9. A prototypical institution: law, regulation and innovation

Frans van Waarden

1 NATIONAL SYSTEMS OF INNOVATION

The 'national systems of innovation' literature (Freeman 1987; Dosi et al. 1988; Lundvall 1992; Nelson 1993; Nelson 1994; Edquist 1997; Freeman and Soete 1997) has given a prominent place to institutions. It has argued that the innovative capacity of nations depends on the system of institutions that they have in place to support or hinder innovation, and hence that differences in the innovative performance of nations can be traced back to differences in institutional make-up.

However, in their terms institutions are mainly organizations, organizations that provide incentives and resources, possibilities and constraints for innovation. The authors of the contributions to the classic anthology of Richard Nelson (1993) discuss different organizations that make up these innovation systems, but they call them institutions. They mean the organizations or sets of organizations that produce or control the major resources for innovation: banks and other finance, providing organizations and financial markets, research organizations, training and educational organizations, unions and other organizations that form part of labour relations, and organizations involved in technical standardization.

They do recognize that the organizations and inter-organizational relations that make up the national systems of innovations are influenced by 'institutions', now used in a more specific meaning than above (where they mean organization sets), namely the 'norms, habits, conventions and rules' of a society. But these remain largely unexplored in this literature.

This chapter elaborates on such institutions, in particular the most ideal-typical ones, law and regulations, and investigate what role they play in national systems of innovation; how they affect innovation, both directly, and also indirectly through their influence on the organizational structure of – and cooperation between – firms that (may) engage in innovation. This affects at an aggregate level the innovative capacity and innovation patterns of different societies.

I will do so by first highlighting a major problem of innovation – risk and uncertainty – and a major function of law – the reduction of such risk and uncertainty. Section 2 discusses some of the risks and uncertainties involved in innovation. Section 3 treats strategies private economic actors develop themselves to reduce such risks and uncertainties to manageable levels, which include of course 'organization'. As these have tended to be insufficient, over time society and the state have aided citizens and firms by creating and maintaining public institutions that help reduce risk and uncertainty (Section 4). In fact, the history of capitalism is a history of the development of such institutions. Examples are the protection of private property and contracts, a stable currency, the limited liability company, the stock exchange (Rosenberg 1994) and not least a system of law (North 1990). Law is a special kind of institution, and that is discussed in Section 5. Section 6 develops a typology of legal systems, based on two dimensions: an emphasis on regulation or on litigation; and an active or a passive use of these. The types that one gets by crossing these dimensions differ in their capacity to reduce risk and uncertainty – and hence in their capacity to foster innovation. Section 7 discusses the effects of statutory regulation on innovation; Section 8 does so for litigation. The paper argues that deregulation measures will not lead to less law and regulations, but to more, though emanating from different actors – courts – and of a different nature – case law. Empirical data question whether this is positive for innovation.

It may be useful at the outset to stress that the relation between law and innovation is full of dilemmas and paradoxes. The relationship experiences a special version of the basic trade-off in capitalist economies between freedom and predictability, uncertainty and stability, competition and regulation. Competition provides powerful incentives for economic action. However, it creates at the same time risks and uncertainties. If they become too great, transactions may seem too risky or even meaningless to economic actors and they may refrain from engaging in any further transactions. A function of regulation is that it may help to reduce such uncertainties to bearable levels. This dilemma holds in particular for innovation as a special kind of economic activity. Innovation is perhaps even more fraught with risks and uncertainties; and in such an uncertain world the reduction of some of them through law (for example, appropriation through patent law) may be necessary to induce firms to engage in innovation at all. On the other hand innovation also requires some degree of freedom and flexibility to try out new possibilities and combinations; and law that reduces risk and uncertainty and increases predictability may limit such freedom.

The focus of this chapter on formal law does, by the way, not imply that there are no other forms of regulation that impact on innovation. There are. And in many forms, varying from informal rules and conventions in science

and industry, to more formal professional rules of conduct and publication rules in science, to self-regulation by industry, or to standards imposed by one industry (notably insurance) on others. However, these are beyond the scope of this chapter.

2 INNOVATION, UNCERTAINTY AND RISK

Innovation is by definition 'risky business'. But not to innovate is also risky. Often, the question 'to be or not to be' translates for business into 'to innovate or not to innovate'. And not only for the individual entrepreneur, but also often for the economic sector that he or she is part of, and even his country. Jorde and Teece (1990) see it as a defining characteristic of innovation. 'Innovation ... involves uncertainty, risk taking, probing and reprobing, experimenting, and testing. It is an activity in which "dry holes" and "blind alleys" are the rule, not the exception'(p. 76).

Actually, innovation is more often uncertain than risky. The difference is, according to the famous distinction made by Knight (1921) that risks can be calculated, but uncertainties not. We run the risk of dying. That we will die sometime is certain, and the probability of dying at age 60 can be calculated. Life insurer base their premiums on such calculations. An uncertainty however, is the chance of a war in Switzerland in the next century, or whether the difficult search for an efficient method of producing electricity from sunlight or wind will ever lead to success. This chance cannot be calculated. Innovations are often of these kinds. The outcome of research investments is often uncertain. Chance and luck come into play. But there are also risky elements in innovation: how great is the likelihood that the profits of an innovation can be appropriated in a certain society, given its patents laws?

Innovation is in many ways fraught with uncertainty. First of all, the outcome of any investment into invention and product development is uncertain. Is it possible to invent a machine which transforms our bodies into electrons, to be instantly transmitted through a cable to the other end of the world, or even to the fringes of the Milky Way? At the moment we doubt it. But would not the one who predicted in 1500 that we would fly at supersonic speed across the ocean be considered to be a fool, if not a dangerous witch? In 1949 *Popular Mechanics* contained the statement: 'In the future computers might even weigh less than 1.5 tonnes' (Hamilton, 1949: 168)! And more down to earth: much money, energy, effort and brains have already been invested over the last century in finding an efficient method of producing synthetic fuel out of coal as an alternative for oil, but so far to no avail. Will the search ever succeed? This uncertainty holds not only for new products, but also for efficient processes, more stable product quality or stable product

supply methods to improve just-in-time delivery. And more uncertain even: how much investment in terms of capital and labour will be needed for such endeavours. It has been estimated that only one out of every 10 000 new chemicals synthesized in the laboratory in new drug development ever leads to a marketable product. Many are discarded sooner or later because of concerns about safety, efficacy, feasibility of delivery or marketability. They can be costly false starts, especially if one also includes opportunity costs (Committee on Contraceptive Development 1990).

What is more, many inventions are unintended and accidental by-products of a search for other products. The search for new dye stuffs on the basis of aniline produced inadvertent new medicines, and IG-Farben got big on it. Viagra was discovered, not out of a conscious search for erections; the latter turned out to be a side effect of a product developed to fight angina pectoris. By accident a multi-billion market was hit. The invention was radical right from the start. (It is already the biggest profit generator ever in the pharmaceutical industry.) Other inventions required quite a lot of development in order to become 'radical' and generate profit. It took some time before the steam engine, originally employed to pump water out of Cornish tin mines, led to a highly successful national network of rail lines, if only because the latter was a 'large technical system' requiring large investments in infrastructure. And how much development and time lag was there between the Wright brothers flyer of 1903 and the Boeing 747, even though both are 'aircraft'. The Wright brothers did not get rich from it.

Unknown are often also the conditions under which the future benefits of innovations are to be appropriated. Will there be a demand for my new electric city car? Even Steve Jobs was not certain about any demand for the first Apple PC that he developed. Can we really induce consumers to buy green cauliflower? How quickly will the competitors catch up? Will my patent protect me sufficiently? How great is the chance of the competitor developing an even better product?

Innovations themselves are of course also part of the environment for others. And as such innovations are a source of uncertainty. A successful innovation can destroy products, markets, firms and traditional vertical supplier chains, and in that way completely change the environment for other firms. The innovation of the one is the source of uncertainty for the other.

These are direct uncertainties and risks of investment in innovation. There are however also indirect uncertainties and risks. Innovation efforts often require the pooling of resources and competences between different people and/or organizations. Often, competences of individual firms do not suffice for developing new products or processes, especially in science-based industries or large technical systems. Cooperation with users, suppliers or competitors, domestically or abroad, is needed. Computer manufacturers have to cooperate

closely with producers of microprocessors, RAM chips and software. IBM developed the first personal computer in close cooperation with Microsoft. Aeroplane manufacturers develop new planes in close cooperation with airline companies and start production of a certain type only after they have got enough orders for that type. The Channel Tunnel under the channel required the pooling of expertise of many construction firms, and not only for political reasons. Cooperation is also needed because many products and processes these days are interrelated, dependent on each other, and require the development of common standards and interfaces, for example the pcmcia cards for computers.

Such cooperation brings additional risks and uncertainties of its own. First of all, there are the risks involved in any economic transaction or cooperation: opportunism, deception, fraud. Furthermore, longer-term cooperation requires that firms make asset- and relation-specific investments, with all the attendant dangers of hold-up and lock-in.

The nature and degree of these risks and uncertainties depend of course on many variables. First of all on technical matters: the type of technology, product and market involved, the duration of the product life cycle, the phase of the innovation cycle one is in (invention, development, marketing, diffusion), or the type of innovation that is typical for this industry (compare for example the typology of innovations in Whitley 1999). This affects the amount, diversity and type (tacit, codified) of knowledge that has to be pooled and hence the complexity of exchanges, cooperation, and more generally inter-organizational relations. Secondly, the risks and uncertainties vary also with the economic circumstances: is production for final consumers or for other industries? Are markets national or international? How predictable are consumer preferences? How intense is competition? How many resources and competences do the major competitors have? Thirdly, risk and uncertainties depend on the societal and institutional environment. Do they enhance or restrict opportunistic behaviour? Do they aid in reaping the fruits of investment in innovation and cooperation?

If innovation is so risky and uncertain, one may wonder why people or organizations innovate at all. Of course the answer is: because not to innovate is equally if not more risky. It is the risk of lagging behind in technical and product developments, of losing in competitiveness, of being forced out of business. There are incentives to innovate: negative ones, like those just mentioned, but also positive ones – the chances to hit the jackpot, to make huge profits on new radical inventions (Viagra) or on the successful development of inventions into profitable products (the inflatable rubber inner tube on the bicycle tyre), or on the successful marketing of them (McDonald's, the fast food chain). As in business in general, incentives are positive (greed, profits) and negative (fear, competition). The paradox is: people and

organizations invest in innovation because of risk and uncertainty; but these activities themselves are also fraught with risks and uncertainties.

And as in business in general, entrepreneurs need not only 'want' and 'fear'; they must also be able to 'hope'. Economic actors must want to innovate, but also be able to do so. Incentives alone are insufficient to move people, to get them to engage in economic and innovative transactions. They must also believe in the sense of it. It must be meaningful. There must be some minimal sensibility in their efforts, some minimal chance of success, of their investments in innovation really producing a marketable product or process, a minimal chance also of being able to appropriate the fruits of innovation. Nobody wants to be a Sisyphus. It is like gambling: the chance of winning is the incentive. But it becomes especially addictive if the chance of winning is realistic, if one wins regularly, if only a little bit. The Las Vegas casinos know that, and advertise with 'pay out rates' of 97 or even 98 per cent. That makes it so addictive that the casinos get rich on the remaining 2 per cent.

The belief in the possibility and sense of economic action, including innovation, depends especially on the nature and degree of risks and uncertainties. The larger these are, the more investment becomes a gamble, and the less likely the investment will be made. A minimal reduction of risks and uncertainties and an increase of predictability makes economic transactions, including innovations, more likely. It allows economic actors to make sensible choices and decisions, including decisions about the long-term investment often needed for innovation, to calculate and evaluate the rationality of these investments. There is a fundamental paradox here: some minimal risk and uncertainty (read: fear, competition) creates incentives for innovation, makes people and organizations move, innovate, be flexible; but too much uncertainty brings immobility, inactivity, resignation. What is needed is a balance between both opposing imperatives.

In the natural economic order, the risks and uncertainties are usually too great. In a situation where everyone is everyone's competitor – read enemy – there are no transactions, investments, innovations or growth. In the timeless words of Thomas Hobbes:

> Men have no pleasure, (but on the contrary a great deale of griefe) in keeping company, where there is no power able to over-awe them all ... During the time men live without a common Power to keep them all in awe, they are in that condition which is called Warre; and such warre, as is of every man, against every man. ... In such condition, there is no place for Industry; because the fruit thereof is uncertain: and consequently no Culture of the Earth; no Navigation, nor use of the commodities that may be imported by Sea; no commodious Building; no Instruments of moving, and removing such things as require much force; no Knowledge of the face of the Earth; no account of Time; no Arts; no Letters; no Society; and which is worst of all, continuall feare. (Hobbes 1968, orig. 1651: 185–6)

3 PRIVATE STRATEGIES OF UNCERTAINTY REDUCTION, THROUGH ORGANIZATION

Unfettered capitalism is typically such a 'war of every man against every man'. However, part of this competitive war is that individual firms try to develop strategies to reduce risk and uncertainty, including the risk of innovation and the risk of cooperation with others needed for pooling resources and competences. Man in general does so, and business in particular. Much strategic action of business is directed at reducing the sources of risk and uncertainty, at either reducing the dependence on unpredictable factors affecting the supply of resources or the sales possibilities; or at securing the needed resources by acquiring some minimal degree of control over the environment. This may mean control over the supply of production factors, the direction of product and process technologies, the strength of competitors, the market or the direction of fashion trends among consumers.

Innovation itself is often not more than just such a strategy of risk and uncertainty reduction. This holds for offensive innovation, but even more for the defensive type. Innovation is often motivated not so much by the desire to be up front, but by the desire not to lag too much behind, to have sufficient knowledge in-house to be able to copy and absorb knowledge and innovations from others, and to have bargaining power to acquire innovative knowledge from others. One is only a serious partner in cooperation or negotiations if one can threaten to take the other's lead away. Only then does one succeed in acquiring full licences from others.

Risk and uncertainty reduction (RUR) strategies more often take the form of the development of specific intra- and inter-organizational structures aimed at reducing dependence on and securing control over environments from which much-needed resources have to be acquired. The internal organization will become structured in such a way that it has optimal capacity to react to and control the environment. A classic method is internal differentiation, to counter external complexity.

More important yet are the external relations with other organizations in the environment, strategies of competition and cooperation. As is often said, innovation requires the pooling of resources, skills, and tacit and codified knowledge. Such cooperation, however, is particularly fraught with risks and uncertainties. Will both partners profit equally from the cooperation? Will they extend their own knowledge base to an equal degree? Who will be most effective in appropriating the benefits? What are the dangers of opportunism, deception, even outright theft and fraud? In principle these dangers are great in a competitive environment; that makes it risky to invest in the relationship, to make oneself too dependent on the other, to develop relation-specific assets. It increases the opportunities for hold-up and blackmail.

Several strategies are open to firms to counter these risks. The familiar one is to integrate with the partner, to replace the 'market' by the 'hierarchy' as the principle of economic governance in the sector. This could lead even to the formation of oligopolies if not monopolies, which allow not only for control over the partners/competitors, but also over the market and the broader business environment. Many mergers and take-overs are less motivated by the desire to combine competences, than to reduce risk and uncertainty by eliminating competitors and acquiring market control, which includes the reduction of the risk of a technical standard of a competitor becoming the dominant one in the market (compare the competition of the VHS and V2000 standards in video recording).

If firms for various reasons do not want to go that far, they can opt for quite a variety of kinds of inter-firm cooperation, varying from temporary, *ad hoc* and loosely coupled forms like joint ventures to more permanent and more tightly coupled ones, like alliances, mutual stock holdings, cartels or trade associations. Furthermore, these can concern horizontal cooperation (with competitors in the same market) or vertical cooperation (with suppliers or customers).

Nooteboom (1999) distinguishes in this connection two strategies for structuring inter-firm relations, the choice of type A relations or of type B. They refer in particular to user-supplier relationships, which can be crucial for innovation in a time when most innovations, especially in science-based industries, require the pooling of competences.

The first ideal type, type A or the 'exit' relationship, is characterized by short-term relations between firms. They do not invest much in their relationship, are cautious if not suspicious or even outright distrustful of each other, and change partners as soon as they are dissatisfied. They regularly survey the market for more interesting partners for cooperation. Nooteboom assumes this type to be dominant in the Anglo-American societies. The opposite is the type B or 'voice' relationship, which he considers dominant in Japan and also in continental Europe. It is characterized by stable and long-term relations between firms, which invest in their relationship, develop relation-specific assets, and voice any complaints they may have, rather than break the relationship.

Each pattern of cooperation has its advantages and disadvantages. They reduce some risks and uncertainties, but they increase others at the same time. Type A relations provide some knowledge of and information from the competitor, supplier or user and thus reduce uncertainties about market demand, competencies of suppliers or strengths of competitors. Cooperative agreements with them make their behaviour more predictable. But the ties and commitments are loose and the chances of opportunistic behaviour relatively great. However, at the first sign of opportunism or deception one can get rid

of partners and trade them in for other ones. Not much is lost, as not much is invested in relationship-specific assets. There is less risk of hold-up. The longer-lasting type B relationships allow for greater knowledge of the partner. Also there is more mutual commitment and mutual investment in relationship-specific assets, including joint projects, which increase the predictability of the partners. The lesser likelihood of 'exit' in the relationship makes for the gradual growth of trust relations, either as the consequence of rational calculations or as the result of shared norms. All that implies greater predictability. However, the risks are too much dependence on specific partners, getting stuck with incompetent or inflexible suppliers or workers due to too much investment in the relationship, hold-up and even blackmail, and lack of fresh new ideas and insights from the outside world.

Which type reduces uncertainty more and facilitates innovation? Type B makes for greater predictability of the environment (and for long-term pooling of competences), and hence allows better for long-term investments, including investment in innovation and product development; this is particularly valuable for products and processes that have long periods of gestation. However, ifrelations are no longer satisfying, the costs of breaking them are higher.

The different strategies of firms for reducing risk and uncertainty lead to different types of capitalism. Mergers and the formation of 'hierarchies' produce 'managerial capitalism' in the typology of Lazonick (1991); type A relations are more characteristic of his type of 'proprietary capitalism' (exchanges through markets), while type B relations are typical of 'cooperative capitalism'.

The types of structures and strategies which firms develop (mergers or type A or B external relations) depend of course first of all on the preferences of the economic actors, including managerial fashions. However the possibilities and incentives depend largely on the nature and degree of the specific uncertainty problems. This in turn depends on the characteristics of the sector: the technology involved or required; the optimal scale of production; the diversity of knowledge involved; the phase of development in the idea-innovation cycle; or whether it concerns isolated products or large technical systems (aeroplanes and high speed trains differ from construction, tomatoes or shirts). These are task and technological contingencies. The choices made will vary also with the types of innovation,such as those distinguished in Whitley (1999).

However, the preference for type A or type B relations depends also very much on the broader economic, political and legal environment. The choice is not a free and individual one, but a collective one, from which one cannot escape, at the risk of losing out. It is like a run on the bank or a currency. Even though you may know that if everyone runs to the bank or sells a currency, the

bank may fail or the currency depreciate and that it is irrational to do so, nevertheless, you had better be the first at the bank. Similarly if you live in an environment where workers want long-term employment contracts and job security, you had better provide it, because otherwise you would not get enough qualified workers. And if in an exit environment stockholders expect reports and short-term profit, you had better provide it, because otherwise the price of your stocks will dwindle. Mutual expectations in a society, that is, institutions and culture must be followed. The possibility of maintaining type B relations depends very much on the presence of trust in these relationships. And as Lane and Bachmann (1996) convincingly show, such trust is highly dependent on stable legal, political and social institutions. That is why one finds type A relations more frequently in one society and type B more in another. These are important environmental or institutional contingencies.

4 PUBLIC UNCERTAINTY REDUCTION THROUGH INSTITUTIONS

Social and economic actors may try to reduce risk and uncertainty for themselves. However, in this they are aided by their social environment, by the societal institutions, which are of course the work of past generations. Private strategies of risk and uncertainty reduction are supported by public ones, one could say.

Institutions affect innovation and organization through their influence on incentives on the one hand, and on risks and uncertainties on the other. They reduce the very high risks and uncertainties in the natural economic order to a tolerable degree and are the instruments to strike a balance between the need for incentives (through some minimal risk and uncertainty) and the need for predictability (that is, reduction of risk and uncertainty).

Different societies have different sets of institutions, and these strike a balance at different locations on the continuum from high to low risk and uncertainty. Where they do so is related to how much risk and uncertainty a particular group of people can bear before it becomes immobile, that is, how risk averse the culture is.

But what precisely are institutions? There is quite a degree of confusion over this concept. I consider institutions ‘more or less enduring sets of social mutual expectations, crystallized in rule systems’. Rule systems are to be taken in the broadest sense of the word, that is, to include not only formal but especially also informal rules and mutual expectations and understandings of social actors as to each other’s behaviour. Rules define what is to be expected of social actors in a specific role and a specific social situation. The rules tell us something about the intentions others may have in this situation and how

they are likely to behave. We expect different behaviour from people on the battlefield, the market, the family, a singles bar or a school. And we also expect different behaviour from a soldier and a medic on the battlefield, as well as from a soldier from the enemy or our own forces (the uniform often defines the role). Such rules have usually acquired a certain permanence, enduringness, stability. When we say that something becomes 'institutionalized', we mean exactly this enduringness. They may have become traditions or conventions.

Metaphors can be illuminating. The philosopher and anthropologist Arnold Gehlen, who wrote much about institutions, remarked: 'Man is like a mollusc, the institutions are the scales and the armour which give him support and protection' (quoted by Hoogerwerf 1999: 5). This is an often-held perspective. However, I think the emphasis is too much on constraining (and protecting) and not enabling. Therefore I prefer the metaphor of the polder and the dykes.

Polders are artificial physical orders, pieces of land taken from sea or lake, protected by raised mounds called dykes and intersected by canals which ensure drainage. Polders exist thanks to the dykes. They make life in the polder possible and provide a minimum of security, certainty and predictability which allow people to live and work in the polder. Only in the relative certainty that their land will not regularly be flooded is it sensible for farmers and citizens to invest, to build roads, houses, farms and factories, and to till the land in the polder.

Markets are artificial social constructs, where people live and work, and institutions are the dykes of the market. They make life, exchanges, transactions and investments sensible and therefore possible. They enable action by constraining the action of others. They filter, preselect or reduce the number of behavioural options or even provide guidelines or prescriptions for behaviour (March and Olsen 1989). The point is, as Hobbes has already emphasized, that the constraint for the one is the reduction of uncertainty for the other, enabling the latter to take initiatives. A reduction in the chance of opportunistic behaviour in customer-supplier relations, or in joint ventures for innovation, facilitates such transactions and forms of cooperation. Such institutions are constitutive for markets. No polders and investments in them without dykes; no markets and investments in them without institutions. The art of constructing the dykes of the market, institutions, is to strike the right balance between the opposing needs for incentives and predictability. For example establishing the right height of the dykes and drainage capacity of the canals is essential. How high the dykes have to be is dependent on the outside threats: the sea level, the tides, the incidence of storms. Similarly, where institutions have to strike the balance depends on the degree of risk aversion of a specific culture.

For Hobbes, order and stability were brought by a 'common power to keep

them all in awe', that is, the Leviathan. We use the more abstract concept of institutions. But many institutions are the product of a collective actor: the state. And the history of state formation is a history of reducing risk and uncertainty. That is the 'business of the state'.

Feudal lords and absolutist monarchs reduced the uncertainties of life. They provided protection for the inhabitants of their fiefs against external and internal threats. They fought off marauding bands, brigands and competing warlords who had cast a covetous eye on the life and property of villagers and farmers. And they shielded their serfs also from threats from within the group, by placing those who threatened life and property of their neighbours 'outside the law' and punishing them. This gave their power and authority legitimacy and gave them the allegiance of their serfs, vassals and feudatories. The resulting implicit contract reduced the manifold risks and uncertainties of medieval life, facilitated social interaction, and made the very existence of society possible. The subsequent centralization of power at the level of the nation-state was legitimated on a similar 'contract' as that which existed between lord and serf, now between king and citizen.

However, solutions to the problem of uncertainty have usually produced new forms of uncertainty. While centralization of state power reduced the uncertainties of life and protected citizens from arbitrary and unpredictable harm from their fellow citizens, it increased the dependence on, and uncertainty over, the arbitrariness and unpredictability of their leader, be it a chief, lord or king. Therefore, the centralization of political power was gradually complemented by the creation of institutional checks and balances of such power, such as the rule of law, limited terms and periodic elections for holders of power, the dualism between parliament and government, federalism, judicial review and administrative law. Up to this day, a major function of the state – and a major source of its legitimacy – is the provision of social order through law. It is the function that makes civil society possible in the very first place. Law has become the central instrument of public strategies of risk and uncertainty reduction.

5 LAW AS AN INSTITUTION

Law is a central institution, because many of the other ones discussed in the literature on national innovation systems, like the organization of research, the financial system, the training system or the system of industrial relations, all have a legal form. Law establishes their structures and processes, their rights and responsibilities. In that sense, law is a meta-institution.

Law is also an ideal-typical institution. It illustrates central characteristics of social institutions very well. It structures mutual expectations between

people in a specific society and does so relatively effectively (think of traffic rules). It is relatively enduring over time, in part because rule changing itself follows specific rules, and as these differ for different levels and types of rules, some are more easy to change than others. Thus in some countries, constitutional law is more difficult to change than regular statutory regulation, and this in turn more difficult than administrative decrees. Case law agin follows different principles of change. The relative slowness of change, the inertia, creates a minimal legal security, read predictability, and allows social actors to adjust their actions to that of others and to make longer-term plans, including investments.

Law also has a systemic nature. Different rules are mutually dependent; they support each other, frame each other, some allow for others, some structure (the interpretation or change of) others and so on. The systemic nature derives in part from the hierarchy of rules, from the different degrees of abstraction, and from the presence of fundamental legal principles. The different levels of regulation are embedded in one another, like Russian dolls 'fit' into one another, even though the fit of institutions is usually not as tight as in that metaphor.

The legal system also has a relative autonomy, because the legal principle of legal security and legal equality forces legal functionaries to interpret individual regulations in the context of others, including earlier case law, which makes for the importance of precedence. That implies that the legal system, even though it is constantly interacting with the rest of society, also follows a certain logic of its own (like that other ideal-typical institution: language). It has its own path-dependent development, which explains why one society has developed a different legal system from another; and which could help in explaining differences in the innovation profiles and performance of societies.

Finally, law is a typical 'national' institution. If there is something specific or defining about a nation, it is that it has its own system of law, valid within its territorial boundaries, backed by its sovereignty and monopoly over the exercise of force, taxation and regulation. That makes it the more remarkable that law is rarely mentioned in literature on national systems of innovation.

6 DIMENSIONS AND TYPES OF LEGAL SYSTEMS

The effects of law and regulation on risk and uncertainty reduction depend on a number of characteristics of the legal system. I distinguish the following two main dimensions that are relevant in this respect: 1) Regulation versus litigation, or law made by the state (statutory and codified law), versus law made by the courts and the litigants (case law); and 2) Active or more passive

Table 8.1 Legal Systems by degree of uncertainty reduction

	passive litigation lower uncertainty	**active litigation** higher uncertainty
passive regulation higher uncertainty	3 Great Britain	1 US corporate law, tort and liability law
active regulation lower uncertainty	4 Netherlands, France	2 US social and economic regulation

Note: 1–4 is the rank order of high to lower uncertainty.

use of the law. Combining these two dimensions gives the following four possibilities, which can be found in Table 8.1. The four possibilities are: 1) activist regulation; 2) passive regulation; 3) activist litigation; and 4) passive litigation.

Activist regulation implies a relatively strict interventionism of the state through state-made law (especially public law or social and economic regulation). In our definition it produces quite precise and strict standards for behaviour which reduce risk and uncertainty. Indicators for activist regulation are:

1. A preference for state laws as against private regulation (for example, self-regulation by trade associations or certification by private organizations).
2. A preference for formal regulations, as against more informal ones, such as gentleman's agreements, covenants or contracts under civil law (for example, between the state and organizations of civil society).
3. A relatively large number of regulations and comparatively high standards, which force, rahther than allow or facilitate behaviour (including in our case innovation).
4. Relatively detailed and precise standards in the law.
5. Relatively closed standards. This means that regulations do not only or so much specify goals or output, but also the means and/or processes to reach them. Rather than specifying that a road should be able too bear a specified weight per square metre, the regulation would specify how the road bed is to be made and how much stone, sand and bitumen is to be used in which mix.
6. Relatively strict implementation and enforcement,that is, a legalistic rather than a pragmatist approach to law.

Underlying such regulation is an activist or even étatist conception of the state in its relation to civil society. It stresses the function of law as the instrument of social change – legal engineering – and this may include using and forcing technology by setting high standards. The approach can also actively protect legal rights, first of all of the state itself, but also of citizens (including their intellectual property rights). However, in the end the instrumental function of law takes precedence over the function of law as a guarantee of rights and over its function in conflict resolution.

A passive use of regulation can be defined as more or less the opposite of legal activism: a state with an attitude of waiting and seeing, giving 'space' to civil society, yielding where possible to self-regulation by private organizations. It is a preference for less formal forms of regulation and for framework and enabling regulations with rather vaguely formulated norms, no high or challenging standards, open rather than closed regulations, stressing goals or outputs and leaving the means by which these are to be reached free; characterized by a flexible and pragmatic style of implementation and enforcement, a willingness to negotiate over implementation and to take account of specific circumstances and compliance possibilities of individual citizens or firms.

In activist regulation, regulatory state agencies are the active producers of law, in activist litigation private parties from civil society do so, by prodcuing case laws and precedents. Formally, case law is formulated by judges, but they are aided by private actors such as litigants and lawyers, who bring cases to court and provide arguments. bringing conflicts in court.

In the following I will discuss the relationship between regulation and litigation on the one hand and innovation on the other, in particular through their effectiveness in reducing risk and uncertainty, which is a major function of the state and of law.

7 REGULATION AND INNOVATION

Innovation is affected by law in many forms. One basic distinction is that between social and economic regulation and civil law, that is, between public law (interventions of the state in society and the economy) and private law (regulating relations between private actors in society). The first type is in the first instance enforced by regulatory agencies and inspections; the second through civil litigation in court. The distinction between public and private law is not the same as that between regulation and litigation, even though that may seem so at first sight. Private law is enforced by private actors in litigation, yes, but in many legal systems there is also regulation of private law, codified in civil law codes. Public law is in the first instance regulation that is enforced

by public agents such as various kinds of inspectors. But subsequently, private citizens may challenge such decisions of inspectors in court and the case law that results becomes part of the public law. Social and economic regulation is most important as a direct influence on innovation. Codified civil law may affect innovation directly, but is more important as an indirect influence on innovation, namely through its influence on organization and contracting.

As regards regulation, one can distinguish between those made specifically for the innovation process and general social and economic regulation that affects innovation, whether intended or not. Both can affect the exploration and/or the exploitation of innovation, and they can do so in different phases of the innovation cycle or the idea-innovation chain: basic research, applied research and invention, product development, manufacturing and marketing. Table 8.2 contains some examples of regulations that affect exploration and innovation in different phases of the innovation cycle.

7.1 Regulation and Phases of the Idea-innovation Chain

Regulation that is specifically created to influence innovation (either negatively or positively) and that affects exploration in the phase of basic research includes all legislation affecting the free availability of information, for example, privacy legislation. Furthermore, some specific legislation affects this phase as well as the subsequent one of applied research, such as laws on animal testing, which many countries have. In the Netherlands this law requires researchers to follow a specific procedure and to submit proposals for testing to an animal experiment committee. Another example would be the law on the recognition and classification of research laboratories or the law on organ donation. Many sectors also have specific regulations. Usually these are sectors that are relatively politicized and where laws express the societal acceptance of certain risks: for example, nuclear energy or biotechnology. They may affect various phases of the innovation cycle.

Exploitation of the achievements of innovation efforts in both phases, but particularly that of applied research, is affected by laws regulating intellectual property (patents, copyright). In recent years, biological material (in the USA pieces of DNA) and software have also been brought under this legislation. It is most effective for technical products with a medium to long life cycle. For short-lived products it may not pay to register a patent., and it is generally difficult to obtain intellectual property rights for organizational and service innovations such as financial constructions, new travel packages or shop formulas.

More general laws that may affect the two phases of invention are environmental standards (limiting certain experiments), general regulation on privacy and the freedom of information, and laws that regulate

Table 9.2 Examples of substantive laws affecting innovation in different stages of the cycle

	Basic research		Applied research and invention		Develop-ment		Manufac-turing		Marketing	
	Exploration	Exploitation	Exploration	Exploitation	Exploration	Exploitation	Exploration	Exploitation	Exploration	Exploitation
Civil law	privacy law	property rights, contract law	contract	property rights, contract law	contract	contract	corporate law, contract	liability and tort law, corporate law	liability and tort law	liability and tort law
Innovation specific	animal testing, lab certification	patent law, copyright law	animal test-ing law, lab certification	patent law, copyright law	technical standards	technical standards	regulation of use of instruments	patent law, copyright law		brands and trade marks regulation
Sectoral-specific regulation	biotech regulation nuclear energy	patents for biological materials and software	biotech regulation, nuclear energy, pre-clinical drug trials regulation	patents for bilogical materials and software	sectoral safety norms: construction,	sectoral spec. safety norms: construction, airplanes	pesticides, chemical regulation	sectoral anti-trust regulation	food and drug standards, adverse experiences reporting rule	public drug pricing regulation
General regulation	environmen-tal standards, privacy regulation, freedom of information	tlaw on universities	environmen-tal standards, freedom of information	tlaw on universities	General health and safety regulation	General health and safety regulation	labour law, environ-mental law	general competition law	advertising, labelling, packaging regulation	advertising regulation, tax law, incomes policy

universities, including the legal position, tenure and remuneration of research professors.

The development phase is affected by technical standardization, registration and certification. They structure the opportunities and constraints both for exploration and exploitation. The manufacturing phase is affected by regulations that set production process standards and norms for how to use instruments or intermediate products (for example, pesticides in agriculture) or deal with waste materials (dung, poisonous chemicals). General regulation that can be important in this phase are environmental law and health and safety at work legislation. Exploitation is regulated in this phase among others through competition law.

The marketing of goods is in many sectors highly regulated, with laws that regulate product quality, consumer information, standard quantities, market ordering, advertising and so on. Examples are food and drug regulation, health and safety regulation for consumers, or weights and measures standards. Here many sectors and products have their own regulations, for example, legislation on agricultural produce, meat, pharmaceuticals, medical services, opiates, dangerous chemicals, cigarettes, automobiles, aeroplanes, public utilities, drinking water, telecommunications, media, professional services, transportation and so on. They may set absolute product standards or regulate registration, market access, advertising, labeling, packaging, pollution, and so on. Product and marketing standards of course feed back to the earlier phases in the innovation cycle. Firms already take account of such product standards in the invention, development and manufacturing phases. Exploitation in the marketing phase is regulated by brand and trade mark protection and again copyright legislation.

7.2 Technology-forcing Regulation

Where these statutory regulations set high standards for future products and where the state allows firms enough time to develop such products, such standards do not only passively provide a stable environment, merely enabling innovation, but they may actively stimulate innovation. They may force firms to engage in innovation in order to be able to meet the high standards. This has been the function of high environmental or product quality standards. Like competition, they provide challenges to ingenuity, inventiveness, and initiatives to mobilize and pool resources and competences. High automobile emission standards have forced automobile manufacturers to develop engines that satisfy such standards. Countries which were first with such rules, or who had the strictest rules (Japan and Germany), ended up also with car industries that had a competitive edge in producing fuel-efficient and emission-clean cars (Boehmer-Christiansen and Skea 1991; Héritier *et al.*1993). Already the

mere threat of regulation (for example, the threat of compulsory recycling or re-useobligations for packaging) has mobilized the industry to get organized around the issue of packaging waste, to develop procedures for recycling, to reduce the total amount of packaging, and to redesign products in order to facilitate the separation of different materials at the end of the product life (Haverland 1998).

The importance of government regulation for innovation is also illustrated by the fact that many major inventions were made either during war or in preparation for war. Just to mention a few from the long list that could easily be assembled: cartography, synthetic rubber, the radar, the aluminum aeroplane, the jet engine, antibiotics, nuclear energy. Such products were developed in response to military orders. In this role the government actually combined the pressures of a demanding client (in a monopsonistic relation) and a regulating sovereign authority.

7.3 Regulation and Consumer Trust

Regulation can also aid innovation in a more indirect way. The commercial success of innovations depends very much on acceptance by the public and the trust they have in it. State regulation may enhance such trust and acceptance, and may in this way also play an important positive role in stimulating innovation. Innovations, in particular radical ones, force consumers to break with habits, routines and traditions, and that is not always easy. Often, consumers have perceived radical innovations as very threatening and have resisted. And sometimes not without reason. History has also shown that in the absence of regulation, serious accidents with new products tend to happen frequently, which makes the public even more wary of such novelties. Steam engines exploded, trains derailed, people were electrocuted by electricity, aeroplanes crashed, bridges collapsed, pharmaceuticals such as thalidomide had unforeseen and unpleasant side effects.

To give just one example: when the steam tram was introduced in the Netherlands around 1880 it met with great hostility and opposition from farmers and other citizens. Farmers complained that their horses were frightened by the trams and hence caused frequent accidents. Citizens were wary of using the tram, because it derailed so often. In order to improve confidence in the new means of transportation, Dutch entrepreneurs founded the Association of Regional Rail- and Tramroads in 1881 to fight this opposition. It first tried to do so by making propaganda for the steam tram, but soon discovered that propaganda alone could not do the work, as long as steam trams derailed so often. Hence the association moved to supplement its lobbying with self-regulation. It set safety standards and provided expert technical advice to the members to reduce the wavelike

wear of the rails, which caused these derailments (Burgersdijk 1956: 22-4).

At present history somehow seems to be repeating itself in the case of biotechnology, in particular genetic engineering. This radical innovation again meets with great anxiety, distrust and opposition. As in the case of the steam tram, the opposition to the innovation has not only rational but also some less rational causes, which are often difficult to understand for those directly involved in the innovation. Fear among the general public often stems from lack of knowledge, emotions and irrational sentiments. What kind of science fiction monsters will genetic engineering produce? Opponents to such innovations reinforce such irrational fears by disseminating misinformation. Thus the organizations for animal protection hung posters of a four breasted woman inb bus stops across the Netherlands a while ago, just as the opponents of the steam train once distributed posters of an aggressive and steaming iron horse. It is also typical ofthe irrational sentiments that there is much more resistance to genetic engineering with large animals such as cows, than with small ones such as bacteria and yeasts, even though the latter may actually be more risky. People identify with cows, but not with yeasts. But yeasts may escape the laboratory much more easily and multiply faster than cows. Thus genetically modified yeasts could wreak havoc in nature much more easily.

Unless such insecurity and distrust surrounding new products get reduced, innovations may fail. Institutions, that is, regulations and organizations, have to be created to generate the necessary trust in the new processes or products among prospective users, whether workers or consumers. This has proved to be a typical task of the state in history. Disasters with new products forced the state to intervene. Explosions of steam engines led to legislation regulating the construction and use of such machines. The thalidomide scandal in the early 1960s forced the state to create statutory legislation regulating the testing, control and admission of new pharmaceuticals to the market, in order to increase the trust of consumers in new medicines.

The recent mad cow disease affair in Britain has shown how costly loss of trust by consumers can be. The British government deregulated and industry chose an ‘economic solution’: it made from herbivorous animals carnivorous ones, by feeding them with cheap bone meal from sheep. Short-term profits reaped long-term loss. If it would have been necessary to kill all cows in Britain in order to fully regain the trust of the public in beef, that would have cost several billions of pounds, according to some estimations. Seen in this light, might not the German protective regulation which is hampering biotechnology in that country so much, turn out to be a quite rational measure in a romantic culture which is so very distrustful of anything artificial, anything non-natural? Isn’t the loss of consumer confidence a far greater danger than remaining ‘backward’, retarding innovation? Would that not be a risk one runs with new products such as transgene cattle? The enormous

investments that the Federal Republic made in nuclear energy have been largely wasted, because there was not enough legitimacy for such innovations among the population. The fast breeder in Kalkar never went into operation – it may be turned into a tourist attraction, but that will never make up for the losses.

What could the state do to enhance the acceptance of biotech innovation? It can – and does – set strict rules regarding processes and laboratories where genetic engineering is carried out, as well as regarding the products and their use. An ethical debate on genetic engineering may in the short run hinder biotech innovation, but in the long run it might help acceptance. In the process the state could try to change the terminology used. Words like 'transgene cattle' (trans = over the border, 'one bridge too far'?) have science fiction-like connotations, and genetic manipulation or biotechnology suggest something terribly artificial. Furthermore, it could advise the industry how to deal with public fears. The technicians involved often have no understanding of this. Would it have been wise to start introducing a genetically created substance like human lactoferrine first in, of all things, baby food? Would the public not accept such a new substance first in pharmaceuticals, where the public accepts that these are necessarily 'chemicals', 'synthetics'? Food by contrast should be 'healthy', and that is to many people: natural.

Regulation of product standards is not only important for acceptance of new products by the public. It also provides a 'technical infrastructure' that facilitates diffusion. Ever since early industrialization made it possible to manufacture a large number of completely similar products, and ever since division of labour made different products interdependent, the establishment of technical standards has become important in order that parts could be interchanged and integrated into larger wholes. Such standards are only effective if they are universally applied and accepted. Hence the state, the only agency that could impose such standards authoritatively and uniformly, did get involved in standardization over time. Where such 'statutory' standards are (still) lacking, as may be the case with new products, the competitive struggle tends to become a struggle over whose norm will be dominant, as is illustrated by the fight between the three video standards or currently between digital camera memory sticks. As long as no standard wins the battle, and that may in some cases be a long time, customers will be confronted with a plurality of standards, which produces many practical problems and costs. Such deadlock may be – and has been in the past – overcome by standards provided by the state and backed by its monopoly over regulation. Standardization regulation is of utmost importance for the diffusion of new products. The present tendency of governments to privatize standardization more, without giving any private certification agency a statutory monopoly, might frustrate the demand for uniform technical standards. Competing certification bodies may

develop competing standards, thus confronting firms and customers again with the problems and costs of technical integration.

7.4 Trade-offs: Between Costs and Risk Reduction, Between Freedom and Predictability

Activist regulation, meaning high, strict and detailed standards imposed on business and actively and fiercely implemented and enforced, as is the case in the US, is often thought to be a burden on industry and of course often it can be. Where research, production and marketing of new products is made contingent upon the satisfaction of detailed substantive and administrative conditions, as for newly developed chemicals or pharmaceuticals, high costs of testing and administration may be involved.

However, the other side of the coin is that firms know what to expect, that it provides a relatively predictable regulatory environment, as long as the standards are also kept relatively stable over time. It allows business to calculate and plan its investments, including in innovation. In particular where such innovation investments take some time before they start rendering profit, this stability can facilitate innovation. Satisfying high statutory safety standards may also be able to protect the firm from high future liability claims.

Detail in regulation can actually reduce costs for business, where it differentiates between different products. A good example is the EU Directive 219 on the use of genetically modified organisms. The Dutch implemented it in greater detail than the Germans, that is, the Dutch differentiated the safety standards for testing of different experiments. Not so in Germany, where all experiments, including the less risky ones, had to satisfy the same strict safeguards, making research there more expensive (AWT 1997: 13).

Of course the drawback of quite specific legal norms and standards is not only that they impose costs, but also that they can reduce the freedom, needed sometimes to experiment freely with new possibilities. The precision of standards produces on the one hand predictability, but on the other hand it also makes also for inflexibility. There is a fundamental trade-off here.

Strict regulation can even forbid or limit certain products outright, thus hampering innovation in these fields. What do we think now of laws such as we had a century ago, that forbade ‘iron horses’ (trains) to drive faster than 15 miles per hour in order not to scare the horses, or required a flagman to walk in front of an oncoming ‘automobile’ to warn pedestrians? They may have limited product development for a short time, but in these cases their ridiculousness was demonstrated by technological advances. Would our present-day restrictions on nuclear energy and genetic engineering turn out to be the iron horse laws of the late 20th century? But one should realize that even such bans may incite creativity in man and firm, namely to circumvent

the rules. Apparently the drive-in restaurant was invented in a reaction to a rule at Tinker Air Force Base in the US, that military in uniform were not allowed to leave their cars. And containers seem to have been invented in order to circumvent a tax on inter-state lorry traffic within the US. At the interstate border, the goods loaded in containers were taken from one lorry on to another (AWT 1997: 15).

A solution to the dilemma of predictability versus flexibility may be open-ended standards, or norms that leave firms some choices. Open-ended regulations set only goals, outputs or performance and leave industry some freedom in how to reach these. This could stimulate innovation in different directions. Where standards are closed and the means, such as specific compositions or processes, are prescribed, there could be less room for innovation. An example of an open-ended norm is the Dutch Energy Performance Standard, which provides tax incentives for 15 per cent less energy consumption, leaving it up to industry to follow different lines to less energy consumption in appliances or houses. A related American example is CAFE, or the corporate average fuel economy, which obliges automobile manufacturers to reach an average fuel use of 27 miles per gallon for all the cars they sell, leaving them freedom to balance between types of cars and fuel economy techniques. A disadvantage of open-ended standards is however that they may impose rather large administrative burdens on industry to prove compliance, as has been the case with CAFE in the US.

Choice is also introduced with the new patent law in the Netherlands, which allows firms to apply for either a 6 or a 20 year protection. The 20 year protection puts higher demands on documentation to show newness, and is hence a more costly applications procedure. For certain pharmaceuticals that may pay off, for other products the quicker and cheaper, but shorter protection can be chosen.

Such open-ended or option regulations however do not in the end solve the dilemma. They may leave greater freedom and flexibility, but they also produce greater uncertainty. Thus in the patent case above, patent holders of a six year licence have a less strong certificate of newness, and may have to spend more on defending their patent in court. Often business seems to prefer security over freedom. Thus in the Dutch construction industry new performance standards for new materials were introduced in 1989, leaving firms the responsibility to demonstrate performance for new materials that they might introduce when acquiring local building licences. The industry preferred security, and drew up a list of materials that were demonstrated to be safe, which was subsequently sanctioned by the state. Here the industry itself implemented in greater detail the more vague and open state regulation. Stricter standards provide more certainty; and can, if formulated at a high level, be a challenge for innovation, either to satisfy it, or to circumvent it.

8 LITIGATION, UNCERTAINTY, AND INNOVATION

Neo-liberals tend to emphasize the need of innovation for freedom. This is considered an essential precondition for innovation: freedom to think, to experiment, to associate, to discover, to try out new and daring, uncommon and not obvious combinations, to travel through unknown lands, to delve into mysterious spaces. Freedom also to exchange information, to travel, to chose one's profession and to follow one's interests. Such freedoms enhance creativity and that is, in the end, where innovation has to come from.

Neo-liberals consider regulations a hindrance to such freedom. They are considered to stifle creativity and innovation; they are supposed to reduce both the willingness and the possibilities for creativity, daringness, risk taking, investment and innovation. Businessmen get bogged down in a plethora of rules and regulations. Furthermore, regulations tend to reduce competition, thus decreasing the incentive for business to remain on its toes, to stay ahead in the race. More generally, regulation produces major costs to business and the economy. As a result, the nation's competitive position risks falling behind in the globalized economy. Thus the diagnosis. The recipe is well-known: deregulation, de-organization of markets, more competition, more freedom for entrepreneurs, for imagination and for creativity.

Such neo-liberals overlook or downplay that freedom can exist only in an ordered context, where basic needs are safeguarded. Secondly, they overlook the fact that constraints rather than freedom can and have been potent incentives for innovation, whether these constraints emanate from competitors, clients (high quality standards, low prices, just-in-time supply), workers and unions (high wages, costly working conditions, as Kleinknecht (1995) has repeatedly argued) or state authorities, in the form of high and strict regulatory standards. Thirdly, they overlook the fact that regulations satisfy another major need of (innovating) economic actors, namely the need for the reduction of risk and uncertainty to some minimal acceptable level. Hence neo-liberal policies of deregulation are likely to have unintended consequences: It is quite likely that deregulation leads to more rather than less regulation in the long run. This has been called the paradox of regulation.

Society, and in particular the economy, is full of conflicts of interests: in business between firms and their workers, customers, suppliers, financiers, shareholders, subcontractors, and last but not least among competitors in markets. There will always be conflicts over the quality of products, the safety of workplaces, the price of services provided, the delivery period agreed and so on. Deregulation does not reduce such conflict. On the contrary: a less regulated economy implies greater uncertainty, less stability, less ordered relations, and hence more frequent and more manifest conflict between economic actors. Such conflicts have to be settled. Parties will take their

conflicts to the courts and these cannot avoid deciding the cases presented to them. As a result, a decrease in statutory regulation is likely to lead to an increase in litigation. As I have argued elsewhere (Waarden 2002), regulation and litigation are to some extent communicating vessels.

Some Dutch lawyers have even proposed explicitly to replace statutory regulation by civil liability claims. The Kortmann Commission recommended in its report *Van keurslijf naar keurmerk* (1993) that the Health and Safety at Work Act ('Arbeidsomstandighedenwet') should be minimized. Firms should be forced to provide safe and healthy workplaces by the threat of costly liability claims on the basis of civil law, from workers whose health had been negatively affected by their working conditions.

Indeed, quite a few countries experience a trend of juridification of social relations and of replacement of regulation by litigation. The Netherlands is a case in point. As I mentioned, historically this was a legal system characterized by reactive litigation. An indication is the lawyer density: in 1999 it had 65 lawyers per 100 000 inhabitants, one-sixth that of the US, with 366 lawyers per 100 000 citizens. However, the number of lawyers increased: by 80 per cent in the period 1993–2001, while the total working population grew only by 19 per cent. The Netherlands is catching up with the US, where the legal profession is a major industry. In 1997, the sectors of law and accountancy provided about 2 million jobs; that is more than the employment in the whole US transport industry – cars, ships, trains, planes, space and guided missiles – together (good for 1.8 million jobs). According to Lord Levine, chairman of the board ofLloyds of London, US tort cases come to 200 billion dollars a year, which comes down to $720 per inhabitant. This equals a tax levy of 5 per cent. The numbers are much lower elsewhere, but the growth rate is increasing. In the UK, judges awarded 15 billion Canadian dollars in liability suits in 2003; but this number is increasing by 15 per cent a year (Levine on CNBC-TV, Saturday night, 17 January 17 2004).

Would this juridification trend be advantageous to business? Would it enhance innovation? The evidence does not support this expectation. The American legal system of active litigation demonstrates the ineffectiveness and inefficiency of this system as a means to reduce risks and uncertainties and to further innovation. The combination of case law and active use of it by citizens, trial lawyers and state officials, has also been called 'adversarial legalism' (Kagan 1994; Kagan 1995a; Kagan 1995b; Kagan and Axelrad 1997). In particular the American tort law system is rather fierce, as it recognizes various principles of liability, the most extreme of which is so-called strict liability, under which defendants can be held liable even without proof of their negligence. And it is fierce because it is so actively used. According to a study by Tillinghast (1989), a leading insurance industry consulting firm, the US tort law system transferred in 1987 117 billion dollars

from manufacturers and service providers to claimants – and not to forget their lawyers. Often the latter collect up to 50 per cent of the damages awarded. Activist litigation tends to produce uncertainty. It thwarts the fundamental function of the law to reduce risk and uncertainty.

Contract regulations and case law are by their nature less general, less abstract and more specific to certain transactions. They emanate from a variety of actors: transaction partners, regulatory agencies, courts. There are more of them, and they are more complex there are therefore more legal experts needed to draw them up and interpret them. They tend to be more opaque and less predictable, and the system of case law becomes more ambiguous.

Where case law is important, there is greater flexibility in law, but also less certainty. Case law is likely to change more frequently than statutory law, if only because in many systems there are formal and time-consuming procedures for government and parliament to change statutory law. Codified civil law and constitutional law is even more difficult to change. By contrast, any individual judge or jury can set new, and sometimes unexpected, precedents in interpreting existing legislation. And high litigation ratios will also make for more change. The more cases come to court, the greater the chances for a new interpretation.

In the American version of activist litigation there are additional sources in the legal system that make for uncertainty. A major one is federalism. Important bodies of law, including tort law, are the domain of the individual states. That is, business faces the prospect of 50 different sets of rules with regard to product liability. Even if states do try to coordinate – they have developed a common code with the *Restatement (Second) of Torts* (1965) and the US Department of Commerce has drafted a *Uniform Product Liability Act* (1979) – the adoption of such codes remains voluntary and states have the power to deviate from or change them and make new rules, and they do so. Thus, for example, rules regarding the strictness of proof of causation of injury by faulty products differ, as do rules regarding product warnings and the degree to which these absolve defendants from liability.

Secondly, the US is one of the few countries where lawyers can work on a contingency fee basis. Such incentives stimulate the creativity of lawyers to find new exceptions, loopholes or interpretations of existing law, if that serves the interest of their clients.

Thirdly, civil cases in the US are decided by judges and juries. The first are in many states elected and owe their office sometimes more to wealth to fund campaigns than to legal knowledge. Juries are often composed of the less highly educated part of the population, as the more highly educated are often more ingenious in getting out of serving jury duty. Such laymen have to decide on highly complex legal, technical and scientific issues, often only on the basis

of the conflicting testimony of experts from both parties. No wonder that the outcome can be erratic, surprising, unpredictable and erratic.

This system has created a body of case law that is becoming increasingly ambiguous and a source of risk and uncertainties. Huber (1990) compared verdicts by juries in cases of allegedly dangerous products.

> Most juries, in accordance with the evidence, found the product not responsible for the plaintiff's injuries. However, in each sequence of trials concerning a particular product, one or two juries, hearing the same evidence as those which found no liability, decided otherwise and awarded the plaintiff massive compensatory and punitive damages. The modal jury award was $0, but the 'average' was in the millions of dollars. For the manufacturer in question, the result was inescapable legal uncertainty, which has a large impact on settlement strategy.'

In a review of malpractice cases against anaesthetists, in 46 per cent of the cases the claimant had received appropriate care, according to an expert panel. Nevertheless, 42 per cent of these 46 nevertheless also received compensation.

> At the same time, many of these malpractice studies show, many malpractice victims, and some legal claimants, who did receive inadequate care, according to expert review panels, received no or relatively little compensation. (Kagan and Axelrad 1996: note 88).

Such unpredictability creates uncertainty.

> Japan-based companies are shocked by the enormous and unpredictable damages awarded by American (and especially California) juries in employment cases. If an employer in Japan is found to have terminated an employee without 'just cause', the primary remedy is job reinstatement, and monetary damages are limited to small severance payments. In the US, however, juries have recently awarded over $15 million to a single discharged employee, and verdicts in excess of $100 000 have become fairly common. (Lofholm 1991), as quoted by Kagan and Axelrad (1996).

The average jury may be reasonable; it is enough if only somewhere in the country a jury is found that imposes ridiculously high damages. This case can then be taken as a precedent for inventive lawyers somewhere else in the country.

The unpredictability of whether one will end up with huge costs for damages leads to an inclination to invest in out of court settlements, even when a defendant may be within his rights according to all legal advice. Kagan and Axelrad (1996: note 82):

> The notable point is that defendant firms are uncertain whether theirs will be in the minority of cases in which firms are hit with enormous judgements. To foreclose

> this risk of catastrophic loss, they are likely to settle out of court more often than they would if there were less uncertainty regarding that catastrophic loss being avoidable.

Given the unpredictable nature of the costs, insurers have become wary of providing liability insurance for certain products or have raised the costs to such levels that firms cannot afford it. In reaction, firms are avoiding risky transactions, risky customers and risky new product introductions. Doctors refuse to do certain operations, and accounting firms refuse to audit risky clients (Berton and Lublin 1992 ; Berton 1995).

There is quite a lot of evidence that the high costs and unpredictable nature of tort litigation deters innovation. In 1986 the Conference Board, a business research organization, reported that in a survey of 500 chief executive officers of large firms, two-thirds claimed that tort claims had had 'major impacts' on their policies. Of these, 58 per cent had discontinued some of their products out of liability fears, 50 per cent had decided against introducing certain new products for the same reason, and 42 per cent had discontinued product research (Weber 1989).

Other statistical analyses have been done by Litan (1990) and Viscusi and Moore (1991). They too find some evidence of the negative effects of tort law on innovation. Viscusi and Moore related product liability insurance loss ratios (costs divided by premiums) to different measures of innovation for a number of economic sectors for the years 1980–84. The database consisted of the entire register of firm policies for product liability (over 200 000), held by the Insurance Services Office. The authors concluded that for industries with relatively low liability costs:

> a higher liability burden fosters additional products-related research. However, once these costs become sufficiently large, the effect of product liability is counterproductive since it dampens innovation and R and D intensity. This effect is consistent with firms withdrawing from new products introductions altogether once liability costs become too large.' (Viscusi and Moore 1991: 84)

They also noted a high volatility of loss ratios over time, an expression of the uncertainty in the legal verdicts and award levels. Apparently, insurance companies were not well able to predict the risks and calculate which premiums would be needed to cover these risks in order to arrive at a profitable loss ratio. Thus for the chemical industry, the loss ratio varied from 2.45 (losses 2.45 times the premiums collected) in 1980 to 0.74 in 1981 to 1.42 in 1984. The drop in 1981 was both the result of a rise in premium price and of a reduction in quantity of policies. The unpredictability led to a reluctance of insurers to write coverage or to them raising the price so high that firms resorted to self-insurance. In high risk sectors liability insurance tended to

become unavailable, a pattern Viscusi and Moore found also in other high risk sectors, such as the drug, construction, industrial machinery, car and aeroplane industries.

These survey data are supported by case studies. A Committee on Contraceptive Development of the Institute of Medicine reported that firms had withdrawn IUDs from the market 'even though the FDA did not raise questions about their safety and very few successful lawsuits had been brought against the manufacturers. Only two firms are currently selling IUDs in the US'. Another large pharmaceutical firm had discontinued research and development of new methods. (Committee on Contraceptive Development 1990: 122). Skyrocketing punitive damages and awards have also led to withdrawals from the market for vaccines and thwarted their further development (Institute of Medicine 1985). Pending litigation on software infringement cases has sent companies into bankruptcy even before the court reached a decision. An example is the case of Lotus against Paperback Software. The latter went bankrupt because buyers could not be certain that they had a legal copy (AWT 1997: 22). The innovation of silicon breast implants threatened to cost its producer Dow Corning close to a billion dollars, so it filed for protection under 'chapter 11' (the Bankruptcy Act).

The volume by Huber and Litan (1991), published by the Brookings Institute, is perhaps the most comprehensive set of case studies on the impact of liability lawsuits on the willingness of firms to innovate. In it, a number of experts assess the influence of liability case law on innovation in five sectors that have been most affected by it – the private aircraft, automobile, chemical and pharmaceutical industries and the medical profession. The editors conclude on the basis of these case studies that:

> In several industries – most notably some types of pharmaceuticals and small aircraft – the combined effects of uncertainty and high rewards seem to have discouraged the research, development, and marketing of entire categories of products. Several authors discern an active, market-wide, liability driven retreat from such things as obstretics and the marketing of vaccines. Mackay [in the volume] discusses various examples of auto design in which European manufacturers and consumers have either initiated or been the first to gain access to innovative design improvements (like antilock brakes and seat belts with tension relievers). Martin [in the volume] presents figures on the declining rate of introduction of new light aircraft in the decades between 1950 and 1990, suggesting that this decline is a direct effect of expanding liability. Tancredi and Nelkin point out how the depressive effect of liability on innovation of medical technologies, vaccines and drugs may be reducing the quality of medical care.' [Huber and Litan 1991: 16–17]

Not that these products were unsafe and that they ought to be withdrawn from

the market. Manufacturers of small aeroplanes and of certain drugs could prove in court that there were no defects in the design of their products. Nonetheless, the products in question were withdrawn from the market 'because manufacturers concluded that even the costs of successful litigation were too high or unpredictable to shoulder' (1991: 17).

The authors in Huber and Litan 1991 emphasize the importance of the uncertainty of the legal system: Lasagna emphasizes the 'unpredictability of litigation', liability 'risks that are almost impossible to quantify' but that include the possibility of 'financial catastrophe' for pharmaceutical companies; Martin quotes an aviation underwriter at Lloyd's as saying, 'We are quite prepared to insure the risks of aviation, but not the risks of the American legal system'.

Litigation has even undone the relative certainty of regulation. Case law has reduced the protection of the American Patent Law:

> Even when the patent office granted a patent, its patent was no guarantee of validity. The patent did not mean, in itself, that the device truly deserved to be patented, or that it would stand up in court. Patent litigation was frequent, complex, fruitful of doctrine and controversy. ... Between 1891 and 1904, 30 percent of all patents adjudicated in the circuit courts of appeal were declared invalid; another 41 percent were held not to be infringed. Only 19 percent were pronounced to be both valid and infringed. (Friedman 1985: 435)

Long, vigorous and costly litigation was needed to defend patents; and often with uncertain results. The risk of losing was high. The same held for other intellectual property rights such as copyrights and trade marks.

9 CONCLUDING PARADOX

The aim of this chapter has been to extend the literature on national systems of innovation, in particular by further developing a concept which is often mentioned – institutions – but hardly ever elaborated. It is the black box – or should one say black sky? – of this literature. I have done so by taking as a starting point the fact that innovation is fraught with risk and uncertainty. Both 'organization' and 'institutions' have a role in reducing such risk and uncertainties to manageable and somewhat calculable proportions and thus to aid firms in engaging in innovation.

'Organization' is the object of 'private' strategies of risk and uncertainty reduction. Economic actors themselves try to increase the predictability by structuring and restructuring their organization. Assuming that innovation often requires the pooling of resources and competences, firms can opt for different strategies of cooperation. They can either try to internalize risk (by

the formation of large hierarchies through mergers and take-overs; or through the engagement in long-term stable (type B) network relations); or they can try to externalize risk, by merely engaging in *ad hoc* temporary (type A) relations with exit options.

Private strategies of risk and uncertainty reduction are often supported by public ones. States and societies have over time developed institutions that do so. Ideal-typical forms are law and regulation. These affect the risk and uncertainty of innovation directly; and they do so indirectly, by influencing private strategies of risk and uncertainty reduction, that is, by facilitating the emergence of either type B or type A relations between economic actors. This chapter has given examples of statutory regulation and civil law that impinge upon the possibilities for exploration and exploitation in different stages of the innovation cycle. Furthermore, a typology of legal systems has been made, combining the dimension regulation versus litigation (or statutory/codified versus case law) and the dimension activist versus passive use of law. Activist regulation is understood to be the use of law by the state to intervene actively in society and the economy: reliance on the state to regulate high and detailed standards, predominantly of a closed nature, and on rigid and strict implementation and enforcement. Passive regulation is the opposite. Active litigation means the active use of law by the litigants in society, including lawyers, leading to the production of a large amount of case law. Again, passive litigation is the opposite.

Many countries have in recent years, under the influence of neo-liberal pro-market ideologies, experienced a trend of deregulation. I have argued that this does not necessarily mean less laws and regulations; it merely means that they emanate from different actors – from courts instead of politicians and bureaucrats – and that they are of a different nature: litigation is replacing regulation. The American legal system, which is already characterized by activist litigation, shows that such a legal system is neither very effective nor very efficient. The costs – to be considered transaction costs – are horrendous – and the goal: reduction of risk and uncertainty, is not realized. The opposite is the case. A paradox indeed: an institution created to reduce risk and uncertainty and the transaction costs that they create, namely law, becomes itself a major source of uncertainty and transaction costs. It does not effectively solve the problem it has been developed for because it just displaces the problem by creating new uncertainties.

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