UNIVERSITEIT
ANTWERPEN

Innovation Policy and Technology Assessment in Flanders

Final Report

Lieve Goorden

June 2004

Study commissioned by the

Flemish Institute for Science and Technology Assessment
viWTA

STEM - RESEARCH CENTRE ON TECHNOLOGY, ENERGY AND ENVIRONMENT
Kleine Kauwenberg 12, B-2000 Antwerp
Tel. +32-(0)3-220-4900 Fax +32-(0)3-220-4901
E-mail: linda.teunkens@ua.ac.be,
Web: http://www.ua.ac.be/STEM

STEM

1. Three generations of innovation and technology assessment policy

Innovation policy, and the related practice of technology assessment, is a young policy domain that has come into being along with the accelerated scientification and technologisation of our culture in the last decades of the previous century. In thinking and practice regarding this policy, much has changed during that period of time. In two areas, much has been learned. In the first place, this policy has gradually been built on better insight into the complexity of innovation as a multi-actor and multi-institutional process in which a whole variety of competencies and knowledge come together. In the second place, this policy has learned to gear itself better to the social context and to be more in touch with the changes that take place there, both as regards concerns and priorities and as regards the roles that various actors can play in that policy.

For a long time, TA practice remained somewhat at the edge of innovation policy. This relates partially to the fact that the thinking on innovation and the thinking on TA occurred largely in separate worlds. Now those worlds of thinking and practice are converging and joining forces in a complementary approach.

The thinking on innovation policy

Authors generally speak of a 'sequence' of several 'generations' of innovation policy (Larosse, 2003; Zeeuwts, 2004; den Hertog and Smits, 2004). This is not to be understood as a series of completely different policy models, with each new one replacing the previous one, but rather, as a shift of emphases in the policy approach, in which new principles and instruments have supplemented the existing ones.

In a *first-generation innovation policy*, the development of innovations is viewed as a *linear process* or a process that begins with science in the laboratory, develops via a number of logically successive steps, and results in the application of new knowledge in commercial products. The focus of this policy is on selectively fostering *critical directions ('picking winners')* in science and technology, and then on improving the flow of knowledge in the innovation chain. A crucial instrument for this type of policy is the financing of *basic research* at the beginning of the chain.

In a *second-generation innovation policy,* there is greater recognition of the complexity of the whole business of innovation. In practice, there is a great deal of *feedback* between the various steps in the process, because science, technology, and innovation are understood to continually react to each other. Science is not necessarily the source of innovation and can itself also receive important impulses from innovation. This policy will therefore encourage two-way communication in the innovation chain. The insight is also growing that innovation is more than renewal in the technological field. Innovation requires *the involvement of many other areas of knowledge and skills*. Furthermore, not only the production of knowledge, but also the distribution of knowledge, and the necessary mediation, are important for the capacity to innovate. This policy accepts the idea of national, regional, and sectoral *innovation systems*. Innovations are seen as being accomplished and distributed through innovation systems: the innovation potential in a sector or region is determined by an interaction among mutually dependent actors who achieve innovation by means of information exchange and cooperation. Networking is vital to this.

In a *third-generation innovation policy,* innovation is placed *on the agenda of every policy domain*. Consequently, the aims of innovation policy are not limited to the economic domain. This innovation policy want to contribute to meeting other needs in society, e.g. in the areas of education, traffic, healthcare, sustainable development, and safety. Innovation is viewed primarily as a *systemic activity* in which policy instruments are not only directed to individual organisations (e.g. research and development subsidies, management support) or bilateral relations (e.g. knowledge transfer), but also to the innovation system as a whole (e.g. managing interfaces and organising learning platforms). As a consequence, government intervention is no longer justified only by market failure, but increasingly also by failure of the system itself. This policy is *developed interactively*, rather than imposed from above, but the process still requires coordination and vision. In this perspective, it is necessary to identify the relevant stakeholders and to involve them in the process. They share knowledge with each other and learn from experience. Likewise, in a third-generation innovation policy, it is important to provide *good public information* on important waves of innovation and ensure greater public involvement in decision-making.

The thinking on technology assessment

In the thinking relative to technology assessment (TA) and in its practice, three generations can also be distinguished (Grin, 1997; Smits, 1994). Here too, the development consists of accents shifting over time, because the three forms of technology assessment continue to be practised concurrently and complement each other.

Analytical or 'early warning' TA came into existence in the sixties from a need for an early warning about the negative effects of technological developments. At that time, there was dissatisfaction with the fact that technological development was often seen as a synonym for progress and was not subjected to a critical evaluation. Therefore, this form of TA engages in a thorough analysis of the social consequences of a technology. This type of research is usually carried out in universities and research institutions.

Such analyses are made in the expectation that they will carry sufficient authority to influence *actors who are directly involved* in technology development paths (suppliers, sponsors, policymakers, users) in their choices. These studies must also give the *affected* citizens and their organisations, which are seen to play a more passive role and experience the positive or negative consequences of the technology, the necessary facts and arguments for engaging in a debate with the other actors.

It turns out that such TA analyses often have disappointingly little influence on the actors who are directly involved in technology development paths. As a reaction to this, a new working method for TA made its appearance: *constructive TA*. It is based on the principle that TA is intended to make a concrete contribution to technology development itself by setting up the TA analysis explicitly from the perspective of a directly involved actor. This can be, for instance, the group of users, and the analysis then serves to support the interests of that party during the design process (e.g. from the perspective of a consumer organisation), but it can also relate to the viewpoint of a different involved party, e.g. the group of producers of a technology, or the government.

TA analyses can also be intended to reflect the perspectives of all relevant actors. The analysis does not serve to support one party in the policy process, but is a source of learning for all parties involved. An *interactively executed TA* is an analysis whose main function is to influence development paths in a direction desired by, or at least acceptable to, the actively involved groups and the passively affected citizens. The analysis is the product of interaction between the TA analyst and the actors mentioned above.

Towards a complementary approach to innovation policy and TA

Innovation is accompanied by uncertainty. This applies to companies that bring new products on the market, to knowledge institutions that explore the boundaries of science, to users who will weigh advantages and disadvantages, and to policymakers who will manage the risks (Den Hertog, Smits, 2004). Although innovation processes have long been presented as linear processes by which new products and processes could be developed and distributed almost systematically, it turns out that innovation processes are difficult to control. This is because they are, for various reasons, difficult to analyse (Petermann, 2000). Innovation processes are open-ended and are stochastic rather than deterministic. Although the actors involved all act consciously and separately, the result of their actions is an effect of unintended social feedback. Furthermore, the knowledge gained by forecasting, planning, and decision-making is limited and uncertain.

As a consequence, the idea must be abandoned that conscious control can exactly produce the desired results. Different from the linear three-step model (from discovery to breakthrough to broad diffusion on the market), an innovation process is more like a self-organising system with many feedbacks and spill-over effects between the various phases mutually and between the company and its environment. Thus, innovation is shaped by many actors. The innovation system is an arena in which there are numerous players: large and small businesses, knowledge institutions, research organisations, and funds, as well as social organisations that take an active interest (e.g. with regard to genetic modification). This also includes governmental agencies, not only the central government, but to an increasing degree, also regional and local governments. None of these players can dominate the arena. However, innovation success is the result of their optimal interaction (Zeeuwts, 2004).

Thus, innovation becomes a search process that progresses by means of variation and selection, one in which very different actors are involved and in which the desired characteristics of the innovation gradually take shape (den Hertog and Smits, 2004). Dialogue in this system is therefore a form of social engineering to guide the system along a new balanced course (Larosse, 2004).

The growing recognition that decision-making on innovation occurs in a context of uncertainty causes government to define new roles for itself in innovation policy. It is the task of the government to arouse the enthusiasm of the actors involved, also on the *demand side of innovations*, and to mobilise them to meet a *social challenge*. They will organise the *interaction* among these actors and see to it that they *learn from each other* with a view to formulating *technology paths* that have the support of everyone concerned.

At two levels of policy formation, TA can help shape an innovation policy with these objectives. With respect to the *management of innovation systems or networks* at the regional or sectoral level, TA can help with the *social embedding of technology*. This concerns the identification of obstacles to diffusion and use (whether legal, cultural, social, or psychological) and focusing on the potential advantages of the technology and on the improvement of social welfare. In the framework of the *strategic innovation policy*, the development of visions, and the drawing up of innovation plans, TA can help with the *implementation of innovation in society*. TA can give support to the social formulation of needs and problems as a starting point for seeking technological solutions.

An interactively organised TA can offer various forms of support to a third-generation innovation policy. An interactive TA analysis can monitor the quality of the dialogue by which the actors formulate *challenges, needs and wants*, and define the *criteria* that a technology must meet. An interactive TA includes *all perspectives* (of parties involved and affected) in the analysis and formulates preconditions for an optimal interaction or concerted action. Also, interactive TA does not coincide with processes of technology development in the 'real' world. It is at most a simulation of those processes, a kind of social *experiment*. The participants go through a *learning process* in which they construct paths together which they can all consider meaningful. The outcome of TA will provide insight into the extent to which certain development paths are considered advisable by all parties involved (there will never be complete consensus). This 'providing of insight' is useful for an actor in the 'real' world who is able to influence existing relationships and choices. For instance, a public actor such as a national parliament can use that insight to take measures that can stimulate the desired changes.

2. Developments in Flemish innovation policy

The formation of a Flemish innovation system

In 1982, after the installation of the first Flemish government, still with limited competencies, the Flemish minister-president launched the DIRV campaign (*Derde Industriële Revolutie Vlaanderen* or Third Industrial Revolution Flanders), which involved a daring technology-push strategy. This DIRV approach, that placed the emphasis on basic research at the international level and the creation of spin-offs, reflected a first-generation innovation policy or the linear innovation model.

The DIRV policy must be understood as a reaction to the defensive industrial policy of the seventies and eighties. In that period, traditionally strong Belgian industries, such as the steel, coal, textile, and ship-building industries, landed in a crisis, to which economic policy responded defensively. It was an approach of 'helping losers' that was designed to preserve employment, with all kinds of support being given to declining branches of business. The low points were the closure or shrinking of a whole series of important Flemish companies (Nobels-Peelman, Cockerill Yards, VTR, Boomse Metaalwerken, Scheepswerven Sint-Pieter). Public feeling was strong and the government was called upon to provide social support during the cutbacks (via employer incentives and redundancy payments) and/or to carry out restructuring operations (via the investment companies NIM and GIMV). This approach was doomed to fail. Because of the saturation of the market and increasing competition from low-wage countries, many businesses had to discontinue their activities in spite of government subsidies.

The defensiveness of the policy in reaction to the crisis can be partially explained by the way expansion had come about in Flanders in the sixties and early seventies. It was mainly the result of exogenous growth, or the arrival of multinational companies that chose the Flemish industrial estates because of their central location in Europe. The government only had to worry about the equal distribution of that expansion among the various Flemish regions with the help of a subsidy and infrastructure policy (expansion legislation of 1959).

The start of the DIRV policy must be placed in this historical context: there was a need for an offensive strategy directed towards structural innovation in the sense of new products, new markets, and new production methods. This is explicitly emphasised in the policy document '*DIRV actie, visie op een vernieuwd Vlaams industrieel beleid*' (DIRV Action, Vision of a Renewed Flemish Industrial Policy), that was submitted in November 1983 by the president of the Flemish Executive (Gaston Geens) to the Flemish Council (which later became the Flemish Parliament): 'Government aid must in principle remain limited to the strong points and the growing market segments, so as not to slow down the cutbacks in the languishing sectors.' The document strongly emphasises the phases of 'discovery' and 'breakthrough innovation' in the innovation cycle as a focus for policy. This was reflected in the philosophy of the research programmes that were subsequently started up. For the stages of 'development' and 'diffusion', it was assumed that initiatives in this area would be taken almost automatically in the companies. Furthermore, little attention was given to feedback mechanisms between the various stages in an innovation process.

At the end of 1981, the Flemish government separated itself from the national government and obtained specific powers in the sphere of economic policy. The national government remained responsible for the creation of a general stimulating framework (fiscal, monetary, labour, social security, and research policy). The powers of the Flemish government relate to the promotion of a competitive position in the area of qualitative structural innovations. By means of a conspicuous campaign such as the DIRV action, the new Flemish government wanted to present a clear image of itself to the general public, with an offensive policy of its own, distinct from both the Walloon policy and the national policy ('what we do ourselves, we do better').

With the launch of the DIRV action, the Flemish government gave high priority to knowledge intensification in the Flemish economy. The DIRV policy was based on a 'science push' strategy. It encouraged world-class research in generic fields of technology such as micro-electronics (by the establishment in 1985 of IMEC, *Interuniversitair Micro-Elektronica Centrum* or Inter-university Micro-Electronics Centre, and the launch in 1982 of the *Vlaamse Micro-Electronica Programma* or Flemish Micro-Electronics Programme) and biotechnology (by the establishment of Plant Genetic Systems in 1985). A regional venture capital fund was established to finance high-technology start-ups (the GIMV, 1981). This was the era of the first generation of university spin-offs.

The existing investment impulses (capital premiums and interest subsidies) were directed more selectively towards those companies that invested in research and development of new products for international markets. 'Technology Days' (with a focus on a certain technology) and the biennial 'Flanders Technology' show were organised. These events were campaigns to arouse public interest rather than initiatives aimed at a greater diffusion of innovations.

In the spirit of the DIRV action, four generic technological research programmes were developed in the second half of the eighties and implemented at the beginning of the nineties. They covered the areas of biotechnology, new materials, energy technology, and environmental technology.

In 1989, most of the powers relating to science and technology policy were transferred to Flanders (until 1989, subsidies for research and development had remained federal). The fact that a department of science and technology was established, under the responsibility of the minister-president, emphasised the 'push' nature of innovation policy at that time. From that point onwards, a legal framework began to develop for a Flemish research and development policy.

A new technology agency, the *Vlaams Instituut voor de Bevordering van het Wetenschappelijk-Technologisch Onderzoek in de Industrie* (Flemish Institute for the Promotion of Scientific and Technical Research in Industry), IWT, was founded in 1991 to bring together all R&D instruments with an industrial objective. IWT was to manage the four technology programmes as well as projects of companies that could be financed in a 'bottom-up' procedure. In that first period, IWT continued to take a 'science push' approach to the selection of projects. The criterion was 'scientific value', based on the conviction that good research finds its way to the market by itself.

An institutional context developed in Flanders that emphasised the central role of research actors in the innovation system (Larosse, 2004). From the beginning, universities were influential partners, because the political emancipation of Flanders was initially a cultural movement. The new public research institutions were given an inter-university structure: after IMEC (1985), the *Vlaamse Instituut voor Biotechnologie* (Flemish Biotechnology Institute), VIB, was established in 1995. VIB is a virtual institute without its own research laboratory. The universities also started setting up interface services for technology transfer. In this first period, with the institutional installation of the innovation system and the influential role of universities, the foundations were laid for a 'science-driven' philosophy, which continues to play a role in current innovation policy.

Towards a generic technology policy

In the nineties, awareness grew that the focus needed to shift from a technology push policy to a policy aimed at technology distribution. This was reflected in the development of a cluster policy, with which the Flemish government wanted to stimulate endogenous growth in Flanders. This meant a departure from the policy of sectoral or technology-related impulse and action programmes. The policy was no longer specific in nature, but generic.

This cluster policy was coordinated by the Department of Economy and was intended to encourage new trans-sectoral platforms in areas in which Flanders was strong. The cooperation among companies in various areas such as market development, training, and research, was encouraged from the top down. The government itself designated six clusters.[1] The goal was to provide new growth and jobs. But initially, there was little interest in this form of cooperation in the field itself. In that period, economic regions tended to be composed of isolated companies, with branches of multinationals that followed their own corporate restructuring strategies and local SMEs that lacked a tradition of cooperation.

In 1994, this top-down approach was abandoned by the policy in favour of a bottom-up mechanism. It was no longer the intention to 'design' clusters. Now, the idea was to let them grow from the bottom. Twelve very diverse bottom-up platform projects were recognised (ranging from furniture to digital signal processing). They had to meet criteria for the development of synergies through joint initiatives. In reality, those criteria did not appear to be very solid and the support system did not attach overmuch importance to proven strengths. The way the government tended to deal with the clusters in the more mature sectors was partly indebted to the traditional and rather defensive policy of the seventies.

With a view to distinguishing these clusters, which were usually formed by existing companies in more mature sectors, the initiative of 'technology valleys' was launched in 1998 (e.g. Flanders Graphics Valley, Flanders MultiMedia Valley, and Flanders Drive, inspired by what was then still the promising Flanders Language Valley of Lernout & Hauspie Speech Products). Technology

[1] Textile machines/textiles/clothing industry; agriculture/biotechnology/food.; environment/chemistry; transport/telecommunications/multimedia; construction and housing; utility companies.

valleys were about new, high-level technology[2]. Consequently, they consisted mainly of companies in the start or growth phase. The support they received was focused on technology, but it also went to other aspects of innovation such as the establishment of regional knowledge centres and cluster platforms as new intermediary organisational forms. The listing in the policy text of ten qualifying 'technology baskets' partially manifests a technology-push logic again, with the emphasis on technological solutions and not on innovative applications to meet certain needs or solve particular problems. The use of the term 'valley' indicates the extent to which the Flemish Government hoped to emulate the success of Silicon Valley. This cluster policy was, to a certain extent, just as much geared to 'picking winners' as the earlier technology policy.

The so-called 'Innovation Decree' of 1999 gave the Flemish government a legal framework to expand its research and development policy into a broader innovation policy. The decree provided for new categories of support for innovation in SMEs, interfaces with universities to promote spin-offs, and networks of cooperation among innovative companies. It created a legal basis for a more integrated perspective of innovation. The economic objective and the non-technological dimensions of innovation were emphasised, but technological innovation remained central in the support policy. The intention was for IWT (which was renamed *Instituut voor de aanmoediging van Innovatie door Wetenschap en Technologie in Vlaanderen*, Institute for the Promotion of Innovation by Science and Technology in Flanders) to evolve from a purely technology-push subsidy instrument into a stimulator of innovation by taking on a variety of new roles, such as the role of coordinator of innovation support through mediators. A part of the budget of IWT now went to 'collective' innovation stimulation in various forms: collective research, training and advice, technology transfer, and the promotion of networking.

This was expressed in three programmes that stimulate networking: *Vlaamse Innovatie Samenwerkingsverbanden* (Flemish Innovation Joint Ventures) or VIS, *Vlaamse Technologie Excellentiecentra* (Flemish Technology Excellence Centres), and *Strategisch Basisonderzoek* (Strategic Basic Research) or SBO. These networks were formed from the bottom up and this formation was actor-driven. The ad hoc character of this policy approach remained under discussion, in particular on the question of whether greater control was needed with regard to choices relating to the investment of scarce resources in projects with a certain critical mass.

Towards the end of the twentieth century, Flanders took a step towards an innovation policy based on a systems approach. The policy provided for a number of instruments that could be used to encourage innovation along the whole path and at the network level.

---

[2] Language technology, biotechnology, multimedia, graphics, media, telecommunications, DSP, automobile, aviation and space technology, and logistics.

From ‘early warning TA’ to ‘constructive TA’

Early warning TA

Initially, technology assessment policy in Flanders came down to encouraging research into the negative effects of new technology to be able to give a timely warning about these effects on the basis of research results (‘early warning’). In this way, it was hoped that corrective adjustments could be made to the framework conditions that determine the success of new technological applications. The need for TA research with regard to biotechnology was expressed by Gaston Geens as follows: ‘Attention is needed for the <u>framework conditions</u> in the social, economic, legal, and ecological areas that determine the success of new initiatives in the field of biotechnology.’

In 1984, the *Stichting Technologie Vlaanderen* (STV) or Foundation for Technology in Flanders was established as part of the *Sociaal Economische Raad Vlaanderen* (SERV) or Social Economic Council of Flanders, and charged with studying the negative consequences of the introduction of new technologies in the work environment and advising the social partners in this regard.

Also, each of the four technology programmes (biotechnology, energy technology, environmental technology, and new materials) that were set up at the beginning of the nineties was provided with a TA research section charged with studying the social effects of these technologies (in the energy technology programme, the TA research was eventually dropped). Here, the research would also look into negative effects in fields other than the work environment, such as the environment, health, safety, ethics, social equality, economy, and law.

Afterwards, it became apparent that such TA analyses have little influence on the actual development of new technology. For instance, there was a discrepancy between the research activities organised by STV in the field of micro-electronics and the first initiatives taken by the DIRV policy in this area. While research was being done in the preliminary path of the basic technology of micro-electronics (R&D to make customised VSLI chips) as part of the *Actieprogramma Micro-Elektronica* (Micro-Electronics Action Programme), the STV was studying the negative consequences of applications of micro-electronics already introduced in factories (CAD systems, robots) on employment opportunities and work quality.

In the two first programmes, biotechnology and environmental technology, the TA sections were separated from technological research in these programmes and the coordination of these two sections came to reside with two different agencies (STV for TA and IWT for technological research).

On the one hand, then, the government pursued a ‘science’ and ‘technology push’ strategy. On the other hand, there was support to predictive research into technology effects, so as to prepare society in time for the arrival of new technology.

Social actors had little impact on this policy. As a consequence of the discussion of the DIRV Action policy document in the debates in the Flemish Council, doubt was cast on the blind confidence of the government in the push strategy of the DIRV policy. Because of this, according to the Council, it was difficult to take into account social needs such as ‘qualitative growth’, ‘useful products', and 'meaningful labour'. In the policy document, the Flemish Council had been accorded the function of permanently evaluating innovation policy. However, this remained a paper assignment, because the Flemish Council was given no resources and instruments to fulfil that function properly. Also scientists (on the DIRV advisory board) and the Flemish social partners (in Vlaams Economisch en Sociaal Overlegcomité, VESOC) formulated, at the start of DIRV, a demand for an innovation strategy that would be more attuned to the users and better geared to meeting social needs.

Nor did the citizen or user play any active role in this innovation policy. DIRV policy viewed technological innovation as a matter of two separate worlds: the world of inventors of new technology, and the world of users. The available resources would therefore be invested in basic research at the beginning of the innovation path, and, at the end of the path, in public campaigns (technology days and technology exhibitions) to let the user know about the new possibilities offered by modern technology.

Constructive TA

The official programme of the Flemish government of February 1989 emphasised new options for innovation and technology policy (the expression 'DIRV policy' was no longer used): 'Research into socially useful applications must be stimulated. A selective investment and technology assessment policy can give important impulses to this.' The need for a TA section in research programmes was now expressed as follows: 'The basis will be an integrated approach in which aspects in the social, economic, legal, and ecological realm do not constitute preconditions, but are <u>essential elements</u> for making corrective adjustments to, and for the orientation of, the global technology programme.'

At the commencement of each new technology programme, a Technology Assessment Report would have to be drawn up and made public. This report was to give an overview of various scenarios considered relevant by the government, with explicit attention to indicators such as welfare, labour quality, ecology, and the rational use of energy and raw materials. Participants in research programmes were expected to clearly situate their project in accordance with the scenarios and indicators designated in the report.

In the Technology Memorandum of April 1994, we read: 'Technology also has important social implications.' Attention must be given to this, but it 'may not slow down or have a negative influence on creativity and the innovation process.'

Gradually TA working methods appeared in Flanders, which strove to complement the 'early warning' approach by being more closely related to technology development. TA was set up in close association with the research and development projects of technology institutions such as IWT and VIB. In that way, TA was practised in very direct consultation with the scientists, developers, and producers of science and technology.

The TA Report for the New Materials research programme was assigned to IWT and was immediately carried out at the level of the R&D projects (5% extra subsidy per project). A third public research institution, the VITO (*Vlaams Instituut voor Technologisch Onderzoek* or Flemish

Institute for Technological Research, 1991) would do research in the field of materials and energy, and their impact on the environment. The research institutions VIB and VITO each got their own TA research programme, both of which were set up from the perspective of those parties that were directly involved with these institutions (researchers at universities and companies).

By relegating TA to R&D projects and in research institutions, the involvement of society became limited mainly to researchers and producers of knowledge and technology. As a consequence, the palette of contributed perspectives shrunk to the areas considered most relevant by these groups, such as environmental protection, risks to safety and health, and market opportunities. The TA research programme of the VIB, for instance, focused on the economic, marketing, and communicative aspects with regard to biotechnological products.

Lessons from this history

So far, the Flemish innovation policy has been characterised by a double ambivalence. To start with, there is the continuing discussion about finding a correct balance between a top-down and bottom-up strategy. The first approach is based on a certain amount of control and is directed at 'picking winners'. A bottom-up policy encourages spontaneous joint ventures that grow from the market. Initially, with the DIRV policy and the policy directed to the first generation of clusters, the emphasis lay on selective support by the government of priority technologies and activities. Such a controlling policy is always a gamble, because there is no reason whatsoever to assume that government officials are better at recognising growth opportunities in the market than entrepreneurs (Hosper, 2002). In the next generation of innovation, networks or platforms were formed more from the bottom up, and were actor-driven. Here, however, the question was whether the lack of public resources, or the complex application of hard criteria for investing public resources, did not make the dividing line between this policy and an ad-hoc policy very thin.

The second ambivalence lies in the fact that, on the one hand, innovation networks were supported in more traditional domains, often leading to a cluster policy practice that was not always based on proven strengths, while, on the other hand, initiatives such as 'technology valleys' and 'technology excellence centres' were launched to promote high-level technology, a practice that is in line with a 'technology push' policy. Experience teaches (e.g. Lernout & Hauspie, GMOs) that it is difficult to identify the winning technologies of the future in advance (Jacobs, 2000).

Both these ambivalences and discussions – on the difficult balance between a bottom-up and top-down approach in the policy and on the relationship between existing and new knowledge and technology-intensive activities – reflect the search for new policy models and for new roles for the government (Larosse, 2000). These roles range from concentrated on coordination, moderation, and facilitation at the strategic level (macro) and at the network level (meso) on the one hand, to helping to search for new promising combinations between existing strong activities, and new knowledge-intensive and high-technology activities on the other hand.

TA policy itself also learned from the struggle with the difficulty of predicting technology and its consequences. 'Early warning' TA was born from the need for timely warning for the negative effects of new technological developments to enable society to anticipate these at an early stage. Experience taught that little can be predicted in the area of the future development of technology and its effects. There is always much uncertainty and insufficient knowledge. As a result, such TA analyses ultimately had little impact on the technology paths themselves.

The technological options from which a choice will be made can only be known beforehand to a limited degree, and the consequences of each choice are difficult to predict. In fact, the developers of a technology are caught in a control dilemma. In the earliest stages of a technology, its development can still be influenced easily, because only few vested interests are involved yet. But at that early stage, there is also a lack of knowledge about possible effects, knowledge that is needed to decide whether corrective adjustment is required. Gradually, the new technology becomes distributed in society and embedded in existing technical and social structures, and various groups develop growing interests in the technology. By that time, the consequences are much better known, but then it has become very difficult to make any more corrective adjustments to the technology. Trying, in an early phase of development, to gain insight into later side effects is a dead-end street. Historical examples show that the prediction of side effects is doomed to failure.

'Constructive' TA is based on the principle that the first assignment of TA is to make a contribution to the influencing of technology development paths themselves. In the first phases of a technology path, researchers and designers make choices that are not based solely on scientific laws or technical considerations, but that are also influenced by the social and cultural context in which those choices are made (Smit and Van Oost, 1999). New technologies come into being as a result of a process of variation and selection: several versions of a product or process are tested (Rip, 2002). Assumptions made by technology designers about the nature of society's demand and needs determine which versions will be tested. Those assumptions can be investigated and made more explicit, especially with regard to why interesting options are not taken into consideration (e.g. the ignoring of certain concerns in society about the environment).

The direction in which a technology develops can be influenced when an intersection or a bifurcation occurs in the development path (Van Eijndhoven, 1995). Constructive TA can help to be alert to the discovery and recognition of these junctions or bifurcations. When faced with a choice between various bifurcations, it makes sense to find out which picture of the use, or of the user, or of society, the researcher and designer have in mind.

With a view to visualising these bifurcations and implicit choices, constructive TA explicitly sets up the analysis from the perspective of a directly involved actor in the technology path. That can be the group of users, or it can be the group of researchers and developers themselves. In Flanders, it was decided at a certain point to incorporate the task of TA directly into technology programmes and technology institutions, and thus to allow the TA analysis, with the help of TA analysts, to be closely connected to the perspective of the researchers and developers. This has the great advantage that the scientists and technologists themselves are caused to think about the choices they make in their work. A limitation of this is that the social involvement in technology paths is thus reduced to the specific perspectives of this group.

A need is growing for forms of TA - such as *'interactive' TA* - that can help to influence technology paths in a direction that is desired by society and citizens in general. This is possible by bringing the perspectives of all relevant actors into the discussion. Once a technological path becomes embedded, all later variations will depend on past choices. Technological development is path-dependent and therefore to a large extent irreversible.

It is therefore important to investigate various perspectives on possible variants of technology paths, both the perspectives of those actors who are directly involved (the producers of knowledge and technology, the embedders of technology, the users) and those of more indirectly involved actors (citizens, the civil society). Then, TA can support the government in the formulation and implementation of socially accepted needs for the technological innovation policy.

Three challenges for an innovation policy in Flanders

In Flanders, it would seem difficult to align scientific and research specialisations with existing economically strong activities. There are few ties in Flanders between the scientific basis and innovative companies. The Flemish innovation system fails on this point. On one hand, there is innovation without research and development, which applies, for instance, to the petrochemical cluster at Antwerp, to the carpet industry in the province of West Flanders, and to automobile assembly. On the other hand, there is research and development of which the results are hardly picked up by Flemish companies. This is or was the case, for instance, with the research by IMEC, VIB, Plant Genetic Systems, and in the ICT sector. There is also a tendency for research and development to be transferred away, as shown by the examples of Philips and Siemens. There was the debacle of Lernout & Hauspie (speech technology). The question that poses itself, now and in the future, is how to better align the innovation system with competitive companies in Flanders.

In our discussions with Flemish actors involved in innovation policy, three central challenges for a Flemish innovation policy have come to the fore, for which a solution must be found to overcome this failure of the Flemish innovation system:

- the need to develop a vision and formulate demands and social needs;
- the importance of embedding knowledge in Flanders via innovation networks;
- the necessity of building broad public support for innovation policy.

An innovation policy can escape the dilemmas of having to choose between ‘controlling or allowing growth from the bottom up’ and ‘stimulating traditional or advanced industry’ by formulating a response to the first two challenges, the need in Flanders for a strategic vision and the embedding of know-how that will be difficult to copy someplace else. The third challenge, that of gaining broad support for innovation policy, assumes an influencing of technology paths, in a direction that is also desired or accepted by the general public, by citizens, and by users and their representatives.

Developing a vision

The Innovation Pact prescribes that, by 2010, 3% of the gross regional product (GRP) should be spent on research and development. According to various discussion partners, this should be supplemented by a mission statement, translated in a list of challenges or of social needs in Flanders. Explorations of social trends and technological innovations likely to develop in the longer term can have an inspirational effect here. Elaborating a long-term vision helps the actors (scientists and companies) to deal with the uncertainties that accompany innovation. It also encourages those actors in their commitment to reach the proposed investment norm in R&D. This vision of the future will then be translated into concrete challenges or projects in various fields of application.

Embedding knowledge

The innovation system fails in gearing research and development in Flemish knowledge centres to innovation in Flemish companies. One can embed knowledge, or prevent knowledge from being copied, by connecting the formulated challenges and needs with the potential for knowledge, technology, and industry in Flanders. Mapping the future explorations mentioned above with the economic and knowledge fabric of Flanders will then help to select priority strengths and areas of research.

This assumes the construction and management of innovation platforms or networks with the following characteristics, amongst others:

- they will search for *synergy* in the framework of a visionary programme (social challenges and problems);
- they will find technological solutions through a *holistic* approach (culturally embedded);
- they will be *virtual* for the sake of efficiency, flexibility, and complementarity.

Broad public support for innovation policy

The need for public support for technology and innovation policy has been expressed in various ways: by stressing the importance of placing innovation on the political and social agenda, by insisting that the demand side should be given more attention in the policy, by demanding greater accountability for the spending of public resources on research and development, and by stressing that innovation policy should be supported by parliament. The resources required to build this broad support – a strategic forum for vision formulation, the drawing up of an innovation plan, the organisation of greater public involvement, the expansion of infrastructure for strategic intelligence – are generally considered worthwhile.

Policy initiatives inspired by a third-generation innovation policy and by developments in the field of interactive TA can help provide an answer for the three challenges of developing a vision, embedding knowledge, and gaining a broad support for innovation policy. A third-generation innovation policy has as its objective the mobilisation of various actors for social innovation projects. That assumes starting with a social challenge and a long-term horizon, continuing to build on strengths and making choices, involving all relevant actors, also on the demand side, respect for everyone's contribution, a government that coordinates, and the organisation of strategic intelligence for policymakers (Zeeuwts,2004). Initiatives in the area of interactive TA can support this approach. In an interactive TA approach, the perspectives of all groups that are directly or indirectly involved in technological innovation are taken seriously, the possibilities of and obstacles to their interaction are made visible, needs and wants form the starting point, and the focus lies on learning processes in the area of meaningful technology paths.

Above, we have sketched the developments that have led to the current state of affairs in Flemish innovation policy. On the following pages, we will go further into the outlined challenges and observed problems as articulated by our discussion partners. The analysis of these discussions justifies the conclusion that Flanders should continue its development towards a third-generation innovation policy with the inclusion of attention for interactive forms of TA. The emphasis on the systemic nature of innovation in third-generation innovation policy provides good conditions for systematic and structural knowledge embedding. The importance that is attached in third-generation innovation policy to horizontal policy, both to give broader support to economic objectives and to promote innovations in other sectors of society, stimulates the debate and, thereby, the development of a vision. The emphasis on learning processes also contributes to vision formulation and creates, at the same time, favourable conditions for an innovation policy that is broadly supported, both economically *and* socially.

3. Contributions of third-generation innovation policy to Flemish ambitions and challenges

What contributions can a third-generation innovation policy make to the challenges facing Flanders, as set out above? In what follows, we will systematically determine, on the basis of the discussion material for these three challenges (formulating a vision, embedding knowledge, increasing support), how the problems can be formulated, what obstacles stand in the way of a solution, and what opportunities exist for dealing with the problems. We will also discuss suggestions on how these opportunities can best be used. The text is a compilation of the analyses and proposals discussed, which does not imply that a consensus was reached on all these points between all the discussion partners.

Challenge 1: stimulating the development of strategy and vision

How is the problem formulated?

The Innovation Pact prescribes that, by 2010, 3% of the GRP should be spent on research and development. This should be accompanied by a clear mission statement for Flanders. Where does Flanders want to be in 20 years? What are the main challenges? Much more than it has ever done so far, policy will have to engage in a debate on its own principles. Finding an answer to the 'why' question is also important because this places research in a social context.

The development of a vision must not be made equivalent to 'predicting'. Experience has taught that it is impossible to make reliable predictions, as there are too many uncertainties in innovation. What is possible though is to focus on a challenge, and then chart the steps required to get there. Such a vision can be adjusted every two or three years during the course of the journey.

The discussion will deal with broad challenges, such as sustainable development or our relation to the third world and how to connect it with knowledge stimulation. It is essential for this vision of the future to be translated into concrete projects that deal with specific issues, for instance: How can elderly people remain mobile and self-sufficient longer? How will we communicate with each other in 2020? How to ensure that everyone has a PC of their own? How to organise safe bicycle traffic? How to make Zaventem airport into a services hub?

Working with a long-term vision helps the actors (scientists and companies) to deal with the uncertainties that accompany innovation. Establishing a long-term vision makes for honesty and creates greater clarity in a context of uncertainty: SMEs, universities, research institutions, and starters can make clearer choices. Misguided investments in R&D can be avoided. A vision will also stimulate the actors in their commitment to attain the financial standard that has been set.

What obstacles stand in the way of a solution?

There are several facts that make it difficult to formulate a vision.

Flanders is small. There are few areas of technology in which Flanders is a world leader (although, a while ago, Flanders was in the forefront of plant biotechnology). How can we establish priorities for Flanders in an international context? Given the situation, would it not perhaps be better to ask ourselves in which fields of technology Flanders could quickly catch up with the leaders (e.g. in the field of nanotechnology)?

The strategy of innovation policy is focused too much on *form* (e.g. initiatives such as 'Technology Day', 'Flanders Creativity') and on facilitating innovation, and too little on *content*.

The *short-term perspective*, both of governments and of large companies, makes it difficult to arrive at a long-term vision. Since a long-term vision goes beyond the term of one legislature, a government is more likely to focus on framework conditions. Because of the current market problems, such as those in the ICT sector, for instance, companies are so preoccupied with overcoming the next low point that they do not think further than six months ahead.

There are mutual doubts between the actors (universities and companies) about the ability and desire of the other to make good on *commitments in the longer term*. Representatives of universities find that companies show too little real involvement in the Flemish Science Policy Council (advisory agency for Flemish science and innovation policy), while representatives of companies find that the position of universities on the Flemish Science Policy Council is too dominant.

Current forecasting and future explorations are done *from too narrow an angle*. The phrasing of the question determines where one looks for an answer. At present, Flemish policy-makers – Agoria, the Flemish Science Policy Council, and the Economy Administration of the Department of Economy, Employment, Home Affairs and Agriculture – tend to focus mainly on technological and economic trends and show much less interest in looking at things from the viewpoint of social needs. What is also lacking is a platform where the connection can be made between social research and technological research.

There are *institutional and administrative obstacles*. The need for innovation is being felt and acted upon in many different fields of policy, which makes for a complex whole. A great variety of actors are involved and they need to ask the right questions. What is lacking here is a platform for mutual consultation, where these questions can be coordinated. As a result, the available budget for innovation is distributed over segmented ministries that support disconnected initiatives.

Opportunities for developing a vision

A lot can be *learned from past experience* in Flanders in the sphere of vision and strategy development, in the first place *from large companies*. The development of a long-term strategy for Flanders is not so different from drawing up a strategic plan for a company. Analogous to a business development function in companies, a region like Flanders can work with four inputs: draw up a mission statement, map out technological trends, and formulate answers to the questions of what the market expects and what society expects. In the sphere of vision and strategy development, a lot can also be learned *from previous policy initiatives*. An example: when VITO was established, there was a vision behind the selection of three technologies (environmental technology, energy technology, and materials technology). Energy and raw materials have an impact on the environment; their waste flows are a burden on the environment. This was why it was decided, at the time, to include environmental technology as the third area covered by this institute. Similarly, we could now start a new discussion on a long-term vision in the area of energy supply and its impact on the environment (with the Kyoto standard as the target). Another example: why not discuss a joining of forces with regard to sustainable and renewable sources of energy, analogous to the concerted action of private and public actors in the past in the matter of nuclear energy that led to the establishment of the Belgian Nuclear Research Centre (SCK/CEN) in 1952?

Scientists engage in self-reflection. Scientists are citizens too, and members of society. That influences their work. For social reflection, it is not always necessary to set up new structures. An example: the research of the department of plant biotechnology of the VIB evolved from plant genetics to plant-system biotechnology. Plants are now studied more as a model system, and the scientists are learning about life processes. This research is shifting towards fundamental research, which can still be taken in various directions. Thus, scientists make corrective adjustments themselves, and they pay attention to developments in their environment. Such intuitive processes play an important role.

There are initiatives for placing innovation on the agenda in other fields of policy. The Innovation Decree of 1999 prescribes that, at the start of a legislature, an innovation plan is to be drawn up, aimed at policy harmonisation across areas of competence. A real effort needs to be made in this regard. There is a long way to go to get innovation on the agenda of all the cabinets and administrations. Occasional initiatives have already been taken: in the media policy, there has been the establishment of a Broadband Institute, and there is the development of interactive digital TV; in agricultural policy, a new regulatory framework has been drawn up; in environmental policy there is now, an innovation platform for environmental technology; in the transport and harbour policy, there has been the establishment of the *Vlaamse Instelling voor Logistiek* or Flemish Logistics Institute; and in economic policy, a part of the Hermes Fund goes to Excellence Centres. The management agreement with VITO specifies that VITO will respond to demands and questions from the various fields of policy.

The objectives of innovation policy go beyond the economic sphere. In the last coalition agreement of the Flemish government, innovation policy is included under the objective of sustainable development. The knowledge centres IWT, VIB, and VITO implement that objective in their research policy. IWT has developed specific mechanisms to promote ecological innovation (10% extra research subsidy if the sustainable development objective is included in the research project). VIB is working on a directive framework for its own research policy, which includes the following components: guiding values, relevant principles, a survey of the relevant stakeholders (both directly and indirectly involved), and criteria of sustainability (economic, social, and ecological). At VITO, the focus of research is on sustainable energy technology (bio-energy). The IWT research programme *Strategische Technologieën voor Welvaart en Welzijn* (Strategic Technologies for Welfare and Well-Being) also fits in with the philosophy of gearing technological research to social needs. Along the same lines, IWT's

Strategic Basic Research (SBO) has recently also been opened up for research projects with a social objective.

Suggestions

Various *framework conditions* were formulated for launching a successful process of vision development in Flanders.

In the first instance, it is considered important for an innovation policy to strive for a *balance between 'controlling' and 'allowing growth from the bottom up'*. This assumes two things. On the one hand, a strategic discussion needs to be set up to formulate the challenges, discuss the choices with regard to achieving the desired outcomes, agree on time-frames, and arrange the collaboration. On the other hand, policy must leave enough room to allow knowledge platforms to develop relative to certain social needs (such as mobility, care of the elderly, or communication). The solutions to such problems are often culture-related and are difficult to implement from a distance.

When consideration is given to visions, challenges, and needs, this need not necessarily be at odds with the condition that in order to receive public support, only the *'best research'* is selected. The selection criteria for 'good' research are usually set by the scientific community itself, and the judgement is left to scientific peer review. A difficulty here is that scientists usually do 'see' these criteria implicitly, and are guided by them, though much of this process is really more like a leap of faith. For the future, it is important to define these criteria more clearly and to make them more explicit.

A discussion about visions and needs must not be conducted *solely with experts*, because they are directly interested. Discussions about future scenarios should involve a broader range of citizens and users. For instance, the process of formulating a vision on communication in the year 2020 would ideally involve government, industry, universities, concerned citizens, and end users. In concrete terms, for example, analogous to the 'House of the Future', a discussion about the 'Neighbourhood of the Future' could be organised on the basis of a glass-fibre network.

Discussions about challenges and visions must be fed by *relevant explorations, scenarios, and data*. These must meet a number of requirements. In the first place, the main thing here is not so much to try and predict the future, but rather, to *describe possible and desirable scenarios for the future*. This requires an input of both knowledge and values (e.g. via a method like 'backcasting', where a challenge and final date are postulated and several milestones are set out for getting there). In the second place, this demands a *multidisciplinary or interdisciplinary approach*. In addition to technological and economic trends, social trends will also have to be studied. Respondents stressed the importance of two kinds of 'road maps': 'technology-driven' and 'application-driven'. For technology-driven road maps (e.g. on the question of how semi-conductors will develop by 2015) the central question is how to shift the boundaries (or road blocks) in the direction of new applications. Application-driven road maps are based on social scenarios, e.g. the question of how people can become pro-actively responsible for their own healthcare capital. This will be based on sociological and psychological research, in this case, about human beings in an 'intelligent environment'.

Challenge 2: embedding knowledge

How is the problem formulated?

The Flemish innovation system *fails in gearing its own research and development to innovation in Flemish companies*. This leads to questions such as: How can knowledge be durably embedded in such a way that it is not easily copied someplace else? How to accomplish that knowledge centres cannot be easily exported or moved? How to prevent brain drain?

Some people associate this failure with a lack of explicit searching for a connection between challenges and needs, on one hand, and the potential for knowledge, technology, and industry in Flanders, on the other hand. The government is afraid to be selective and allocate limited resources to priorities. It is difficult to justify the effective utilisation of public resources for innovation without clear policy objectives.

This failure is also associated with a lack of creative thinking on the good management of innovation platforms and knowledge networks, and a lack of investment in this area.

What obstacles stand in the way of a solution?

Globalisation erodes the possibilities of embedding the decision-making power of local institutions. There are few large innovative companies in Flanders that make their own decisions. It is becoming clear that Western countries no longer have a monopoly on knowledge. In an international context, the sphere that can be controlled or even influenced by Flemish technology policy is very small.

A discrepancy has developed between the actual roles that the actors presently (can) play in innovation networks and the roles these same actors expect from each other:

The *universities* are expected to (continue to) supply the basis for unexpected discoveries. But the two-speed growth of research resources – faster for applied research than for fundamental research – is making this less likely. Universities are becoming more and more actively involved in the valorisation of their research. The greatest growth of research resources in the most recent period was intended for research with broad application possibilities, mainly strategic basic research (IWT) and research in excellence centres. The resources for fundamental research – *Bijzonder Onderzoeksfonds* (Special Research Fund) or BOF, and *Fonds Wetenschappelijk Onderzoek* (Research Foundation) or FWO - have also increased, but to a lesser degree, and the chance of qualifying to receive funding for this type of research (FWO and BOF) is smaller than for strategic basic research.

The *government* is increasingly expected to take on a more proactive role. This collides with the current role of government, which still focuses on distributing money, creating preconditions, facilitating, and removing thresholds. The new role also comes in conflict with a lack of alignment of policy at the federal, regional, and local levels. Since the regional and local embedding of innovation platforms is also becoming more important, the various governmental agencies will have to work together more. Another impediment that keeps government from assuming a more proactive role is its lack of strategic intelligence. At present, large players can outstrip government with their knowledge.

Society expects *companies* to take on longer-term commitments in the area of innovation. In practice, it turns out that large companies hardly look ahead at all, as they must book results in the short term. They compensate for their lack of long-term vision by buying up small companies. This creates the risk of lock-in, or the danger that large companies are less concerned about innovation than they are about increasing their sales volume. For SMEs, the threshold to government support remains very high. Something that does *not* work is for SMEs to have to request support themselves and write their own project proposals.

Opportunities for embedding knowledge

In recent years, there has been an increase of spontaneous cluster initiatives between companies and knowledge centres, reflecting the growth of new business models and network models (such as outsourcing and strategic alliances). The new question is therefore whether a Flemish cluster policy will be able to support this new network of relations in an adequate manner.

A growing portion of the budget of IWT is going to the stimulation of 'collective' innovation in various forms: collective research, training and advice, technology transfer, promotion of networking. This is expressed in three programmes that stimulate networking:

- The VIS programme (*Vlaamse Innovatie Samenwerkingsverbanden* or Flemish Innovation Joint Ventures): these are bottom-up initiatives that must meet certain criteria (e.g. at least ten companies must participate in so-called 'thematic' networks);
- The *Vlaamse Technologie Excellentiecentra* or Flemish Technology Excellence Centres: these are not programmes based on research, but innovation-driven networks that are supported by the Flemish government because of their strategic importance for Flanders. Five platforms have been started up (automobile sector, logistics, mechatronics, geo-information, and broadband) and three are in preparation (new materials, food, and environmental technology);
- *Strategisch Basisonderzoek* (SBO) or Strategic Basic Research: this is a programme to stimulate interdisciplinary research at universities (in cooperation with companies) with a longer-term horizon and with valorisation for the Flemish economy and society (5 networks).

Suggestions

Good management of innovation platforms will emphasise the following *actions and goals*:

Create synergy. The power of innovation platforms is their critical mass and the synergy and complementarity of the actors involved. Innovation platforms will concentrate on generic problems in the framework of a visionary programme and of future explorations on technology and society. At the regional level, they will enter into a strategic 'thinking partnership' with universities. From this network, the companies will then distil various fields of application. The management of knowledge exchange is crucial in these platforms. Clusters must also be sufficiently open to admit new companies.

Search for *technological solutions taking a holistic approach*. The cultural embedding of innovative solutions for social problems will become increasingly important. Therefore, innovation will require a holistic approach. An example is the challenge of self-sufficiency for elderly people. The technology should be developed step by step, in consultation with healthcare professionals and legislators, and through cooperation between engineers, social scientists, and legal experts. The users must also be involved.

Give preference to *virtual knowledge centres*, for the sake of efficiency, complementarity, and flexibility. Researchers are increasingly cooperating across physical units. This is facilitated by the growing share of software in all technologies (in addition to ICT, computers are increasingly dominating the areas of biotechnology, mechatronics, and nanotechnology). In a virtual research network, the best competencies and strengths in different places can be coordinated. After a while, these networks acquire a character and researchers begin to identify with them. Thus, research is not disconnected from the places where students are trained, and the training is given within one's own research culture. An advantage of virtual centres is their flexibility, because no research theme is ever eternal.

Focus on *public-private cooperation*.

Let the actors set up *experiments* together.

Through good management, the *innovation cycle* from discovery to invention and valorisation, with all the feedback loops involved, can be *completed much faster*. This could result in an edge over other countries.

On the establishment of innovation platforms (e.g. 'Zaventem as a services centre') it is best not to set up any new organisations, but to focus on the *creation of interfaces* between existing services instead.

Some creative thinking must be done about the formulation of a *set of instruments* designed for an innovation platform or system in its entirety. The set of instruments of IWT, for instance, can be employed as part of a broader range of instruments. An example: the 10% extra R&D subsidies that are obtained for a research project if it includes 'sustainable development' in its objectives, does not, as an isolated measure, really provide much motivation for explicitly choosing to develop sustainable technology. Therefore, this instrument needs to be incorporated into a broader set of instruments, covering the whole innovation system (e.g. drawing up a life-cycle analysis of the technology, calling for public tenders, imposing standards, etc.).

Think carefully about new roles for the various actors. For the *government*, this could be the role of *sensor*, for instance: mapping trends, searching for complementary activities, describing the steps to be taken. Or it could be the role of *managing* the construction and dismantlement of networks. Other conceivable roles are that of *moderator:* getting the actors involved to agree on their common direction, or of *knowledge broker*: stimulating the flow-over effects of knowledge. The *university* will supply human capital, place the emphasis on research driven by curiosity, and become a partner of the government in the production of public knowledge. *Large companies* will no longer want to lead in all areas, but will set up preferred partnerships with innovative smaller companies.

Challenge 3: building broad public support for innovation policy

How is the problem formulated?

The need for a broader support for technology and innovation policy is expressed in various ways. Some of our discussion partners think that (technological) innovation is not sufficiently featured on *the social and political agenda.*

There is also too little insistence on *accountability* for the utilisation of public resources for research and development. In the past, for instance, a lot of money has been spent on plant biotechnology, although there was little public acceptance of these developments.

Innovation policy pays insufficient explicit attention to the *demand side* of innovation, i.e., the needs of citizens and consumers.

The advisory agency for innovation policy, the Flemish Science Policy Council, does *not represent a cross-section of the population*, but is composed of experts, who are interested parties.

The *Flemish Parliament* is not sufficiently involved in innovation policy.

What obstacles stand in the way of a solution?

The respondents identified several likely ways of obtaining a larger support for innovation policy: in particular, a strategic forum; an innovation plan that is discussed in parliament; involving the general public; and providing for more strategic intelligence in policy. However, there are a number of obstacles which make this difficult to accomplish.

Obstacles to a strategic forum

In the current set-up of the Flemish Science Policy Council, there are, according to the opinion of some respondents, barriers to be overcome before the council could assume the role of a full-fledged strategic forum. Traditionally, in Belgium, there is a partition between advisory councils (of which the Flemish Science Policy Council is an instance) and the government. Political concerns predominate, and there is a tendency to give advice without having to bear any responsibility. Consequently, the government feels free to ignore the recommendations made by such a council. Some respondents also find that companies are insufficiently involved in the Flemish Science Policy Council, pointing out that companies tend to delegate people at the consultant level and not their top decision-makers. Companies have responded to this criticism and made it clear that they will show greater commitment and contribute more actively to the discussion on these forums if they see that their ideas area actually taken up. In addition, the influence of the universities is considered to be quite great compared to the weight of companies, not only in the sub-committee on 'Science Policy' in the council, but also in the sub-committee on 'Technology Policy'. It is also suggested that the industrial federations act insufficiently on behalf of their members and that they are unable to enforce agreements on their industries.

Furthermore, there is still discussion about the way in which recommendations and decision-making in the field of innovation policy should be organised: versus the model of the emancipated agency with a Board of Directors that bears its own responsibility, there is the model in which a leading official is advised by advisory committees ('Better Administrative Policy').

In the past, certain actors had no part in strategic recommendations. The unions, for instance, were not involved in the consultation on the Innovation Pact. Only science and technology really carried weight there.

Obstacles to an innovation plan and its discussion in parliament

In the past decade, there has been little opportunity for a thorough discussion of science and technology in the Flemish Parliament. Science and technology come up in parliament only during discussions of the budget and of the policy document. Management contracts with large research institutions are not a topic of parliamentary debate. Science and technology also form an area of policy on which few decrees are passed.

There should be more members of parliament who feel personally involved in science and technology. Respondents noted that this involvement was greater during the era of the DIRV action.

In the meantime, viWTA (*Vlaams Instituut voor Wetenschappelijk en Technologisch Aspectenonderzoek*, Flemish Institute for Science and Technology Assessment), has been established and incorporated in the Flemish Parliament. Some of the respondents felt this might be an obstacle for cooperation with the Flemish administration in the area of science and technology.

Obstacles to greater public involvement

There were no ready answers to the question of how to bring about a broader discussion about innovation policy. This is because thinking seriously about 'innovation' is an abstract and difficult exercise. How to deal with the many uncertainties involved, both in the area of technology development and in the area of public attitude?

Some of the respondents doubted whether discussions about new technology (e.g. about GMOs) are actually about real problems. Doesn't perception play a major role in such discussions? And how do you deal with those perceptions? There is always a danger that developments will be stopped if a discussion is started in too early a stage.

A few other obstacles to a good debate with a broad public were mentioned. Scientists are often not very good at explaining things in terms the lay public can understand. Sometimes they are also tempted to tell tall tales. And politicians, in turn, sometimes feel compelled to follow the voice of the majority (e.g. in the area of food safety).

Lack of strategic intelligence in the government

Writing, implementing, monitoring, and evaluating an innovation plan requires reliable intelligence. This information and knowledge is only inadequately present in the Flemish administration. With regard to monitoring, the Flemish interuniversity research network '*Steunpunt Innovatie'* (Advice and Information Centre on Innovation) is developing indicators, but that is still a long way from a workable monitoring system.

Opportunities for gaining broader support

Opportunities for a strategic forum

In the past, there have been several top conferences about strategic choices for Flanders, although they were organised rather unsystematically: there was the so-called 'Pact of Vilvoorde', *Kleurrijk Vlaanderen* (Colourful Flanders), the Innovation Pact, and the *Ondernemerschap Conferentie* (Entrepreneurship Conference). To reach a social consensus on these choices, a more systematic reflection on the future will be necessary.

Opportunities for an innovation plan

With regard to the *formulation* of innovation policy, the Innovation Decree of 1999 prescribes that an innovation plan for a term of office of five years be drawn up and submitted to Parliament.

With regard to the *execution* and *monitoring* of the innovation policy, a separate Ministry of Science and Technology has been proposed for the future. If this ministry is to have real authority, a balance will have to be struck between the powers of the administration and the cabinet in the sphere of policy implementation. IWT has also set up an innovation network for the exchange of information among all intermediary actors who support innovation.

Opportunities for greater public involvement

Most of the respondents subscribe to the idea that the average citizen *is interested* and that the average scientist *is willing to take part in the social and public debate.*

There is already *much involvement* on the part of society *in innovation policy.* Roughly forty representatives sit on the committees of the Flemish Science Policy Council. Add those involved in decision-making at VIB, IMEC, IWT, and VITO, and one soon arrives at a total of 160 representatives, who can discuss various aspects of innovation policy. Each of these knowledge centres practices technology transfer, and in that framework, can provide information and encourage debate.

ViWTA exists as a parliamentary TA institute and establishes TA best practices in cooperation with knowledge centres, administrations, social actors, and the general public.

There is the *Stichting Technologie Vlaanderen* (STV) or Flanders Technology Foundation, which arranges TA studies with regard to the work environment, in direct communication with the *Flemish social partners.*

Moreover *much importance* is already attached to *good public information.* The policy document 'Wetenschaps- en Technologiebeleid 1999-2004' (Science and Technology Policy 1999-2004) emphasises the importance of good public information: 'If we want to retain the advantages (of a new technology) and avoid negative side effects, a proactive policy is necessary. Therefore it is the task of the government to inform everyone about what is going on and on the likely future impact of technological innovations. The imparting of a positive but also critical attitude to science and technology must enable the individual to function in society as a capable and well-informed citizen. The purpose of informing the public is to promote critical thinking and well-founded public opinion.'

The Flemish Science Policy Council also emphasises informing the public: 'The Council advocates a real dialogue between society and science. A prerequisite for this is the supply of accurate scientific information. This information must not be limited to scientific-technical aspects, but must fuel a debate on the ethical, social, and economic consequences of new technologies.'

In the most recent management agreement with the Flemish Government, the VIB was charged with making public information a central focus of its social task. This translates into the preparation of brochures, books, teaching packages, school projects (scientists@work), exhibitions ('Eet es Genetisch' on genetically modified food, 'De genen van ons bomma' [Grandma's Genes]).

The Flemish Administration of Science and Innovation also invests human and financial resources in public information (TV programmes, technology days, action programmes, science communication). Public information serves a variety of purposes: it is meant to encourage young people to go for a career in science or technology, it is a way of accounting for public expenditure on research, and it should enable the public to engage in debate in a well-informed manner.

In the spring of 2003, the first experience with *involving citizens in public debates* was gained by the viWTA (a public forum on genetically modified food), the King Baudouin Foundation (a public forum on genetic tests), and the Federal Ministry of the Environment and Consumer Affairs (two local citizen panels in Gembloux and Beernem on field tests with transgenic crops).

Opportunities for developing strategic intelligence

Experience with technology explorations is being gained in large companies, business federations, IMEC, Agoria (the industrial federation of technology companies), the Flemish Science Policy Council, the *Steunpunten* (Advice and Information Centres), *Administratie Wetenschap en Innovatie* (Flemish PublicAdministration on Science and Innovation), and IWT.

The universities have set up various initiatives in the broad field of TA studies: studies into public attitudes with regard to science and technology, cross-disciplinary research, pilot projects in science communication, science shops, and a project to introduce a focus on social needs into industrial networks.

Suggestions

For a strategic forum

There is general agreement on the importance of a forum for reflecting on the strategic aspects of innovation. With regard to the questions of what should be discussed in such a forum and how such a forum should be composed, however, opinions differ.

Subjects of discussion. Some respondents are of the opinion that the discussions should centre on 'content', e.g. a mission statement for the Flemish innovation policy (e.g. in relation to the 3% standard), initiatives to involve citizens or end users in vision formulation and innovation platforms, and future scenarios for various fields of policy (e.g. agriculture and mobility). Others think the discussions should be about the big options in the distribution of resources for research and development; about the relationship between research and social, economic, and scientific objectives; about the relationship between fundamental and applied research; or about the relationship between research for existing industry and for applications in the distant future. Still others think that the discussion can only deal with procedures or ground rules (e.g. how to design clusters) and should not concern itself with content.

Composition of the forum. The idea of an Innovation Council modelled on the Finnish example was suggested. In this model, there is no hierarchy among the actors. The strategic reflection involves various ministers, led by the prime minister, and all the relevant actors take part in the discussions, contributing their competencies. The first question is then who should be involved in such a platform. Some respondents stressed that the highest, coordinating and strategic level of decision-making on science and technology should remain workable. There is need for a balanced involvement of all sectors and of fundamental and applied research. The Flemish Science Policy Council already brings together a good number of these actors. There may also be a role for new actors in this policy domain. Trade unions could focus on themes such as organisational innovation, change management, knowledge management, and education. The ecology movement could call attention to the trend towards using fewer materials. The involvement can be increased further by specific ad hoc initiatives. For instance, the Flemish Science Policy Council plans to submit an analysis of the strengths and weaknesses of Flanders to a panel of 200 to 300 involved individuals.

For an innovation plan

Most respondents endorse the *importance of an innovation plan*, although some find this too controlling from the top down. With such a plan, science and technology are placed on the political agenda and social attention is given to innovation (as in the DIRV period). An innovation plan is in line with the growing social involvement in new technology (e.g. the controversies about GMOs, nuclear energy, and computer fraud). It is also in the interest of the actors involved when innovation policy is supported by parliament.

An innovation plan will emphasis the *integration* of innovation in the various fields of policy (e.g. energy, healthcare, agriculture) and will underpin the social debate with *future scenarios* in those fields.

A *division of labour* will be sought *between the administration and parliament*. The administration will prepare, implement, and monitor the innovation plan. They will build up the necessary expertise for this in the area of forecasting, monitoring, and evaluation. It is the task of parliament to weigh interests and priorities in the light of a long-term agenda.

For greater public involvement

It is considered relevant for the general public, consumers, and citizens to be involved in one way or another at *various decisive moments in the innovation policy*: when establishing the strategic options, when elaborating visions for the future in specific sectors or technological fields of application, and in the phase of almost market-ready products. Especially with regard to this last phase, there is unanimity on the relevance of *discussion platforms for experiments with users*. Here, researchers and technologists will take on board the sociological aspect and interpret and translate users' needs and wishes, in a dialogue with users (e.g. in experiments with a couple of hundred early adopters). The development of a vision for particular *technologies and fields of application* (e.g. the fields in which IMEC and VIB are active) in forums with an input from governmental agencies, companies, and universities, as well as the general public (groups of citizens/end users), also has general support. However, in this context, it is remarked that the great uncertainty that exists at this sectoral level as a consequence of the complexity of technology and society should be taken into consideration here. Therefore, competent input from experts, e.g. in the form of relevant future scenarios, remains important and necessary, because the social discussion on these matters must be a knowledgeable one. With regard to the relevance of public participation in a discussion about *strategic options,* reactions are more reserved. Strategic choices at the Flemish level are generally a complex matter, and it is difficult to fathom the priorities of the general public by means of broad surveys (with simple questions and multiple-choice answers). At the strategic level, the representative political power relationships and parliamentary debate are seen as decisive.

A good monitoring of the *quality of a public debate on technology and innovation* is a first requirement. Therefore, the questions of when, with whom and how to conduct the debate must be carefully weighed. With regard to the question of *when* to have the debate, the general opinion is that, for ethically controversial subjects, e.g. cloning, it is best to start the debate in an early phase – the generic phase – of the research. It is likely that the importance of an ethical discussion in an earlier stage will only increase in future, as nanotechnology blurs the boundary between physics and biology (e.g. chips in the brain). But in many fields of technology (such as ICT), one must have an understanding of the technological applications before one can talk about ethical problems. On these subjects, the discussion is more likely to be about the question of how these applications can be used ethically.

With regard to the question of *with whom* to have the debate, it is suggested to take it *step by step*. The first stage should be a debate among specialists (e.g. if it is about a generic technology such as medical imaging, this should first be discussed in medical circles). This is then followed by discussions in working groups with stakeholders (e.g. NGOs and patient organisations). Next, the subject can be taken up in a public debate. It is remarked that not all citizen panels or citizen forums need necessarily be public. There is also an important responsibility in the area of *reflection by the researchers and the companies themselves*. To this end, good citizenship and corporate governance should be stimulated in companies and research institutions. Scientific groups can be self-regulating. In some technological fields, such as the field of energy technology, it can make a lot of sense to set up *local initiatives* to involve a broad public (e.g. the participatory management of windmills). Such initiatives cause people to think seriously about what is feasible.

With regard to the question *how to conduct the debate*, it is important that all participants are familiar with the content, so that they can make a constructive contribution. A good public information campaign is a prerequisite for this. The government must see to it that this campaign is geared to specific target groups. Another prerequisite is that sufficient *time* is taken for a public debate. It is also important to seek and use *adequate methods*. The discussion should be conducted in terms of a *weighing of the advantages and disadvantages* of certain applications, and not in terms of the pros and cons of certain technologies or products. A good debate calls for a setting in which people listen to each other and in which people *learn from each other*. Therefore, the organisers should take care to create the right framework for arguments to be exchanged in an open and calm way. All actors must be honest in this exchange. It is a matter of give and take. More specifically, scientists and experts must be open and honest about conflicts of interest, their own motivations, risks, and the costs and benefits.

For the contribution of strategic intelligence

It is crucial that think tanks and discussion groups that deal with long-term choices are fed by relevant data, otherwise such initiatives bleed to death. Here lies an important new role for governmental agencies. *As regards contents*, two suggestions were made: to gear TA initiatives to those fields of technology we can connect with in Flanders, and to organise social explorations in addition to the existing initiatives in the area of technology explorations. There were also two *institutional* suggestions: to organise an interface between social and technological research, and to arrange for a neutral agency or interface to be responsible for explorations, so as to guarantee a diversity of information, data sources, and interpretations.

The possible role of TA and users in a modern innovation policy

Third-generation innovation policy requires policy instruments that do not focus exclusively on individual organisations or bilateral relations. Third-generation innovation policy is not possible without instruments that are geared to the innovation system as a whole. In this respect, the five systemic functions discussed in the report by Ruud Smits and Pim den Hertog (2004) should be the focus points of an innovation policy. They are: managing interfaces, building and organising innovation systems, setting up platforms for learning and experimenting, providing an infrastructure for strategic intelligence, and stimulating demand articulation and the development of strategy and vision. Recent research by Smits and Kuhlmann (2004) shows that these instruments are making headway, but require much more development.[3]

Strategic intelligence, and more specifically technology assessment, can make an important contribution to the support of these systemic functions. The table below (den Hertog, Smits, 2004, Goorden, 2004) shows a summary of what this contribution could consist of. Attention is also given to the role of users and citizens in the realisation of these functions.

---

[3] The authors discuss, as examples of system-oriented policy instruments, the Dutch programme *Duurzame Technologische Ontwikkeling* (Sustainable Technological Development), the Dutch network *Netwerk groene ruimte en agrocluster* (Network for Green Space and Agro Cluster), the cluster policy of several OECD countries, and the German *Futur* programme. Although none of these programmes and activities can be viewed as full-fledged systemic instruments, they each support two or more of the systems functions mentioned.

The possible role of TA and users/citizens in a modern innovation policy

Innovation system functions	**Possible roles for TA and users**
Managing interfaces	o involve users in innovation initiatives in sectors/fields o create a TA section in innovation research o assess intermediaries as brokers between knowledge demand and knowledge supply o organise a platform for the interface between technological research (explorations) and social research (explorations) o appoint a broker between actors who have a need for TA and agencies that can supply TA knowledge and experiments o attune TA initiatives to those fields of technology in which Flanders is strong; organise this in cooperation with the technology institutes (VIB, IMEC, VITO) o involve users in innovation clusters (the Flemish Innovation Joint Ventures, the Flemish Technology Excellence Centres) o involve social actors in Strategic Basic Research (SBO)
Building and organising (innovation) systems	o review the operation of existing innovation systems (e.g. clean-up and/or reorientation of the existing knowledge infrastructure) o formulate preconditions for an optimal interaction among the actors in the innovation systems: re-examine the survey of the relevant social actors (and include the demand side and users), think of new complementary roles for these actors in innovation networks o seek synergy in innovation networks in the framework of a visionary programme o support the search for technological solutions in a holistic approach (socio-cultural embedding of these solutions)
Creating forums for learning and experimenting	o involve users as co-developers in innovation experiments o develop innovation forums connected to social

	issues (safety, quality healthcare, administrative innovation) o experiment with systemic innovation instruments o experiment with strategic niche and transition management o establish platforms for experiments with users for very specific technologies or fields of application (e.g. the knowledge neighbourhood, the self-sufficiency of the elderly in the future) o experiment with social forums where debates can be held on future scenarios for broader technologies or fields of application (e.g. technology in agriculture, food, energy) o stimulate learning opportunities between large companies and governmental agencies on parallels between strategic vision formulation for a company and for a region o stimulate constructive TA studies that clarify the perspective of users, e.g. in the sphere of communication and ICT o set up pilot projects on interactive forms of public information on science and technology
Establishing an infrastructure for strategic intelligence (explorations, TA, evaluations)	o conduct TA studies that assess the consequences of new technology in the long term o challenge TA researchers to come up with concrete proposals for innovation policy o give (potential) users access to strategic intelligence o make use of synergies between exploration communities, TA studies, evaluation studies (Flemish Science Policy Council, AWI, STV, viWTA, *Steunpunten*, companies, and industrial federations) and create a central strategic intelligence clearing house o carry out social explorations to fill the gap in this area in relation to economic and technological explorations o enable synergies between TA research at universities and scientific-technological research in technology institutes and universities o arrange for the necessary knowledge infrastructure in the government for drawing up, executing, and monitoring an innovation plan

Stimulating demand articulation and the development of strategy and vision	o initiate systematic (as opposed to occasional) reflection about the future in a strategic forum; think about the social actors who can be involved and about the themes that can be discussed o organise, at the strategic level, a discussion on questions such as with whom, what about, at what stage in the innovation cycle, and according to which ground rules, debates on vision formulation should be held with regard to specific technologies and fields of application o develop nationwide innovation strategies in social domains; translate this into an innovation plan; determine which kinds of knowledge and kinds of social perspectives are needed for this o promote parliamentary debate on issues relating to science, technology, and innovation o invest in forms of public participation (public forums, consensus conferences, scenario workshops, etc.), to involve citizens in vision formulation and demand articulation; guarantee the systematic nature, the plurality, and the legitimacy of this dialogue by research into suitable analytical and participatory methods

The contributors to the discussion

An Van de Vel, Agoria

Dirk Van Dyck, UA

Gilbert Declerck, IMEC

Guido Vermeylen, Umicore

Jan Cornelis, VUB

Jan Kretzschmar, VITO

Jan Larosse, IWT

Jan Synave, Bekaert

Jo Bury, VIB

Johan Van Helleputte, IMEC

Koen Debackere, KULeuven

Luc Kupers, Genzyme

Paul Lagasse, RUGent

Paul Zeeuwts, IWT

René Custers, VIB

Roger Bouillon, KULeuven

Thierry Van Landegem, Alcatel

Veerle Lorries, AWI

References

Adviesraad voor Wetenschaps- en Technologiebeleid (2003): Backing Winners, Van generiek technologiebeleid naar actief innovatiebeleid, AWT-advies no. 53

Agoria Vlaanderen (2004): Innoverend Ondernemen, aanbevelingen voor een succesvol stimuleringsbeleid, Brussels

Deblonde, M. (2004): Transgene gewassen: van Europese crisis naar transparant Belgisch beleid. Kwartaalschrift Economie, vol. 1, no. 1, pp. 49-62

Deblonde, M. and Warrant, F. (2004): SPIRE Science and Precaution in Interactive Risk Evaluation, Intermediary Report, January 2004, p. 27

Den Hertog, P. and Smits, R.(2004) : Co-evolutie van innovatietheorie, innovatiepraktijk en innovatiebeleid, Analyse van de mogelijke rol van parlementaire TA in Innovatiebeleid, Studie uitgevoerd in opdracht van viWTA, Universiteit Utrecht, Dialogic.

Florida, R. and Tinagli I. (2004): Europe in the Creative Age, Alfred P. Sloan Foundation, co-published in Europe with Demos

Goorden, L. (1990): De Stichting Technologie Vlaanderen en Technology Assessment, in Tijdschrift voor Arbeidsvraagstukken, vol. 6, no. 2, p. 79-90

Goorden, L. (1991): Technologie in de jaren '90: ergens tussen brave new world en utopia, Toekomststudies en Onderwijs, Koning Boudewijnstichting, p. 43

Goorden, L. (1992): Technology Assessment en Technologiebeleid, discussienota Stuurgroep Technologiebeleid, Sociaal Economische Raad Vlaanderen, p. 22

Goorden, L. (1994): Ontwikkelingen in wetenschap en technologie nopen overheid tot meer bescheidenheid, in Tijdschrift voor Hoger Onderwijs en Management, no. 2, pp. 44-47

Goorden, L. (1995): Management Van Wetenschap, van W. Vander Meeren and L. Van Langenhove (ed.), review in Tijdschrift voor Hoger Onderwijs en Management, no. 2, pp. 71-72

Goorden, L., Bruggeman, P. and Steyaert, S. (1995): De Vlaamse Technologie-programma's: enkele ervaringen met Technology Assessment, Informatiedossier Stichting Technologie Vlaanderen, p. 138

Goorden, L. (1995): Onderzoek in bedrijf hoeft niet minder fundamenteel te zijn dan aan een universiteit, Naar een nieuwe samenwerking tussen bedrijven en universiteiten, in Tijdschrift voor Hoger Onderwijs en Management, no. 1, pp. 52-57

Goorden, L. (2000): Technology Assessment, Arbeid & Milieu Magazine, issue 3

Goorden, L. and Vandenabeele, J. (2002): Publieksparticipatie aan besluitvorming over technologie: burgers en experts uitgedaagd, in: Ethiek & Maatschappij, Universiteit Gent, October, pp. 32-48

Goorden, L. and Vandenabeele, J. (2003): 'Public Participation in Decision-Making on Science and Technology: a Challenge for Citizens and Experts,' in: The IPTS Report, JRC, EC, March 2003, pp. 25-32

Goorden, L. (2003): Finding a Balance between Technological Innovation and Deliberation. Lessons from Belgian Public Forums on Biotechnology, Paper Prepared for the Session 'New Forms of Citizen Participation in Technology Policy: European Perspectives' at the Annual Meeting of the American Political Science Association, Philadelphia, USA, August 28-31, p. 31

Goorden,L. (2004): Innovatiebeleid en technology Assessment in Vlaanderen, Eindrapport, Studie in opdracht van het viWTA, Brussel.

Goorden, L. (2004): 'De horzel en het luie paard, over technologische groepsspurt en morele verbeelding', series 'Essays voor morgen', Kleurrijk Vlaanderen, Uitgeverij Van Halewyck, June 2004, p. 61

Goorden, L. (2004): Technologische innovatie en deliberatie: waar ligt de balans?, in Kwartaalschrift Economie, Universiteit Antwerpen and Universiteit Tilburg, March issue

Grin, J. et al. (1997): Interactieve Technology Assessment: een eerste gids voor wie het wagen wil, Rathenau Instituut, The Hague

Grin, J., A. Grunwald (eds.) (1999): Vision Assessment: Shaping Technology in 21st Century Society, Springer

Hertog den, P. and Smits, R. (2004): Co-evolutie van innovatietheorie, innovatiepraktijk en innovatiebeleid, analyse van de mogelijke rol van parlementaire TA in innovatiebeleid, Study commissioned by viWTA, Brussels

Holemans, D. (1994): Naar een sociaal-ekologisch technologiebeleid, Agalev discussion text, December

Hosper, G. J. (2002): Clusterbeleid tussen trend en traditie, in Tijdschrift voor Wetenschap, Technologie & Samenleving, vol. 10, no. 4, pp. 152-156

IWT (2004): Advies van de Raad van Bestuur (22 January 2004): Bijdrage t.b.v. de beleidsverklaring van de volgende Vlaamse regering i.v.m. het Innovatiebeleid, Brussels

Jacobs, D. (2000): Industriebeleid in de kenniseconomie: de relevantie van de clusteraanpak, IWT Observatorium, Brussels

Larosse, J. (2000): Kanttekeningen bij vijf jaar clusterinitiatieven in Vlaanderen, IWT Observatorium, Brussels

Larosse, J. (2001): De ontwikkeling van het innovatiebeleid en de opkomst van een 'Nieuwe Economie' in Vlaanderen, in Het Belgisch Innovatiesysteem: lessen en uitdagingen, Rapport Belge en matière de science, technologie, innovation, DWTC, Brussels

Larosse, J. (2003): Towards a 'third-generation' innovation policy in Flanders, contribution to MONIT Workshop (TIP-OECD) 'Horizontal Innovation Policy: Incorporating Innovation Policies across the Board', October, Brussels, IWT

Larosse, J. (2004): Do small countries have (dis)advantages? The rise of MAPs as instruments for strategic innovation policy. The case of Flanders, January, Brussels, IWT

Petermann, T. (2000): Technikfolgen-Abschätzung und Diffusionsforschung, TAB-Diskussionspapier no. 8, Bureau für technikfolgen-Abschätzung beim Deutschen Bundestag

Rip, A. (2002). 'Co-evolution of Science, Technology and Society', expert review for the Bundesministerium Bildung und Forschung's Förderinitiatieve, Politik Wissenschaft und Gesellschaft, as managed by the Berlin-Brandenburgische Akademie der Wissenschaften, Twente University, Enschede.

Smit, W. and Van Oost, E. (1999): De wederzijdse beïnvloeding van technologie en maatschappij. Een technology assessment benadering, Uitgeverij Coutinho, Bussum

Smits, R. (1994): De vermaatschappelijking van de besluitvorming over technologie, in Technologie en Samenleving, chapter 15, Open universiteit Heerlen, Garant, Leuven-Apeldoorn

Smits, R. and Kuhlmann, S. (2004) 'The rise of systemic instruments in innovation policy', in: The International Journal of Foresight and Innovation Policy*,* vol. 1., no. 1

Smits, R., A. Zweck, M. Rader, R. Barré, and A. Salo (2001): Strategic Policy Intelligence: Current Trends, the State of Policy and Perspectives, JRC-IPTS European Commission

Van Eijndhoven, J. (1995): De ondraaglijke lichtheid van het debat, De bijdrage van Technology Assessment aan het debat over wetenschap en technologie, Rathenau Instituut, The Hague

Van Mechelen, D. (2003): Beleidsbrief 2003-2004, Beleidsprioriteiten Wetenschappen en Technologische Innovatie, Brussels

Vandenabeele, J. and Goorden L. (2004): Consensus Conference on Genetic Testing: Citizenship and Technology, Journal of Community & Applied Social Psychology, 14, pp. 1-7

Vandenabeele, J. and Goorden, L. (2002): Biotechnologie en het debat anno 2002, Vlaams Interuniversitair Instituut voor Biotechnologie, April 2002

Wichard, I. (ed.) (2002): Perspectieven op de kennissamenleving, gesprekken over 'Nederland als kennisland', AWT background studies, no. 29, The Hague

Zeeuwts, P. (2004): Naar een innovatiebeleid van de Derde Generatie, Samenleving en Politiek, vol. 11, no. 2