a scale of 1-5, where 1 is to a lesser extent and 5 is to a greater extent).

18. To what extent did the project provide the opportunity for policy makers to learn ? (Please choose on a scale of 1-5, where 1 is to a lesser extent and 5 is to a greater extent).

19. From the point of view of the firms participating in the demonstration project, would you say that the project has influenced any of the following? (Choose all relevant):
    - Increased recruitment
    - Increased revenues
    - Access to new markets
    - Access to new investors/easier access to finance
    - Substantial organisational changes e.g. merger or takeover
    - Development of new lines of business or business models
    - New industrial or research network
    - Better visibility
    - Increased production
    - Increased efficiency/productivity
    - Reduction in operating costs
    - New clients due to the environmental profile
    - Increased competitiveness

20. In your opinion, has the project contributed to any of the following? (choose all relevant)
    - Increased public awareness of technology/product
    - Changes in public opinions on the technology/product
    - Changes in transport habits
        o If Yes , please describe (free text field)
    - Changes in the behaviour of firms

o   If Yes, please describe (free text field)
- On reflection, do you think government agencies should have been more involved? Y/N

21. In your opinion did the project have the effect of changing the behavior of the firm? Y/N

22. On reflection, do you think that government agencies should have been more involved? Y/N

23. In your opinion, has the project produced any environmental improvements? Y/N

24. Which business sector(s) benefit from this project? (choose from all relevant sectors from the following list):
    o   Electricity generation
    o   Agriculture
    o   Forestry
    o   Waste processing
    o   Chemical industry
    o   Freight transport
    o   Person transport
    o   City planning
    o   Automobile industry
    o   Machine manufacturing
    o   Other please specify (free text)

25. Do you think the technology could be used in other sectors in the future, perhaps with some adaptation? Y/N

26. Is there a potential for the use of this technology to increase? Y/N

27. Did the project include attempts to develop supporting technologies? Y/N

28. Has the technology been used in new projects? Y/N

29. Did the project include attempts to develop a new infrastructure? Y/N

30. Has the project made you aware of a need for:
    o   Further development of the physical infrastructure such as IT, roads, science & technology infrastructure to make this product/technology successful
    o   Has the project made you aware of limitations in the national economy, which might hinder a transition to a new socio-technical regime
    o   A consistent and adequate framework of regulations
    o   More and better contact between actors, both nationally and internationally
    o   New national or international standards

31. Has the project made you more aware of weaknesses in the system of public funding which could be improved?

32. Has the project made you more aware of limitations in the national economy, which might hinder a transition to sustainable transport? Y/N

33. Did the project find good ways of resolving conflicts Y/N

34. Do you think that the different partners had different expectations of the project? Y/N

35. Do you think that expectations became better aligned during the project? Y/N

36. Was the economic risk spread evenly between partners? Y/N

37. Did the project achieve a good balance between developing the technology/product and demonstrating how it worked? Y/N

38. Were technological improvements allowed in the project (in addition to fault fixing)?

39. In your opinion was the project mainly a project to develop technology or was it more focused on social changes? Choose on the scale where 1 is mostly technological and 5 is mostly social.

40. In your opinion, was the technology/product you were testing/demonstrating radically new? Y/N

41. Were the project activities mostly related to verification or to creating something new? Choose on the scale where 1 is mostly verification[5] and 5 is mostly novelty.

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[5] Verification = to produce evidence of a working technology

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List of figures