Chapter 6 Barriers for innovation

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6.1 Introduction

In all industrial countries the governments embrace innovation as a source of future wealth. The European Union sees innovation as a key factor to become the most dynamic and competitive region of the world in 2010, as stated in the Lisbon agenda. In the Netherlands the previous administration has, under direct guidance of prime minister Balkenende, established the 'Innovation Platform' in order to promote innovation in society as much as possible.

This is not surprising. Countless studies have led to the conclusion that innovation is the main source of productivity rise and wealth creation, not only nowadays, but throughout the centuries.[1] However, history also shows that innovative developments often provoke strong economic and political resistance. Acemoglu and Robinson describe how the political establishment in the Russian and Austrian/Hungarian Empire tried to hold back the industrial revolution, because they perceived it as a threat to their political power.[2] In Islamic lands, religious leaders forbade the printing press as a source of blasphemy and heresy; according to Landes this is the main reason why the Islamic world started to lag behind the West in economic development.[3] And even today, access to the internet is restricted in China and other countries to secure political stability and protect the powers in charge.

In modern Western economies too, technological change does not emerge without provoking resistance. Innovation changes the established economic and political relations, so there are winners and losers. The mainstream view among economists is that the 'losers' oppose technological change in order to protect their economic interests. For instance, a monopolist may try to stop the introduction of a new, superior technology by a competitor, in order to protect its market share. Societies that want technological and economic progress, must arm themselves against this, for instance with an effective regulation of competition.

According to Acemoglu and Robinson, however, the 'political-loser' hypothesis is not completely satisfactory and certainly not complete.[4] It fails to explain why the economic losers don't use their power to capture the gains of innovation for themselves. This means that the power distribution must be accounted for as well. Groups or individuals without political power disadvantaged by economic and technological change cannot stop it. Those with economic and political power can. Hence, we have to consider economic and political institutions[5] if we want to understand how innovation is obstructed by important actors in society.

6.1.1 Economic and political losers

Economic analysis usually assumes that the market determines the level of technological development. Spurred by competitors, companies are developing new technologies all the time, creating new attractive products or more efficient production methods. This is the simple Darwinistic model of competition.

However, there are nearly always other factors besides market forces, namely the institutions constraining them. In the public sector, where the market fails, the decisions on technological developments are obviously taken in the political process. On the other hand, political interference in the private sector is not unusual. When public health and safety are at stake, there are good reasons to curtail the market for goods and services. Examples are new types of medicinal drugs and cars. Inevitably a 'political market' emerges, where *rent seeking* and lobbying by interest groups can determine the outcome of the innovation process or – even more effectively – where interest groups try to control the decision making process – the economic and political institutions.[6] There can be different reasons for individuals or groups in society to resist innovation.[7]

Loss of jobs

People may fear to lose their jobs. The best known examples were the Luddites in Britain, who fought tooth and nail over the introduction of weaving machines during the Industrial Revolution. They did not have the power to stop progress and some of them ended up on the gallows. There is little historical evidence that fear of job loss can halt technological progress, but it can slow it down. To what extent this fear can slow down

the innovation process, depends on the institutionalised decision-making process. Think of the current discussions about the influence of 'private equity' on corporate decisions.

Direct economic damage

New efficient production methods and technologies replace existing ones. Established companies lose market share or go out of business. Valuable knowledge and skills are lost. This is 'creative destruction' as defined by Schumpeter. The owners of those companies, knowledge and skills will try to slow down or block the introduction of new technologies, especially if it is difficult or expensive to switch to new technologies. Baldwin and Robert-Nicoud noted the asymmetrical nature of lobby activities for technological change: high sunk costs and exit barriers ensure that losers lobby harder than winners.[8] As a consequence, the government policy tends towards protection of vested interests.

Negative external effects

New technologies can also provoke resistance from groups without direct financial interests, because unfavourable external effects are feared. Nuclear energy, genetically modified food, the bio-industry, prenatal screening, megastores and numerous other innovations cause fear in society at large, because they could somehow damage the quality of the society. It depends – again – on the economic and political institutions to what extent resistance of external groups can block innovative developments.

Information problems and uncertainty

Every innovation, especially a fundamentally new one, creates uncertainty about the social consequences and who is to gain and who is to lose. That is why it will always be a matter of dispute if the market is the appropriate mechanism to decide. Precisely because the uncertainty is high, political debate, political pressure and propaganda are bound to influence decisions on technology. A remarkable example is nuclear energy, which is fully accepted in France, while there is widespread resistance against it in this country. Invoking technical experts is only a partial solution, since they usually have opposing views and expectations on the social consequences of important technological changes.

Distrust

Resistance against technological changes can also be the consequence of politically or culturally determined distrust. The introduction of quinine in England was banned at the end of the 17th century because the Jesuits had brought it to Europe; it was called 'Jesuit powder'.[9] There are many examples of major established companies ignoring major inventions done by small companies assuming "if it was really any good, we would have invented it ourselves' – the 'Not Invented Here" syndrome.

6.1.2 Market failures and coordination problems

Obstacles to innovation not always come from individuals or groups. They may also be the result of the nature of the market or the 'system'.

Lacking markets

For some inventions there is little if any market. This applies, for instance, to sustainable energy. As long as the costs to the natural environment and other external effects are not accounted for in the energy prices, the development of sources of sustainable energy is bound to remain slow and difficult. Nobody is willing to invest in a product if there is no prospect of commercial application. In theory it is the task of the public sector to correct this failure of the market. However, this has to be done cautiously, since government intervention can disturb the situation, creating new obstacles.

High costs of adaptation

Some innovations that are technologically superior, fail to break through because a large number of potential users has already chosen for inferior technology making the costs for adaptation too high. Economists call this 'path dependence' or hysteresis. The classical example is the DVORAK keyboard, which is considered superior to the standard QWERTY system, but has not broken through because all keyboards in the world would have to be replaced and everybody would have to learn to type again.[10]

System repercussions

More generally, the problems of the introduction and implementation of an innovation grow larger as the number of different actors, activities and technologies grows larger, in other words: if the system repercussions are greater. A switch from petrol to hydrogen or

bio-ethanol as car fuel does not only require different engines, but also far-reaching and therefore costly changes in the production and distribution system (refineries, filling stations), quality- and safety standards, technical knowledge in garages, fiscal arrangements (taxation of cars and fuel) , etc. Many forms of innovation, especially in the public sphere, can have far-reaching system repercussions.

Coordination problems

In some cases different actors are unable to agree on a common approach, bringing the innovation process to a halt. Uncertainty about the outcome, distrust of other parties or disagreement on the sharing of the costs and of the rewards can stand in the way of cooperation. In that case a moderator can play a useful role. This can be the government, but not necessarily so.

6.1.3 Counterproductive policy

All these factors can be reasons to reject the market mechanism for decisions on the development and introductions of new products and technologies. A 'policy' must be devised for the correction of failures of the market mechanism and to promote and guide innovation. This policy can involve many things: subsidies as an incentive to innovation; permits, procedures and quality control to assess innovations on their social impact; organisations to widen bottlenecks and remove obstacles; mediators and moderators to bring parties together and promote cooperation. However, all this does not guarantee optimal results. There is not only failure of the market, but also failure of policy. The government is susceptible to lobbying and *rent seeking*. The government too has to cope with uncertainty, incomplete information and tends to avoid risks. It can be manipulated by parties whose cooperation is necessary but who are pursuing their own interests. The need for transparency and accountability results in detailed regulation and bureaucracy which discourage the innovators. The policy can even create new obstacles to innovation.

6.1.4 Case studies

The following sections describe four cases of innovative developments meeting a variety of obstacles. These four cases are:

1. Wind energy in the Netherlands

2. The 'low noise coach' Whisper
3. The Electronic Patient Dossier
4. Energy houses

6.2 Blowing in the wind

In the 1970's interest in the Netherlands for alternative sources of energy – one of them being wind energy – grew, partly spurred by the oil crisis of 1973 . The government has tried to promote the development of wind turbines since those days, with considerable subsidies for research institutes and enterprises. While the Netherlands initially had a leading position in wind energy, it has clearly fallen back in the successive decades. Why has wind energy not been as successful as in other countries?

6.2.1 Netherlands must become front runner[11]

The 1974 White Paper on Energy contained an outline of a plan for the development of alternative sources of energy; with the government subsidizing and coordinating projects. Two new organisations were created: the LSEO, the Dutch acronym for a national coordinating committee for energy research, and the NEOM, the Dutch energy development company. The LSEO was responsible for, among other things, the selection of projects qualifying for a subsidy. The task of the NEOM was to promote projects and knowledge transfer between research institutions and commercial enterprises.

Although the country had no experience with the construction of wind turbines for energy production, the LSEO did not foresee problems in this area, because of a lengthy experience in the construction of classical windmills. This committee even expected a leading role for the country in the development of wind turbines. To this end, the government invested a large amount of money in R&D.

However, the construction of wind turbines appeared more difficult than expected in the 1980's. Due to technical problems and high maintenance costs, the needed investments turned out to be much higher than expected. The energy efficiency was disappointing. As a consequence, energy companies and major turbine manufacturers like Fokker and

Stork withdrew from the project. The government then changed its policy and concentrated on smaller manufacturers. They had started in the late 1970's with the production of smaller wind turbines and could not expect much government subsidy in those days. However, this change in government policy has not led to success either. Before the turn of the millennium most Dutch wind turbine manufacturers had gone broke or had been taken over by foreign competitors.[12]

Unlike in the Netherlands , wind energy in Denmark has proven very successful. Several Danish companies have conquered a strong position on the world market nowadays.[13] Countries like Spain and Germany also have a relatively successful wind energy policy. Table 6.1 indicates that the total wind energy capacity in these countries is much higher than in the Netherlands.

Table 6.1 Wind energy in nine countries in 2006

	Capacity (MW)	**Wind energy/ Total electr.prod.**
Denmark	3,136	20%
Germany	21,283	9%
Ireland	866	5%
Italy	2,285	1,5%
Netherlands	1,655	3,2%
Austria	965	3%
Portugal	1,874	9%
Spain	12,500	8%
USA	31,000	0,8%

Source: Wind Service Holland, 2007

6.2.2 Obstacles for wind energy

Lack of market demand

Although the price gap is narrowing, wind energy is still more expensive than fossil fuel, partly because the costs to the natural environment and other external effects are not included in the price of 'grey' electricity. Because this didn't make wind energy very interesting for private investors, the government had to create a market. It tried to do so by subsidizing R&D, investments and energy 'resupply' to the power grid.

At present, in the year 2007, wind energy is still not profitable and the market still depends on government subsidies. According to the Dutch Wind Energy Association the installation of land based wind turbines will not be possible without subsidy before 2014; at sea it will not be before 2021. Wind park subsidies until 2020 will amount to € 2,400 million (€ 500 million on land and € 1,900 million at sea).[14] Creating a wind energy market does not only take much time (several decades), but also a large amount of public means (a few billions of euros).

Lack of interest of energy companies

As a consequence of the lack of a real market for wind energy, private investors were hardly interested in small scale, sustainable energy production from wind. It just did not fit in the business model of any commercial enterprise. Energy companies were focused on large scale energy production from natural gas, coal, oil or nuclear fuel. Neither were they involved in the development of wind turbines. This attitude of the energy companies has changed a little in the 1990's, when subsidies for owners of wind turbines became available.[15]

No level playing field

Wind tubine owners produce wind energy for their own use, but supply their surplus production to the power grid (i.e. the energy companies), for which they receive financial compensation. The 'resupply' tariffs for this compensation have been kept low by the energy companies for a long time, leaving the wind turbines unprofitable in many cases. The unfair competition only came to an end in 1996 when the government started to add subsidy on these tariffs.[16] This sort of subsidy existed in other countries for a long time already, in Denmark even since 1984. Table 6.2 indicates that the 'buy-back' tariffs in the

Netherlands in 2003 were higher than in Denmark, Germany and Spain, but the country had lagged behind in the production of turbines so much, that it could not catch up anymore.

Table 6.2 Buy-back tariffs in four countries in 2003

	State subsidy since	Buy-back tariff (€ cent/kWh)
Denmark	1984	4.4
Germany	1991	6.2-9.1 *
Netherlands	1996	7.8-9.7 *
Spain	1994	6.3

* Depending on location
Source: Van Giesel en Van der Veen, 2004

Coordination problems[17]

Many parties were involved in the development of turbines in the 1970's and 1980's: the government, research institutes and major companies like Fokker and Stork. Although they did cooperate, they did not reach a successful common approach to any sufficient degree. An important problem was the minor role of the energy companies, who were the obvious potential buyers of the wind turbines, so the 'market' was not involved in the development.

The minor manufacturers of wind turbines too were ignored if it came to handing out subsidies. This only changed in the late 1980's , when the government adjusted its policy, after the major companies (Stork, Fokker) had withdrawn. Although small companies had sought cooperation with the research institute ECN, this cooperation had its limitations, since the ECN operates on a far more academic level than the more application oriented manufacturers. The mutual cooperation between minor manufacturers was practically non-existent.

Because of these coordination problems, little if anything was learned, preventing the rise of the level of technological innovation and practical application of wind energy in the Netherlands. In Denmark, in contrast, there has been close cooperation between manufacturers of wind turbines, owners and research institutes; small companies also cooperated closely. Moreover, the energy companies played a major role in the development of wind turbines; the Danish government has created a production company for wind turbines in cooperation with the energy companies. The good cooperation between technological research and application resulted in important learning effects. The success of the Danish wind energy policy is, according to Kamp, due to this learning process in particular.

6.2.3 Political windiness

Lacking a market for wind energy, the government had an important task in creating one. In practice, it has not been very successful in doing so. This section focuses on the reasons for this lack of success.

R&D-bias

As in many other countries, the development of wind turbines in the Netherlands focused strongly on the stimulation of demand, partly through technological research (*technology-push*). This stress on the supply side resulted in generous subsidies for research institutes (ECN, Universities of Technology in Delft and Eindhoven) and (major) companies (Stork, Fokker, Holec), who were active in the development of turbines. During the first year of the National Development Program for Wind Energy (NOW), 15,000,000 guilders (1 Euro = 2.20 guilders) was made available from March 1976 until March 1977. In the following years, projects were subsidised with many more millions of guilders.[18]

The focusing on technological research reduced the attention for the demand side of the market. So there were no subsidies for wind turbine manufacturers, making it unattractive to invest in their development. As late as 1986 the first investment subsidies were introduced, enabling a certain growth of the wind turbine market. However, this was not enough to save the Dutch manufacturers; most of them went out of business in the 1990's or were taken over by foreign enterprises.[19]

Denmark chose right from the start for a policy for both the *technology-push* as the demand side of the market. Investment subsidies for buyers of wind turbines existed there since the 1970's, enabling the creation of many small wind turbine companies.[20] Germany was initially strongly focused on research, like the Netherlands, but because lack of success, attention shifted to a more market driven policy. In 2000 a bill was passed (*Einspeisegesetz*) to stimulate the use of sustainable energy in general. The law compelled energy companies to pay an acceptable price for 'resupplied' wind energy.

Erratic policy

A consistent long term government policy is very important for the creation of a successful wind energy market. However, this is what has been lacking only too often. Especially the subsidy of wind energy was subject to varying political criteria.[21] Since the introduction of investment subsidies for wind energy producers in the late 1980's, many arrangements have been abolished and/or modified. For instance, subsidies were initially related to the installed generator power in kW, encouraging the installation of relatively heavy generators. This had a negative effect on the quality of the turbines, making them unsuitable for export. Later the subsidy was related to the actually produced energy in kWh.

Until 2004 there also was a subsidy for import of 'green' electricity from abroad (Regulatory Energy Taxation – REB), that frustrated rather than stimulated the domestic production of wind energy. Since Dutch enterprises were allowed to invest in foreign wind parks with Dutch subsidies, they invested less in their own country. The creation of the MEP-subsidy (concerning the ecological quality of the electricity production) had to remedy this.[22] Although the MEP was very popular, it was ended in august 2006; the subsidy for off shore wind parks had been scrapped the year before already. This continual changing and/or abolition of subsidy regulations made it very difficult for manufacturers and energy producers to develop a long term strategy.

Learning process for the government

The Dutch government has learned from some of its wrong policy choices. When it became apparent that focusing on technology did not bring about the desired results, more attention was paid to the demand side of the wind energy market, resulting in subsidy for 'resupplying' to the power grid and investment subsidies. Moreover, the

government involved small manufacturers of wind turbines since the mid 1980's. They had been ignored until then.

6.2.4 Conclusion

The ambitious plans in the 1970's for a leading Dutch role in wind energy have had very little success. Thirty years later the Netherlands even lags behind. One of the causes of this lack of success of wind energy is the poor cooperation between different actors, who learned little from each other as a consequence. Investment subsidies and subsidies on buy-back tariffs were introduced only in a late stage, making investment in wind energy unattractive for commercial enterprises. The government also has (unwittingly) created obstacles itself, by unduly stressing technological research, while neglecting the demand side. Its policy on subsidies was erratic. Certain regulations were actually counterproductive.

An important lesson is that the 'market' must be involved right from the beginning. Learning effects are greatly improved by good cooperation of researchers, manufacturers and users. If the government wants to support innovative developments, it is necessary to have a consistent long term policy that partners in the innovation process can rely on. For the development of an effective policy thorough market knowledge is necessary. The government must invest in this policy, otherwise it is pushed around instead of being a coordinating force.

6.3 Waiting for the bus

A couple of years ago the company e-Traction from Apeldoorn developed a coach called the Whisper; it is far more silent, environment friendly and cheaper in use than normal coaches. A prototype was commissioned in Apeldoorn in 2005 for the first time. In spite of the advantages, plans to use the coaches on a regular basis have not yet materialised. The question is why it is still not being used all over the country.

6.3.1 Advantages of the Whisper

The Whisper has a conventional diesel engine and an electromotor. When it brakes or moves downhill, the released energy is stored in batteries. This energy can be used again for the electromotor driving the back wheels. The batteries can be supported, if need be, by the diesel engine when moving uphill.

A study by TNO has concluded that the Whisper has a number of advantages. Firstly, its engine produces less noise than that of ordinary coaches. Its typical noise level is 58 dB instead of 78 dB.[23] Another great advantage of the electromotor is that it saves much energy. A normal coach with a diesel engine runs on 2.2 kilometre to the litre, the Whisper 6.3 kilometre to the litre. Thirdly, the Whisper is very environment friendly: it reduces CO_2-emission with 85%.[24] Finally, the energy advantages can help to keep the ticket price low.

Although the purchase price of the Whisper is higher than that of a normal coach, the difference can be earned back in little time. The first five Whispers will each cost about € 280,000, while the price of a normal bus is about € 200,000. If the production of the Whisper goes up, scale advantage will reduce the price to € 220,000.[25] Because the Whisper saves about 20,000-25,000 litre diesel oil per year with its electromotor, the price difference would be earned back in little time.

6.3.2 Bus stop

In 2005 the prototype of the Whisper was used for the first time in the municipality of Apeldoorn. Only test drives have been made ever since. E-Traction depends on subsidies in order to make the Whisper a success. The costs of a try-out with five prototypes amount to € 1.8 million. The ministry of traffic and environmental care (VROM) is willing to pay a subsidy of € 350,000 but the remaining costs are still too high for e-Traction. The company hopes for subsidies of provinces, municipalities and/or public transport companies to enable a start of the project.

Three Dutch municipalities have shown interest in the Whisper so far: Apeldoorn, Amersfoort and Enschede. The province of Utrecht intended to grant a subsidy for five

Whispers in October 2005, to be used on the bus line from Central Amersfoort to the Amersfoort district Vathorst. In this way, the province wanted to stimulate new development in public transport and reduce inconvenience for the population. When the Whisper coaches had lived up to expectations, all buses in Amersfoort would be replaced by Whispers.[26] Anno 2007 none of the three municipalities has made a start yet with such a Whisper project, but in the mean time plans have been made in cooperation with the urban region of Rotterdam to convert five normal buses to Whispers and use them in regular service.

6.3.3 Obstacles for the Whisper

Catch 22: everybody is waiting for everybody else

E-Traction depends on several parties for the introduction of the Whisper: municipalities, provinces, transport companies and coach builders. In practice none of them is willing to bear the initial costs. Every party has its reasons – often understandable reasons at that – to look to other parties to jump first. As a consequence, nothing happens. The innovator (e-Traction) is caught between these different parties and has not been able so far to convince any of them to make the first move.

Although a coach of the Whisper type has widely acknowledged value for the common good, there is no real market for it yet. None of the parties involved is willing to invest in a product without a proven technological quality and commercial value. Because of uncertainty about the market potential of the Whisper, manufacturers hesitate to join forces with e-Traction. It is too risky for them to invest a few millions of euros in the development of five Whispers without certainty that the market is actually willing to pay for it. Moreover, adaptation of their existing production lines is costly.

Uncertainty is also an obstacle for transport companies to participate in the project. Since they have a responsibility to their customers, they are unwilling to experiment, risking that the new Whisper technology breaks down.

The government : a silent partner

The province of Gelderland has given subsidies in the past to e-Traction for the development of the prototype of the Whisper, but it is not willing to invest more; the provincial authorities think that market partners must take responsibility for market introduction of the Whisper. The municipality of Apeldoorn, the home town of e-Traction, is not willing to invest more either, because it does not see this as a task of a local authority. The arguments of both these authorities are understandable. They must be cautious with their market interventions, because unfair competition can create new obstacles.

Moreover, a local authority can only intervene in the market in a limited way. Municipalities hand out concessions to transport companies, for a temporary transport monopoly. Once a concession has been given, a municipality cannot easily change the conditions. That is why a municipality cannot compel local transport companies to buy the Whisper, since the conditions of the concession do not mention a specific type of vehicle to be used.

The so called innovation concession will probably allow municipalities to adapt their concession policy from the end of 2007. This enables local authorities to introduce innovative products because of their public interest. Transport companies having a concession already can be compelled from then on to purchase some coaches based on ecological arguments. That would brighten the perspectives for the Whisper.

Quality control

An additional obstacle for e-Traction is that the Whisper has to be inspected by several quality control institutions on safety aspects. An important example of a certificate to be obtained is the CE-benchmark, indicating that EU-safety guidelines have been observed. In order to obtain a certificate, a new product must undergo several tests; the certification process can sometimes be lengthy and costly. Although this certification is essential, it can be an obstacle for innovative companies, especially small ones, without much time or money.

6.3.4 Conclusion

The main problem of e-Traction with the introduction of the Whisper is that none of the actors in the innovation process can break out of the 'catch 22'-situation; everybody waits for somebody else. A real market for the Whisper is effectively non-existent, although its importance in saving fossil fuel is widely acknowledged. It is understandable that potential subsidizing authorities are hesitant, since it is not their task to buy or use such vehicles. Existing safety requirements of coaches ensure that they must be tested by several organisations, which is another obstacle for the company in Apeldoorn.

The role of the authorities as '*launching customer*' can be particularly important to promote innovative developments. The innovation concession enables the authorities to hand out concessions based on other criteria than the price. To be sure, we must be on our guard that this kind of concession is not going to evolve into a kind of covert support with taxpayers money.

6.4 Virtual patient

As early as 1997 the former health minister Borst announced that a start would be made with the introduction of the Electronic Patient Dossier (EPD), to facilitate the exchange of medical records between health workers. Ten years later there is still no working countrywide information system. How is it possible that it takes so much longer than expected?

6.4.1 Advantages of the EPD

The EPD is intended to facilitate the exchange of medical records between health workers. Authorized personnel must be able to query and view up to date information of a patient anytime anywhere in the country. This could be of great importance for stand-in GP's or in a first aid polyclinic. With the EPD a doctor can see the complaints of any patient, his diseases or allergies, current medication, counterindications, etc. This will be helpful to prevent medical errors and to enable doctors to give better medical care.

Another advantage is more effective medication monitoring. Erroneous medication is the cause of about 90,000 hospitalisations per year in the Netherlands. The main reason is, that different pharmacists, doctors and hospitals do not know about each others prescriptions. The direct costs of this amount to about € 300 million per year.[27] The total nation wide costs of incorrect medical information transfer are even higher: over € 1 billion annual costs and € 1.6 billion incidental costs.[28] Although an EPD could not rule out all such errors, it could reduce them drastically.

The EPD could also result in higher efficiency, because medical records do not have to be gathered again and again by different health workers and institutions, and lab work does not have to be repeated. Finally, the EPD can contribute to demand-oriented care. When patients have their own medical data at their disposal, they are better able to discuss decisions on care and treatment with their doctors and other health workers.[29]

6.4.2 Delayed progress

After the go ahead of health minister Borst in 1997, the branch organisations of hospitals, GP's and specialists signed a declaration of intent for the realisation of a nation wide electronic infrastructure for all health services. Minister Borst foresaw in 2001 that the EPD would be operational in 2004; a few years later this appeared not to be feasible. The National ICT Institute for the health services (NICTIZ), which has to coordinate the development of the EPD under guidance of the ministry of health, announced in 2003 a delay of three years fro the EPD to be fully operational.[30] Even this prediction had to be adjusted.

The initial plan was the health services to take responsibility themselves for the implementation of the EPD. When this appeared to slow down the whole process, parliament forced the ministry of health late in 2005 to take over this responsibility. The current target date to go operational nation wide for two components of the EPD, the Electronic Medication Dossier (EMD) and the Dossier for stand-in GP's (WDH), is in 2009.

The introduction of the EMD and WDH has several phases. The basic infrastructure (National switch point– LSP) is now ready. After a *proof-of-concept*-phase and a front

runner phase the nation wide implementation will take place. The front runner phase is now in progress; the aim is to test the functionality in a limited working environment with GP's, group practices, hospitals and pharmacists on safety, reliability and user friendliness.[31] In the eastern region of Twente a local WDH will be made accessible via the LSP and in Rotterdam and Amsterdam the already operational EMD will be linked to the LSP.[32] When all these field tests have been completed and evaluated, the regional and the nation wide implementation of both systems can start. After that other components of the EPD can be added.

6.4.3 Obstacles for the EPD

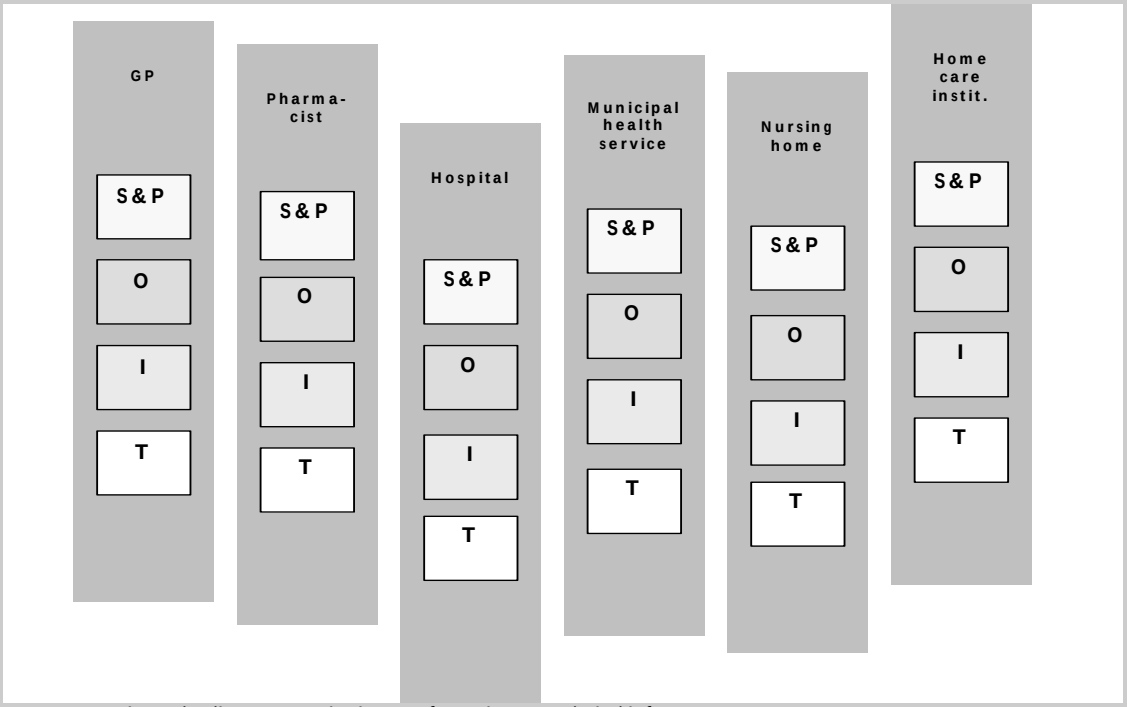
Complexity of the operational environment

Many different health services and persons are involved in the implementation of the EPD: GP's, dentists, hospitals, home care organisations, pharmacists, psychotherapists, physiotherapists, obstetricians and nurses. The ministry of health has to coordinate its policy with about 25 branch organisations. Since they have all their own ideas and interests, it is not always easy to reach consensus. This is one of the reasons why a rapid and simple implementation of the EPD is difficult to achieve.

For example, the implementation of the EPD in hospitals appears to be a laborious process. All hospitals have their own board of governors whose consent is required. Moreover, hospitals are complex organisations, since they often host no less than twenty specialisms, with their specific ways and methods. This adds greatly to the complexity and reduces the efficiency of the EPD. Negative experiences with automatization in hospitals has bred a lot of scepticism.[33] In general, Dutch hospitals have no intention to hook up to the LSP in the near future; in 2007 less than 30% had reserved budget for this purpose, and 75% indicated it was not attractive at the moment.[34]

GP's, pharmacists, hospitals, municipal health services, nursing homes and home care institutions all have their own strategies and automatization policies; their ICT infrastructures are also different. This means that strategy, organisation, coding of information and the technical infrastructure have to be made mutually compatible. Figure 6.1 gives an overview.

Figure 6.1 The EPD has to be standardised at different levels*



* S&P =Strategies and Policy; O=Organisation; I=Information; T=Technical infrastructure
Source: NICTIZ

Resistance of the actors

Health services have their own systems already

Most health services already have a system to store medical records. Most GP's have already an electronic patient dossier containing consult reports, inquiry results and medication. Communication between some of these existing systems is possible already, for instance between the systems of GP's and pharmacists. Communication is usually limited to some health services in the same region.

The health services will have to hook up their existing systems to the new EPD. Health workers and hospitals still without systems of their own will have to introduce a whole new system. Many of them are not keen to do that, especially if they are content with their existing system. GP's find the EPD time consuming, since they have to 'translate' their activities into diagnostic codes.[35] There is also a lot of distrust of the new system; there is no certainty that it meets the same requirements as the existing ones.

Costs of the EPD

There are also financial objections to the introduction of the EPD. Connecting the existing information systems to the WDH costs a GP about € 4,500 in all; they could be earned back in five years already, according to a calculation of bureau 'Squarewise'.[36] Other health workers too face similar initial costs, that can be earned back in a few years. Although the EPD has little if any net costs over a period of a few years, the initial costs can be an extra threshold for new users.

The EPD can also result in loss of income for some health workers. Since it contains information about earlier inquiries of a patient, those inquiries, like taking X-ray pictures and blood samples, do not need to be done again when a patient is transferred to another medical practice.

Loss of autonomy

The introduction of the EPD implies that medical records stored by a doctor or other health workers will be accessible to others. This means loss of an information monopoly and autonomy and enabling colleagues and patients to get more detailed knowledge of their professional practice. The (compulsory) sharing of information on patients means loss of territory and power, for instance within the organisation of a hospital. The introduction of market forces only adds to the anxiety.

A survey of the Royal Dutch Medical Association (KNMG) in 2004 shows that 80% of the respondent doctors is unwilling to give direct access to electronic data to other health workers or other institutions for clinical purposes. About 76% of them says to have no need to query data of colleagues.[37]

Uncertainty

Protection of privacy

A major issue related to the EPD is the authorization to access medical records. Especially health workers value the confidentiality of their medical records; patients themselves are often less concerned about it. The Law on the protection of personal information (WBP) and the Law on medical treatment agreement (WGBO) stipulate that a health worker can get access to medical records only if it is necessary for the treatment

and if the patient does not object. Health workers who are registered in BIG have a right to view medical records. These are doctors, dentists, pharmacists, health psychologists, psychotherapists, physiotherapists, obstetricians and nurses. The WDH-component of EPD is accessible only for GP's, their stand-ins and their medical assistants. The EMD-component is, for the time being, accessible only for GP's, medical specialists, hospital and general pharmacists and their assistants.[38]

There are, to be sure, good reasons for all this attention for privacy. For example, when a company doctor can view a medical record of a job applicant, he could halt the procedure if he finds a psychiatric record in the applicants file. However, too strict privacy rules also have a downside: the obvious advantages of the EPD would be lost. The fear for privacy violation can also be used as a pretext to thwart or delay the introduction of the EPD.

Box 6.1 **Experiences abroad**

In spite of all the delays in the EPD project, the Netherlands are still one of the three front runners if it comes to exchange of medical data, the others being Britain and Canada. Most other countries run into similar difficulties, like privacy protection, safeguarding and interoperability with existing systems.[39]

The introduction of an EPD in Britain was also delayed with several years. At present the schedule for phased introduction starts in 2007. Unlike in the Netherlands, it is introduced *top-down*: health workers are not involved in the implementation of the new system. The National Health Service has signed a contract with one ICT-supplier for each region for the delivery of one integrated system for each hospital. Health workers and patients have strongly criticized this model, since they, the future users, have not been consulted. The privacy is also a matter of concern, since the police and the secret services must also have access to combat heavy crime. Britain also has to cope with costs running up much higher than budgeted; the initial budget was about € 3 billion, but it has already more than trebled.[40] The costs of the Dutch EPD are 'only' a few dozens of millions.

The implementation of a nation wide EPD in the USA is still not forthcoming. A National Health Coordinator appointed in 2004 has to realise such a system. It is expected to take about ten years.[41]

Protection against hackers

Another aspect of the EPD is the protection against hackers. An incident in 2005, when hackers tested the system by breaking into the data of 1.2 million medical records of a

Dutch hospital,[42] sparked a heated debate on the protection of medical records. In order to prevent all too simple unauthorized access to medical records in the EPD, national guidelines for protection have been defined. Health workers have to identify themselves with a special 'UZI-pass', and the computers of health workers, hospitals etc. and the LSP must meet high standards of protection. A health worker who does not meet the requirements cannot hook up to the LSP.[43]

The stress on protection of the EPD illustrates a phenomenon that can be observed in other innovation processes too: the safety standards for new systems are much higher than for the existing ones. However, absolute safety does not exist, and striving for watertight guarantees can be an effective obstacle to the introduction of innovations.

Lack of market demand

A major problem of the EPD is that there is no effective demand for it. Patients, who would ultimately benefit most from it, are no actors on the market and cannot exert pressure to introduce the new system. Moreover, the lack of competition in the medical sector ensures that health workers have little financial incentive to realise optimal safety for their patients. Because lack of transparency, medical errors often go unnoticed and market forces have little effect. As a result, the government had to adopt an initiating and guiding role for the development and implementation of the EPD. Because the government pays and controls the development of the central facilities of the system almost completely, health workers and ICT-suppliers are not really challenged to think pro-actively about an EPD that is as effective and efficient as possible. Since the government represents the supply side and controls the demand side, it is susceptible to lobbying and *rent seeking* by market parties who want to profit from the introduction of EPD, or just want to prevent the introduction.

The health worker as a hostage

Since many health workers do not have expertise on ICT, they depend on the ICT-suppliers for the implementation. This gives these suppliers a strong leverage over their customers. Moreover, cooperation with a chosen ICT-supplier has *lock-in* effects: it is very difficult to switch to something or someone else. Since the data in a nationwide EPD must be available anywhere anytime, the system cannot be switched off during the search for another supplier.

6.4.4 Conclusion

In spite of the obvious advantages of the EPD, the innovation process is a laborious one. There are several causes. The numerous parties involved in the development and implementation of the EPD are very diverse, and have different interests. There are also considerable initial costs for the customers in the introduction phase, putting up a threshold for many would be customers. The EPD also results in loss of autonomy, because medical records must be shared with other health workers and can be viewed by the patients themselves. The lack of an 'articulated demand' from the patients slows down the introduction of the EPD too. Finally, protection of privacy against unauthorized users and hackers results in more delays.

A complex system innovation like the introduction of the EPD can make a mediating role of the government necessary. An absolute requirement for successful implementation is that the objectives are clear and that a realistic and feasible time schedule is projected, enabling market parties to adapt their strategies and investments to it. Besides this, a carefully administered combination of 'carrots' and 'sticks' is necessary to ensure sufficient progress is made. The government as a moderator must monitor the whole process and not get trapped in a quagmire of contradictory demands and interests.

6.5 Energy neutral houses

Sustainable energy plays an increasingly important role in our society. Fossil fuel is bound to be exhausted some day, so there is growing attention for alternative sources of energy, like wind and solar heat. The increasing dependency on major energy companies and governments and the decreasing number of countries exporting fossil fuels, are also reasons for this growing attention.

As early as 1974 de *Stichting De Kleine Aarde* ('Little Earth Foundation') built an energy neutral house, meeting its energy needs from alternative sources of energy, like wind and solar heat. Several initiatives of this kind have been developed in this country by companies and private persons since 1974. In spite of the public interest in the reduction of energy consumption, initiatives run into all sorts of obstacles.

6.5.1 From recycling house to energy neutral house

Energy neutral houses function partly or (rarely) completely separate from the power grid and use alternative sources of energy, like wind and solar heat. As early as 1974 de Little Earth Foundation built an energy neutral house in the town Boxtel, in the south of the country. This house had a windmill generating the necessary electricity, a solar collector supplying heat and a methane gas installation for cooking. Drinking water was obtained from a well.

In the Netherlands and elsewhere, numerous initiatives of this kind have been realised. A special type of energy neutral house is under development by the OTB Group in Eindhoven. This Energy House is, in principle, completely independent from the power grid. The generated energy can be stored for later use. Energy is stored in batteries or by producing hydrogen through electrolysis, which can be used in a fuel cell for heat production. At present the development is in the *proof-of-principle*-phase, in close cooperation with the Eindhoven University of Technology and the Fontys Hogeschool.[44]

6.5.2 Advantages of an energy neutral house

Energy neutral houses use sustainable energy only, so a major advantage is the absence of CO_2-emission. Moreover, solar heat and wind energy are inexhaustible sources of energy, a good alternative for fossil fuels that are bound to be exhausted some day. The independence from dubious suppliers is another advantage. Because energy is generated right where it is consumed, there are fewer losses in transport and conversion; energy production in large power stations makes transport of fuel and of generated electricity over long distances necessary; more than 60% of the generated power [45] is dissipated before it reaches the consumer. Of course there are no energy bills to be paid, since sun and wind are free.

6.5.3 Obstacles for energy neutral houses

Unfair competition

There is no fair competition between sustainable energy and fossil fuel, because the costs to the natural environment and other external effects are not accounted for. The

generation of 'green' electricity is more expensive in the Netherlands than that of 'grey' electricity. The taxation in the Netherlands is relatively low for fossil fuel with high CO_2-emission. That is why there is no such thing as a *level playing field*. In order to realise fair competition, all market parties should carry their own financial burden, which must include the damage done to the natural environment and by contributing to global warming. Nowadays this is only partly the case.

Resistance of vested interests

Energy neutral houses are a potential threat to vested interests on the energy market. Since some houses are not connected at all to the power grids, this means loss of income for oil companies and energy suppliers. It is understandable that they try to protect their interests. Although they do not overtly resist alternative energy projects, their cooperation, if any, is half hearted, especially if their own market position is in peril. Political lobbying enables them to influence political decisions in their favour. Suppliers of fossil energy do cooperate when natural gas retains its importance and when energy is 'resupplied' to the grid. In this way oil companies and energy suppliers remain in control. The construction companies are equally lukewarm to integrate renewable elements into new houses, as was found out by the 'Little Earth Foundation'. One reason is the uncertainty among contractors and project developers, since renewable materials and new building concepts remain to be proven in the construction branch. Some municipalities in the province of Brabant have compelled local project developers to integrate solar panels or heat pumps into newly built houses.

6.5.4 Energetic authorities?

Strict regulation

Construction companies have to cope with a plethora of regulations and certificates. These are an obstacle to innovation. In energy neutral houses some components are used that need special regulations. An example is the use of hydrogen in the Energy House of the OTB Group, for the storage of surplus energy. Since hydrogen is a fuel with unique properties, special laws, regulations and permits have to be devised. The often laborious development process leads to delays in the innovation process. Since most people are ignorant about the technicalities of the application of hydrogen, there is much uncertainty about the safety aspects.

Erratic policies

The social and environmental advantages of sustainable energy are acknowledged by the Dutch government. In practice, however, this results in erratic policies, since different political parties have different ideas about it. Although the government wants to stimulate the use of sustainable energy, it has abolished several 'sustainable' subsidies in recent years. In 2003 the Energy Premium Regulation (EPR)[46] – a subsidy for energy saving appliances like solar boilers and solar panels – was scrapped; the subsidy for off shore wind parks was scrapped two years later and in 2006 the subsidy promoting the ecological quality of the electricity production (MEP) – came to an end as well. The lack of consistent government policy makes it very difficult for enterprises to devise a long term business plan. The abolition of the EPR has led to a collapse of the Dutch market for solar boilers and solar panels. Some companies had invested during many years in these products, but saw their home market shrink and had to turn to foreign countries. Moreover, the buy-back tariffs are low, discouraging Dutch consumers to use, for instance, solar panels. The Dutch tariff for resupply is 6 cents per kWh; in Germany it is 46 cents.[47]

Research of Simona Negro of the University of Utrecht confirms that policy on sustainable energy is erratic and inconsistent, making it very difficult to develop a reliable market. In 1998 the Netherlands started with gasification of biomass in the Amer power station near Geertruidenberg. Initially, everybody was enthusiastic because its efficiency was much higher than that of the burning of biomass. But when some difficulties arose because the technology appeared to need some further development, and obtaining biomass for an affordable price difficult, enthusiasm declined and the experiment was ended. That led to the collapse of the whole innovation system for gasification technology.[48]

Devising subsidy conditions

Requesting a subsidy by a company often runs into practical difficulties. The regulations are often very complex, or it is hard to meet all requirements. Especially small companies – without specialised staff that can concentrate on lobbying for subsidies – are the first to give up, leading to an end to their innovative activities.

For the development of the Energy House the OTB Group has requested subsidy in the past; eventually this request case was rejected. One of the given reasons was that no other relevant market parties – like architects, constructors and project developers – were involved. Another reason was that the chance of success was slim, according to the subsidizing agency Senternovem, since apparently no professional party with the required expertise was involved in the project. Because the Energy House of the OTB Group still is in the development phase, active involvement of such professionals is not yet possible; they are only willing to commit themselves when the *proof-of-principle* phase is completed. After successful completion of the first phase of the Energy House, the follow up will be pursued by a separate enterprise, with a number of parties as shareholders. These partners could bring in financial, building/developing and possibly technical/scientific expertise.[49] One more reason for rejection was that the applicability and the environmental advantages of the Energy House were perceived as meagre, because the technology is designed first and foremost for newly built free standing up market privately owned houses. However, the OTB Group had good reasons to test the technology first in a limited environment; after proven success, the technology can be applied to other sectors of the housing market.

6.5.5 Conclusion

The importance of a sustainable economy is acknowledged by an ever increasing number of people. Although the building of energy saving houses in the Netherlands can give an important contribution to this, developers of the necessary technology run into quite a few obstacles. There is no fair competition between suppliers of sustainable energy and 'traditional' companies, since environmental pollution is not included in the energy prices. Established energy companies and oil companies have no financial interest in energy saving houses and are for that reason not eager to cooperate in the development. The government too creates obstacles, since it fails to devise a reliable and consistent policy. Finally, the development of energy saving houses is delayed because of uncertainty about the application of sustainable components .

When a social issue rises high on the political agenda, as is the case with sustainable energy, political parties want to promote themselves with 'new policy' to achieve various objectives. However, for market parties it is far more important to have clear, consistent

long term objectives than having to respond time and again to policy changes and initiatives.

6.6 General conclusion

In spite of all high minded rhetoric, innovation is often a laborious process, as pointed out in this chapter. An *uphill struggle* against uncertainty, disbelief and risk avoidance. A difficult fight against vested interests, arcane conventions and procedures, and rigid institutions.

Innovation is no *manna from heaven*, but it causes some to lose, some to gain, economically or politically. Fear to lose market share or political influence are a major obstacle. When the development of sustainable sources of energy appeared on the political agenda in the 1970's, the established energy companies stayed focused (with few exceptions) on fossil fuel and nuclear energy. The production of wind energy was considered unprofitable and was discouraged with very low resupply tariffs. This may be rational from a corporate point of view, but it shows once more that innovations often have to be initiated by economical and political outsiders, who should not count on support of the powers in charge.

Uncertainty and distrust too frustrate innovation. The Whisper is, in spite of the obvious advantages of reducing fuel consumption, CO_2-emission and noise pollution, still not in use because manufacturers of coaches and transport companies are not sure about the technical reliability and commercial feasibility, and do not want to take the economic risk. Authorities are – justifiably – not keen to intervene directly in the market, which would upset the *level playing field* for transport- and manufacturing companies. A 'catch 22'-situation prevents innovation to materialize. It illustrates how the innovation process falters if the corporate world and the authorities do not create space for experiments and show courage to force a breakthrough.

Moreover, market failures can hinder innovation. The failure of the Whisper and the Energy House to break through is partly due to the absence of positive external effects in the calculations of the market prices. The implementation of the Electronic Patient

Dossier is frustrated because of the absence in market of the group that would profit most of it (the patients). The authorities can adopt the role of regulator, market supervisor, *launching customer* or moderator , trying to create openings, but all the time it is prone to stepping on economic and political land mines, blowing up the project or at best causing delays.

The more comprehensive the consequences of an innovation are, for existing methods and organisations, the more difficult and slower the introduction will be. The EPD is a case in point. It affects the policy, the organisation and the financial interests of a large number of individuals and organisations. Without clear guidance, based on clear objectives, and a consistent strategy for implementation, a project like this can easily get bogged down in a lengthy and costly operation.

Last but not least, the policy itself can become a part of the problem of innovation. Conflicting policy objectives, lack of knowledge of the market, limited policy horizon, risk avoiding behaviour in government bureaucracies, and fear of loss of political prestige can lead to interventions that frustrate rather than promote innovation.

As pointed out in this chapter, obstacles for innovation result partly from the nature of our institutions. The organisation of the energy market, the transport market or the health services are no neutral entities, but reflect economic and political interests and powers. The same applies to taxation on pollution of the environment, investment subsidies or rules for awarding contracts intended to regulate the market. Innovation policy thus requires willingness to adapt the structure of institutions if they obstruct innovation. Willingness to brave vested interests, to give outsiders a chance, to make experiments possible, to reward risk taking, to accept failure, to simplify procedures, put reputations on the line and to pursue a consistent policy. To row against the stream, so to speak.

REFERENCES

[1] Baumol, W.J., 2002: *The free-market innovation machine: analyzing the growth miracle of capitalism*, Princeton University Press, Princeton, N.J.
[2] Acemoglu, D., and J. Robinson, 2000: 'Political losers as a barrier to economic development', in: *American Economic Review*, vol. 90, no. 2, pp. 126-130.
[3] Landes, D.S., 1998: *The wealth and poverty of nations: why some are so rich and others so poor*, W.W. Norton, New York.
[4] Acemoglu and Robinson, 2000.
[5] We use the word 'institutions' here as defined by North: " Institutions are the humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct) and formal rules (constitutions, laws, property rights). North, D.C., 1991: 'Institutions', in: *Journal of Economic Perspectives*, vol. 5, no. 1, pp. 97-112.
[6] Buchanan, J., R. Tollison and G. Tullock, ed., 1982: *Toward a theory of the rent-seeking society*, College Station, TX: Texas A & M Press.
[7] Mokyr, J., 2000: 'Innovation and its enemies: the economic and political roots of technological inertia', in: M. Olson and S. Kähkönen, ed.: *A Not so Dismal Science*, Oxford University Press, Oxford, pp. 61-91.
[8] Baldwin, R., and F. Robert-Nicoud, 2007: 'Entry and asymmetric lobbying: why governments pick losers' in: *Journal of the European Economic Association*, vol. 5, no. 5, pp. 1064-1093.
[9] Duran-Reynals, 1946: *The fever bark tree: the pageant of quinine,* quoted by Mokyr (2000).
[10] David, P.A., 1986: 'Understanding the economics of QWERTY: the necessity of history', in: W.N. Parker, ed.: *Economic history and the modern economist*, pp. 30-49.
[11] Kamp, L., 2002: *Learning in wind turbine development : a comparison between the Netherlands and Denmark*, University of Utrecht, Utrecht.
[12] Kamp, L., and K. Mulder, 2005: *Technological promises based on old traditions: the introduction of wind turbines in the Netherlands*, TU Delft, Delft.
[13] Kamp and Mulder, 2005.
[14] See website Nederlandse Wind Energie Associatie: www.nwea.nl.
[15] Interview with Linda Kamp, August 23rd 2007.
[16] In the province of Zeeland a subsidy on resupply to the main grid existed in the late eighties already.
[17] Kamp, 2002.
[18] Kamp, 2002.
[19] Kamp and Mulder, 2005.
[20] Kamp, 2002.
[21] Interview with Gijs van Kuik, August 13th 2007.
[22] Mast, E., G. van Kuik and M. Zaaijer, 2007: 'Offshore wind energy policies and their effects: experiences in Denmark and the UK and prospects for the Netherlands', Proceedings of the European Wind Energy Conference 2007, Milan, April 2007.
[23] 'Fluisterstil door de binnenstad', Nederlands Dagblad, April 23rd 2005.
[24] 'TNO meet laag gebruik fluisterbus', De Stentor, October 27th 2004.
[25] 'Fluisterstil door de binnenstad', Nederlands Dagblad, April 23rd 2005.
[26] Provincie Utrecht, 2005: *Aanvraag stimuleringsfonds luchtkwaliteit – schone bussen*, Provincie Utrecht, Utrecht.
[27] 'Naar groepsgebonden, rationeel voorschrijven', Pharmaceutisch Weekblad, February 4th 2005.

[28] These include societal costs of sick absence and disability. TNS NIPO, 2004: *Fouten worden duur betaald. Een onderzoek naar medische overdrachtsfouten (deel 2)*, TNS NIPO, Amsterdam.
[29] See website ministerie van VWS: www.minvws.nl.
[30] Eindrapportage KPN, 2006: *Zorg voor innovation! Snelle Beter – Innovation en ict in de curatieve zorg*, KPN, Den Haag.
[31] Ministerie van VWS, 2007: *Voortgangsrapportage ICT inzake de invoering van het Elektronisch Patiënten Dossier (EPD)*, Ministerie van VWS, Den Haag.
[32] Until now this is restricted to personal data, medication history and applications for electronic expenses claims. Treatment history and potential allergies are not included yet.
[33] 'Elektronisch patiëntendossier (EPD). Medisch specialist: "What's in it for me?"', Health Sciences Digest, 2005.
[34] 'De patiënt is de baas', Digitaal Bestuur, January 2007.
[35] 'Huisarts vindt EPD tijdrovend', Automatisering Gids, 2004, no. 40.
[36] Ministerie van VWS, 2007.
[37] KNMG, 2004: *Eindrapportage Onderzoek naar wensen en ervaringen van artsen op het gebied van autorisatie voor toegang tot en gebruik van patiëntgegevens*, KNMG, Utrecht.
[38] See www.minvws.nl.
[39] Ministerie van VWS, 2005: *ICT in de zorg. Van Elektronisch Medicatie Dossier naar Elektronisch Patiënten Dossier*, ministerie van VWS, Den Haag.
[40] 'IT-ontwikkelingen in zorg lopen vast', De Ziekenhuiskrant, June 26th 2007.
[41] Ministerie van VWS, 2005.
[42] 'Het medisch geheim gehackt', De Volkskrant, September 3rd 2005.
[43] See www.minvws.nl.
[44] OTB Group, 2007: *Energyhouse. Independent zero emission solutions*, OTB, Eindhoven.
[45] European Commission, 2006: *Action plan for energy efficiency: realizing the potential*, EC, Brussels.
[46] See website Senternovem: www.senternovem.nl.
[47] Interview with Cees Collart, Augustus 6th 2007.
[48] Negro, S., 2007: *Dynamics of technological innovation systems. The case of biomass energy*, Universiteit Utrecht, Utrecht.
[49] OTB Group, 2007: *Memo energyhouse*, OTB, Eindhoven.