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Tracing science and technology
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By Trond Arne Undheim

Introduction

The aim of this essay is to describe the Science and Technology system (S&T system) in Italy, especially focusing on transport and mobility. In this context, this means looking at the interactions between science, technology and society from a macro perspective, sweeping different areas and relating many different players to each other. S&T systems are generally complex, but I will look at some access-points such as (1) specific policies towards this sector, (2) cultural and social foundations for S&T, (3) relations between different agencies interested in the S&T complex (government, R&D, SMEs, corporations, organizations, magazines). I will also consider some Italian research done in this field, especially when it relates specifically to Italy.

The essay is written within the framework of an EU project on Interactive Technology Policy, supported by the Targeted Socio-Economic Research Programme (TSER). In particular, we want to focus upon the implications from the joint processes of social and cultural shaping of mobility and transport policies. It is our view that this brings about conceptual advantages that enable us to bypass the current supply- and demand based understanding of policymaking in this sector. Our aim is to sketch the contours of a new technology policy paradigm, namely an interactive, integrated approach to policy studies, where several new features are included.

Interactive might sound like an ambitious term, given that technology policy at best is mediated between expert groups and politicians, rather than through general feed-back mechanisms. In fact, this way of looking at policy is an attempt to escape the general assumption that policy formation is a one-way deal. This can be seen in the static research done in this field, perpetuating this view. It could also be taken to mean, however, that there *should* be interactivity in these issues, given that technology affects everybody. In this light, then, it makes sense looking for the hidden interactions, and looking for new opportunities for interaction.

Technology policy is, in our perspective, not only the »promotion of technology and technology diffusion» as in the definition given by an OECD panel writing on this issue in 1992. In fact, this is a too narrow notion, only looking at what we label the »pushing logic» of technology policing, the engineer's perspective, stressing the need to accept that technology takes the front stage in policy formation. The issues of *innovation, regulation and infrastructure*, however, together constitute a conceptual framework relevant for policy (Sørensen, 1998), only partly containing this pushing logic.

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The dimensions of technology policy

Innovation has been an increasingly important concern to policy in the last 10-15 years. The speed of change in technological development, fuelled by the international competition and increasingly global markets poses real challenges to any national technology policy. "Innovate, don't stagnate", as the commercial goes, reflects a global rhetorical trend that has actual policy implications. The concern for development of new technology and new practices that enhance our use of technology, including the diffusion of technological knowledge and technological concerns in society at large, is also a relevant part of the *pushing logic* of innovation. As Fleck (1988a) reminds us, innovation must be implemented. He has therefore coined the frase *innofusion* to describe the "learning by struggling" which is involved (in Williams & Edge, 1996:874).

Regulation is about reducing the space of technological development by specifying interfaces between different sorts of technologies, or specifying standards or levels of risk. At best, regulation means monitoring state-of-the art technological challenges, making possible concentrated R&D efforts, and stimulating strategic areas. Using the flowery metaphor of Rip & Kemp (1996:61), governments both "let certain flowers blossom", and "engage in weed killing". Regulation is often the main instrument used by the state to guide technological development in a desired direction. Although it has been said that "regulation is the mother of invention", technological innovation does not follow the rules specified. Innovation, per definitionchallenges existing paradigms, and doesn't necessarily complement them.

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Infrastructure is largely an institutional concern on part of national or regional governments. The open aim is to ensure access to relevant resources and impose efficient mobility flows, typically by building highways, bridges, airports and the like. The projects are typically large and controversial, due to the impact upon the various local communities, as well as the natural resources affected. Lately, information and communication technologies (ICT) are changing the scope of such policies, introducing new technology that alters the understanding of communication in substantial ways. To an increasing degree, ICT measures are deemed relevant to overall policy, as well as in numerous specific domains. Rhetorical constructions like US Vice President Al Gore's *information superhighway* point to the issue that transportation needs necessarily are transformed and reconfigured with the introduction of ICT in society at large. This has, for instance, implications for thinking about regional development, as can be seen in the *Information Society Project*, co-sponsored by various DGs within the European Commission.[1]

Without further explanation, all of the above could be labeled the policy instruments approach to technological change. There is the belief that policy itself creates something, that it somehow adds value, and is capable of transforming technological trajectories by itself. Another option also exists. Government can exercise its powers and influence by changing the rules of the game, by stimulating a certain type of public discussion about technology. This could be labeled the strategic game approach, and is more facilitation than regulation (Rip & Kemp, 1996:64). Large firms with access to information agencies or powerful networks are other actors that could employ this strategy.

With Interactive Technology Policy, we intend to view the concerns for innovation, regulation and infrastructure as mutually constitutive. Playing out on a reflexive negotiation space where *total costs* as well as *total benefits* are involved, we want to study the strategies of a variety of users, firms, policymakers and designers. Only by understanding the image-configurations and total concerns of these actors, as well as of the S&T system as a whole, technology policy can be really interactive.

Social shaping of technology in Italy - a short history

Current approaches to the interdisciplinary study of technology and society have the asset of describing technology and society as mutually

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[1] **Feil! Bokmerket er ikke definert.**

constitutive. Of these, the promising *social shaping of technology* perspective investigates (1) the direction as well as the rate of innovation, (2) the content of technology as well as (3) the outcomes of technological change for different groups in society (Williams & Edge, 1996:868).

The social shaping perspective (also described in Cronberg & Sørensen, 1995) is, however, almost non-existent in Italian debate on these issues. Late industrialization, a resistant culture and a divergent economic structure are national factors that account for this (Ancarani, 1999:1). From the 1990s and onwards there is a political concern for the lack of «scientific culture» in Italy. Recently a working group has come up with some policy measures to better this, but the problem remains.

Very few Italian scholars are working on technology policy. Within the field of industrial relations virtually nobody works in that domain. Political scientists study public policies, but more often than not leave out issues of technology. The Social Studies of Technology (SST) tradition does not exist in Italy, although one can trace some studies that have a relevance towards a more general understanding of science and technology in society (Ancarani, 1999:1). Only at the National Research Council (CNR) there is a substantial output of public policy studies, but they have little overall societal impact.

When so little research has been done, the very task of deciding which actors are involved in the formulation of public policy on technology is a very difficult task. In any case, we need to ask who are the principal actors in the formation of technology discourse in Italy. A tentative answer, based on the experience in other countries might reveal that entrepreneurs, policy makers, the general public, research journalists, researchers, CEOs in major corporations, the high-tech industry etc. all have a role to play. That is, could lack of public involvement have significant consequences? How can the basic options of exit, voice and loyalty (Hirschman, 1970) be understood in the domain of technology? In what areas does the government encounter opposition? What concerns do the citizens have themselves? The concise importance of each of these groups remains to be studied in each case.

A major issue to be resolved is whether policy formation in this area is any different than in other areas. What about the governmental level? The 1992 OECD report on S&T policy in Italy pointed out that the variety of Italian actors involved in policy formation could cripple an effective management. Other countries, like Denmark, Sweden, Finland and Germany, have

specific agencies in charge of technology policy. However, results are not given, and such bodies receive harsh treatment by industrial commentators for not always targeting their specific needs. Such bodies seem to start living a life of their own, detatched from real needs.

The Seveso accident of 1976, where toxic dioxine from a chemical plant was released on a densely populated area in Northern Italy, is a tragic, but effectual illustration of interactive technology policy at work. Together with Bhopal (1984) and Chernobyl (1986) the Seveso incident became a symbol of the pathologies of our technological civilization, but more significantly in this context, it became a symbol of public recovery of a trauma. It inspired and provoked a wide public concern, ranging from community groups to public agencies, accelerating safety regulations on the European level. The Commision eventually in 1982 established the Directive 82/501/EEC, notably Article 8 stressing the public's moral and pragmatic *right to know* (De Marchi, 1997:533). The citizens of Seveso and many interest groups, such as the worker's unions and the women's movements, had a voice in public debate on the Seveso case for a long time. A key issue was risk assessment. The concept of "total costs" in industrial ecology is also one of the eventual outcomes.

Innovation

Adopting the view that technological change always occurs within a web of social processes, and that negotiations between different social groups can be a crucial factor in order to understand both governmental policy, and social and cultural reactions to a given technology, innovation becomes a complex issue (Sørensen, 1997:4). Shaping a favorable environment to technological innovations is fundamental to such development.

To try to pinpoint the conditions under which such development occurs, is a subtle, and extremely disputed issue. It is no secret, then, that innovation is a cultural phenomenon more than a technological one, if these two notions were to be separated. Innovative environments "reflect a given state of knowledge, a particular institutional and industrial environment, a certain availability of skills to define a technical problem and to solve it, an economical mentality to make such application cost-efficient, and a network of producers and users who can communicate their experiences cumulatively, learning by using and doing" (Castells, 1996:37). Generally, we must distinguish between macro-economic forces initiating and driving

change at the national and global level and the country's inherited and distinctive social & economic structure as well as local characteristics like:
- availability of financial support (competent venture capital)
- knowledge
- social networks
- entrepreneurial culture
- infrastructure
- political organization
- institutional infrastructure (universities, research centres, science parks).

Then, there is the question whether pro-active policies are needed. In some cases there is conflicting evidence whether planning initiatives or Laissez-faire works better.

The very notion of stimulating innovation is entrenched in the larger problem of how to stimulate creativity. Now, creativity can be studied both at individual and aggregated levels. As many have observed, the creative approaches are those that defy classification, and the creative people those who »defy the crowd» (Sternberg, 1995). Creative people »buy low and sell high». According to Sternberg's investment theory of creativity, it requires a confluence of six distinct but interrelated resources: intellectual ability, knowledge, styles of thinking, personality, motivation, and environment (Sternberg, 1997:488). Most of these resources are culturally entrenched. No wonder, then, that the innovative approaches to technology can not be controlled, nor stimulated in a substantial fashion by any governmental policy alone.

There are many interactions between the national styles of technology studies and the economic and political features of the nation state (Sørensen, 1997:2). Especially in a country like Italy, where the historical development of science and technology, as well as politics, have taken many deviant turns compared to other European countries. The direct implications of this are seen especially in the context of what we have labeled «interactive technology policy», where we try to pinpoint activities outside the traditional policy analysis framework. However, such an approach needs to take into account the civic culture, not only of the nations involved, but also of the regions. Local participation, and faith in common goals, sometimes is a prerequisite for industrial growth. In some successful regions, industrial concerns and public concerns go hand in hand. Regions, then, become like products (Thorvik & Undheim, 1998:33). What really happens is the effective use of *social capital* - «a civic community resulting from a complex historical process of social co-

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operation based on active citizen participation, trust and tolerance», as scientist Robert Putnam defines it (Putnam, 1993. In the South of Italy, notably Campania, Calabria and Sicily, this is arguably not the situation. Innovation, then, goes counter culture.

Many would claim the emphasis upon cultural factors is opposed to a policy sector view in which the administrative structures take a larger role in the picture. In this view, then, the institutionalization of a certain type of technology policy or sector, then, becomes an important measure. In this vein Jänicke (1990:215-217, referred in Weale et al, 1996:258) has argued that the environment issue in policy is captured by four indices:
(1) the establishment of an independent ministry
(2) the creation of an environmental agency
(3) the passing of an environmental framework act (possibly leading to a constitutional protection of the environment)
(4) the production of an environmental report

But there are good reasons to combine these two approaches. One could focus on the way these institutional frameworks were established, look at the actors and institutions involved, look at the resistance, and try to understand the eventual outcomes of policy struggles. Struggles over technology should occur in the traditional political field, but also in the public sphere, through expressions of public concern by interest groups and concerned citizens.

In many ways, of course, the interconnections between purely technological arguments, and overall socio-structural arguments become problematic. Practical discourse is always conceptually messy, compared to the policy or legal measures that are the outcome of these debates. Then, of course, comes the issue of whether a given policy really has been debated. Many laws and policies are passed without a lot of public discussion. Probably, technology is a field where this is more relevant than in anywhere else. The issues often become too complicated to discuss, or become politicized (in a negative sense) and thus of little relevance to the policy-making issues under consideration.

The existence of such a structure, of course, does not by itself tell a whole lot about the real state of affairs. Italy created a formal environmental administration in the 1980s, as did Greece and Spain, but only in Italy did these issues have a history of public awareness, and existing plans. Now the European Community pushes environmental issues in a more general way, and member countries more or less follow the path.

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Strategic interactions between different public bodies are common in policy-making. This is, for instance, the case with Italian environmental policy. Air quality limits and guidance values are proposed by the Ministry of the Environment in Rome in agreement with the Ministries of Health and Industry and the Conference of Presidents of the Regional Governments. In spite of this interaction, no large-scale environmental policies were carried out in the early 1990s (Pianta & Sirilli, 1997:250). Too much interaction has its price.

Most commentators claim the Italian technological system is weak and seems to be segmented in a dualistic structure where few high-tech sectors co-exist with a pool of traditional ones, rather peripheral in the innovation flow network (Leoncini, 1996:425). In fact, we can count core Italian industries like Pirelli, Olivetti, Fiat and Telecom Italia on one hand. Innovation policies seem to favor the largest firms, according to a large innovation survey carried out in Italy in the mid-1980s and the early 1990s (Pianta & Sirilli, 1997:245). Only 5% of the large firms had introduced innovations. According to the survey, 7552 out of 23000 firms have introduced a product or process innovation accounting for two-thirds of total employment and sales. The most striking finding, however, is that most firms attached little significance to policy measures. Most policies, including financial support, were not considered relevant. This is peculiar, considering the significance of SMEs in Italian industry.

However, Italy has been especially able to transfer technology from other countries, especially in traditional low-tech sectors as textile and clothing (Ancarani, 1999:3). Indeed, the one characterizing feature of the overall Italian S&T system is the acquisition and subsequent adaptation of foreign technology to specific needs, a policy which can be said to solve short term problems but compromise future competitiveness (Otero Hidalgo, 1997:231).

In Latour's vocabulary, *actants* are those non-human resources that nevertheless are a policy concern, and thus are endowed the status of «actors» in a policy process, in the sense that somebody will speak for them and voice their concerns (Latour, 1998). Technologies that affect the environment directly are especially relevant here.

The diffusion of technology necessarily brings about issues of communication. How can different cultures of expertise, much less general citizens, understand each other and produce meaningful dialogue about

technology when the context is highly politicized? Italian policy makers have been little bothered by external expert advice, due to a colonization of expertise by the political parties. Also, the case could be claimed that these experts, when consulted, have not been listened to. Italian sociologist Gallino claims *policy-makers*, a group which he himself incidentally now takes part of, lack an understanding of the advice they get from expert panels. This is one reason why experts have little real impact in Italy (Ancarani, 1999; Gallino,1992a). Believing a communicative clearing of intentions could solve this problem, Gallino tries to analyze the different rationales that underlie such misunderstandings, stressing three types of actions; cognitive, practical and discursive.

The impact of Italian innovation policies has been limited, according to results from the Italian innovation study (Pianta & Sirilli, 1997:245). Existing policy tools favor large firms, not SMEs, and institutional constraints and incentives, like environmental ones play a larger role than policies themselves.

Does Italy lack a scientific and technological culture?

Many observers, both foreign and national ones, have claimed that Italy lacks a scientific culture. Italian research has been somewhat backwards oriented, has to a large extent imported results from abroad, and has little backing among the general population.

The funding of research is a key to what type of technology studies we have seen appear in Italy. Apart from CNR, the trade unions are a major sponsor, thereby pushing a bottom-up perspective, and not so often integrated perspectives seeking to link policy and participation. As Diane Pinto claims, most of Italian sociological work cannot be separated from a certain political activism from the left (Pinto, 1981). Most of Italian sociology in the 70s were devoted either to the study of politics or to the study of development or underdevelopment. Thus the prominent themes are the changes in the labor market and labor union movements, the composition of social classes, urban studies, and the tension between the welfare state and the market economy in Italy. R&D spending in Italy is among the lowest in all OECD countries. Italy has spent a stable average of 1.1 percent of their GNP since the 1980s, while countries like the Great Britain, and France lie around 2.3, the US around 2.6, and Japan on an impressive 2.8 percent, mostly due to a recent strategic focus on this issue.[2]

Two notable exceptions are, firstly, the popular magazine *Sapere*, founded in 1935, the oldest Italian scientific magazine containing recent developments in science and technology. *Sapere* has contributions from experts and journalists specialized in their fields. Secondly, the »Ettore Maiorana» Centre for scientific culture in Erice, Sicily, created 36 years ago by the famous Italian physicist Antonino Zichichi, who in 1965 discovered anti-matter. During this period fourty thousand scientists from one houndred countries have taken part in the post-university schools in the most advanced fields of science, technology, medicine and many other sectors related to modern life. The Erice Statement, written in 1982, proposes that »technology is the study of how the power of mankind can be increased», and is an appeal to ban secrecy in scientific endeavors of all kinds. This declaration has gone round Laboratories around the world and is also on presidential tables. It has been a major impetus for science policy in the 80s, resonated by such figures as Deng Xiao Ping (China), Mikhail Gorbachev (USSR), Olaf Palme (Sweden), Sandro Pertini (Italy), Ronald Reagan (USA) and Pierre Trudeau (Canada).

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[2] http://www.murst.it/Ricerca/Quadro/indice.html

The novel approach in Erice must be viewed in the light of the Italian university tradition. »Here the student may address any kind of question to the teacher, the prime objective is to learn...we award no diploma», Zichichi states. The Erice centre aims to bring together top expertise from the best universities in the world to give students the state of the art knowledge necessary to think about the right problems. However, the aim of this centre is not only to address specialist issues, but also to promote public understanding for scientific problems. Thus, Erice is not only known throughout Italy as a centre of scientific excellence, but it also nurtures the thought that the great projects of scientific collaboration between East-West-North-South »must not be the privilege of a few, but become the patrimony and the heritage for the people of all nations». From these flowery phrases to the Italian reality there is certainly a few miles to run. However, it points to the fact that not everything in Italian thinking about science and technology is inferior to the state of the art elsewhere. The Erice centre is only one such internationally renowned institute in Italy.

Planning has never been the strong side of Italian politics or Italian culture. Some claim Italy is better described as a »life-force» rather than a culture of rational life and planning. It has been claimed that the polemicist always wins over modest field research. The Italian culture has a resistance to sociology (Undheim, 1997). At the same time, Italy has an enlarged public sector with most public utilities owned by the state. Although telecommunications as of January 1st 1998 was liberalized all over Europe, most other services remain within state control.

Another particular feature is high-energy physics. Nuclear physics has always had a dominant place in Italian science policy. This is partly due to the group created around the scientist Fermi in the 1920s and 1930s, who produced successful research even with limited resources, but also due to a traditional Italian university system in which everything is hard to change (Cambrosio, 1985). But although we can easily quote a few examples of the contrary, Italy remains asociological, antisociological, indeed, anti-social (Ferrarotti, 1989). No wonder, then, that there is a certain resistance to scientific culture.

Recognizing that Italy has such a fundamental deficit the Italian ministry for universities, research and technology (MURST) has put together a report to diffuse »technological and scientific culture» in Italy.[3] Conscious

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[3] http://www.murst.it/Ricerca/Diffusione/Documenti/Sintesi.doc

of the new challenges brought forward by the importance of science and technology for future growth in the economy and welfare of a state, the working group claims it is necessary to establish a dialogue between the actors of the research system and the citizens. This dialogue must be intense and not only occasional. Information about current activities and their overall importance of such research to »economic development and cultural and civil growth» is vital towards such an effort. In a sense, research needs to become more transparent. In fact, the distinction between *science* and *culture*, as if they were different, both underlines and influences the differences. It is important to form a critical mass of citizens who understand such issues.

The issues are so crucial precisely because of these features of contemporary society:
(a) Omnipresence of technology intertwined with science
(b) Rapid amnesia of all technological & scientific knowledge
(c) Internationalization of the labor market and of professional competence
(d) Social exclusion processes.

Policy proposals from the working group include:
(a) Teaching science in a practical, as well as historical and humanistic context (showing how science is part and parcel of the Italian society)
(b) Interdisciplinary education is fundamental, because most situations require a broad array of such competencies, as well as knowing how to work with other people
(c) Continued education
(d) University teachers must be more involved in the learning processes in ordinary schools
(e) Support scientific museums, change the image of such museums. Knowledge is not only a self-motivated pursuit of knowledge for its own good, but as knowing how to behave (towards today's technological artifacts and other contemporary challenges), as well as know-how. Italy must promote interactive science museums of the type seen in other countries, with the use of new technology and presentations of industrial innovations. Sensitize the general public to the frontier research themes, help them orient themselves in an ever more complex world.
(f) The media must devote considerable attention towards S&T issues. Still this is largely insufficient and inadequate. A new type of communicator must arise, capable of transmitting precise and understandable information on many different levels on the developments of research and its implications. It is important that they resist the temptation to only focus on spectacular and fascinating aspects of these issues, but

also inform and stimulate to develop a greater understanding of what this means

The state must take a major coordinating role, in order to implement policy. In addition, the support of professionals (researchers, museums, science information agencies, educators etc.) as well as direct forms of association among citizens, is fundamental.

Typical to the Italian context, and reflecting their long tradition for social movements, and the study of the impact of such movements, the working group suggests that it is necessary to enhance what they call the »associazionismo qualificato e motivato», the qualified and motivated associationalism. In short, they want to stimulate groups among the general public to take an active part in society, also on scientific and technological issues. In many ways this idea resonates with the idea of an »interactive technology policy». Only, Italy has a long way to go. As the web-presentation of the conference week on Le immagini della scienza e della tecnica hosted by MURST March 23-29th 1998 states: »we don't lack neither knowledge nor technology, while the awareness of how to value it is scarse»[4].

In collaboration with APRE (EU), MURST (Italy) has from 1994-1999 had a multi regional project on research, technological development and higher education. Also in this vein, however, is the Pirelli International award, given to outstanding contributions to promote La cultura scientifica in Italy.[5] Here is an international Italian owned corporation that finds this issue important enough to promote.

When analyzing public policy in the S&T domain it becomes immediately obvious that the role of technology in Italian public policy has been a subordinate of industrial and economic policy, and more so than in other European countries. The reasons for this are many.

First of all, Italy never was completely industrialized. The incredible success of Italian design, fashion and manufacture occurred mainly in the Northern and to a lesser degree central parts of the country. Instead Italy could be described as a transformational economy, much in the line of Japanese economy (Mignone, 1995:99), thus extremely open to international trade and foreign economical stimuli. This, incidentally, also is one of the reasons for the thriving success of the northern Italian small-

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[4] http://scienza.quipo.it/
[5] http://www.PirelliAward.it

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scale manufacturing business. And indeed, with what the evolutionary economists call an innovation-based economy, a transformational economy would seem to be more ready to incorporate swift changes. Only, the rules of technological development seem to change as they come along. Industrial policy thus faces enormous obstacles. Also, if the economic theory of long-waves is even partly true, short-term policy options are doomed to have little effect.

Italian attitudes towards foreign investment have changed in the 1990s. From a hostile or indifferent attitude, Italian industry and policy makers alike have opened up. Mostly this is due to need, but it also reflects a sense of *global competition,* Italy wanting to catch the opportunities out there. Still, however, Italian policy is passive in this domain (Vitali, 1994:78).

Industrial clusters have received much attention in recent years. A careful sketching of such patterns in Italy reveal a traditional industrial triangle (Lombardy-Liguria-Piedmonte), now widened to include practically the whole of the Po-valley. In Tuscany and Umbria, industry is concentrated along the plains and in hollows near the Arno and Tiber river basins. In the south however, the major developments happen in the coastal zone of Caserta-Naples-Salerno or the Bari-Taranto-Brindisi triangle (Mignone, 1995:100).

Three state bodies have played a major role in Italian economic recovery: the IRI (Institute of Industrial Reconstruction), the ENI (National Hydrocarbons Agency) and the EFIM (Agency for holdings in and Financing of the Manufacturing Industry). Until the 1990s they covered every sector of the economy, including banking. Now, many of these functions are becoming privatized. How ready, then, has Italian policy makers been to act? Maybe it's more a question of ability? Significant policy results could only be obtained after reaching a critical mass (the systems dimensions in absolute terms is relevant). The system might not be ready for real change. In addition, structural differences between the Italian and the other European industries come into play. In Italy, the most significant channel of diffusion is the use of materials, while in Germany it is the manufacturing process (Leoncini, 1996:429).

With these issues in mind we could take a look at the Italian policies of innovation. Proactive policies from the Italian government in the 1980s include:

- The Applied Research Fund (1968 and onwards), a measure that has been criticized for being too complicated, with the result that many SMEs did not apply (OECD, 1992:81).
- The Technological Innovation Fund (1982-), destined to subsidize the leasing and purchase of high-technology machine tools by craft enterprises and small-and medium sized industrial enterprises (SMEs). This has functioned exceptionally well (OECD, 1992:82).

Together these form the framework of state intervention in the corporate sector (OECD, 1992:74). In sum, they come out with a lot of problematic features. In addition to the problems with the Italian bureaucracy, the S & T system is little coordinated and there is a general lack of evaluation of the results produced.

Regulation

A most powerful tool in changing the direction of industrial concerns, regulation sometimes works better than incentives and funds. Arguably, this has been the case in the environmental concerns of Italian firms (Pianta & Sirilli, 1997:251). Governmental policies setting standards or providing incentives for introducing less polluting and dangerous products and processes played an important role in technological change. This because firms payed substantial attention to external contstraints like workplace safety and health and ISO quality standards.

But what about the SMEs, the most striking feature of Northern Italian industry? It appears that current innovation policies do not take their particular concerns into account. There is a need to favor innovations which create new markets, as well as an urgent need for industrial policies promoting SMEs access to cooperative instruments, or what is aptly called "learning by cooperating" (Berra, Piatti, & Vitali, 1995).

The policies for technological innovation in Italy have generally been labeled and treated under specific technologies, not as a whole. The policy-intensive sectors in the Italian technology regime sectors are telecommunications, distance education, automation and informatization of public services etc.

In general the Italian policy in these areas reflect the European Commission policies and regulations like the directives for telecommunications, transport systems, television etc. The actual policy is

directed and executed by the Ministry of Transport, the Ministry of Industry and of the Ministry of Universities and Scientific Research.

However, the Italian «southern question» is a particular feature, also regarding technology policy. The poor southern part of the country has been the single biggest problem since Italy was united in 1861, and trillions of lire have been wasted in useless schemes. In 1998, however, it seems the government is convinced that the small- and medium-sized industries, which have made northern Italy incredibly wealthy, can be replicated in the south. Central in these issues are Bossi, di Pietro and Cossiga (Severgnini, 1998:51 in *The World in 1999*, The Economist Publications).

The so-called *Mezzogiorno* suffers from an extensive brain drain towards employment in the north. Italian industrial policy *has* been directed towards the South, but with little effect. Aside from the fact that many would claim industrial policy has served northern interests by promoting an alliance between heavy industry and large banks (Mignone, 1995:130), the *Mezzogiorno* has cultural deficits that deteriorates both inward and local investment in the region. There is the sense that «nothing can be done», and all outsiders are viewed with suspicion. In Naples the historical experience of many rulers, numerous invasions and exploitation, has lead to a deeply rooted distrust in government as such.

The creation of the Southern Development Fund, the *Cassa per il Mezzogiorno,* now abolished, did not prove effective. Major reasons for this was lack of control with how the money was spent, and the fact that various mafia-organizations control construction enterprising (Severgnini, 1998:51). Moreover, Italian economist D'Antonio claims policy for the South needs to take into account that economic development these days ride on investments in human, not physical capital. The Italian policy regime has to take this into account (D'Antonio, 1991:401).

Conceptualization, appropriation and control of technology in Italy has been handled by various experts in fields as diverse as the labor market, industrial relations, various levels within the Public Administration and services and organization. The study of policy as such has little tradition in traditional political science departments, deployed with electoral and constitutional experts from the law tradition.

Little attention has been devoted to the study of Public Administration, due to a lack of cultural accentuation of the importance of this institution. There is the notion that public institutions work badly, and that there is no need to

document this. There is also some resistance to the innovative claims of technology among researchers. Bianco found that introducing informatics in public institutions not in itself is an innovative factor (Bianco, 1989 in Gallino, 1992:92).

Though little coordinated in the past, Italian technology policy now is put forward by MURST, Ministry for Universities and Scientific and Technological Research. It was created as late as in 1989. Before that, the complexity of institutions responsible for setting, controlling, coordinating and implementing intervention policies created a big time lag between policymaking, lawmaking and actual implementation.

Italian technology policy has been largely driven by the firm belief in big science, space research and high energy physics in particular, as well as some support for the small-scale businesses in the North. Direct financial incentives are the most typical interventions.

The corresponding environments in the South (described above) have not received equal support, and technology is definitely not a strongpoint there. The Southern situation, the so-called *Mezzogiorno* complex, also has historical and cultural explanations, and the problem remains, creating a great industrial divide between the North and the South.

With a population of 57,7 million, GNP per capita remains $ 21,685, compared to a country like Norway's $37,339 per capita (The Economist, 1998). Italy generally spends little of its GNP on R & D – roughly 1.1 percent throughout the 80s, although a steady increase now puts Italy among the first 8 countries in the world, according to OECD (1991). In comparison with other countries in southern Europe, like Spain, Greece and Portugal, Italy ranks first (Otero Hidalgo, 1997).

Where as the Italian context for science and technology is not the best, some major firms have enjoyed a considerable success, and have also contributed immensely to research. The Italian computer firm Olivetti has had a profound influence upon industrial research in Italy, fostering sociologists like Ferrarrotti and Gallino, but also, together with IRI, ENI, INTERSIND, FIAT and PIRELLI has created a market for industrial research. In turn this has spurred the creation of consultancies like Arpes, RSO, Studio Staff and similar firms. Olivetti is only one example. The role of corporate actors in Italian industrial research can not be understated.

On the other hand, this might also be one reason why innovation rates have been slow, especially within large firms (around five percent). It is very difficult for a large firm to be innovative, and their best option really is to allow for growth outside the firm, thus relying on external R&D, and then buy it when the innovation is a fact.

Technology foresight studies, aiming to identify potential important technologies early enough to facilitate their development and utilization, are rarely used in Italy. In the absence of government action, a private research foundation, the Fondazione Rosselli, recently carried out a mini foresight study, proposing an extensive agenda for science and technology policy. The method used was to expose expert panels to different techniques, like Delphi surveys, panel discussions, brain storming, scenario building, expert networks etc. The policy agenda coming out of this, however, consists of the traditional interventions like financing to industry, and suggestions to how industry better can use public research infrastructure. What Italy needs is a real foresight study, as well as greater will to invest in R&D within industry (Sirilli, 1997:360).

CNR, the national Italian research council, is the public research foundation of highest esteem in Italy. It co-ordinates, funds and controls most scientific and technological research in the country[6]. CNR was created in 1923. In this first period it had an instrumental role in the fascist state. (Russo, 1986). CNR is since 1963 responsible for national consultant committees, and from the 1966 reform it has emerged not only as a funding agency, but also as a performing body (Review of national science and technology policy (OECD), 1992:159).

Recently (1998) the CNR has again been reorganized. The reform implies that CNR is to focus on »advanced, fundamental and applied research, both to maintain and develop scientific competence and to be ready to intervene effectively and with full impact in the strategic sectors defined by the national programme system». The concept of »technology transfer» is a central term in the legislative document of August 6 1998[7].

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[6] http://www.cnr.it
[7] For instance, they use terms like "openness of the activities to precompetitive development and technology transfer".

The governmental agency MURST was created in 1989, and is responsible for most tasks in national research policy[8]. A new feature is the emphasis put on external expertise as part of the policy.[9]

There are also other agencies and initiatives relevant to technology in Italy. The Italian National Agency for New Technology, Energy and the Environment (ENEA) is an organization for scientific research and economic development[10]. Around 3800 people work there, of which half of them are researchers and engineers. ENEA's mission is "R&D for innovation and sustainable development of the country". It transforms technological & scientific knowledge into practical solutions that enhance economic and social development in light of two principles:
a. Compatibility between economic development and environmental safety
b. Compatibility between productivity system and maximum employment
ENEA is heavily involved in Southern Italy, where it operates three research centres (at Trisaia, Portici and Monteaquilone). According to ENEAs mission statement and plan for 1998, the public administration has considered innovation of extreme importance, and has accordingly used ENEA's resources as consultants on everything from teaching technological competence to diffusing European research programmes, to local interventions.

In addition, there are institutes made specifically for certain interventions, such as:
- INFN (The National Institute of Nuclear Physics), founded in 1951 as a public body, now, 20 years later it has become independent
- ASI (The Italian Space Agency), set up by the government in 1988 as a supervisory body
- IRES (Institute for Social and Economic Research) in Turin
- CNPDS (National Center for Foresight and Social Development)
- ILSES (Lombard Institute for Social and Economic Studies) in Milan
- CNST (National Council for Science and Technology) – set up in 1990 (promising!)

[8] Sono trasmessi al Ministero dell'università e della ricerca scientifica e tecnologica (MURST) i bilanci annuali e una relazione annuale sull'attività svolta, che è inviata, a cura del Ministro dell'università e della ricerca scientifica e tecnologica, al Ministro del tesoro, del bilancio e della programmazione economica, al Ministro della funzione pubblica, nonché al Parlamento.
Schema decreto legislativo –Riordino del Consiglio Nazionale delle RichercheArt. 8, part 2 (www.murst.it)
[9] http://soi.cnr.it/~tminfo/rel_garaci/garaci.html
[10] http://www.sede.enea.it

- CUN (National University Council) – an elected body representing university staff

In Trieste there is the International Centre for Science and High Technology, an autonomous institution supported by the United Nations Industrial Development Organization (UNIDO). Their particular focus is sustainable technology transfer and SMEs[11].

Infrastructure

Here we will focus upon transport and telecommunications, two major sectors where government is heavily involved in shaping the infrastructure.

Traffic congestion is a major problem in virtually all of the Italian cities. According to a recent survey, inhabitants in Milan, Rome, Naples and Bologna spend an average of two hours in traffic daily (cited by Hoogma, 1998:10). Most of them have their own cars, as the quality of the public transport system is shallow. Hoogma (1998) claims this is due to lacking investments and incentives by the national government, but probably there are other important reasons. The subway project in Naples has been subject to large delays, and the invested money just seems to disappear. The public claim the Mafia is in control. Normally, this would be up for investigation, but such is not the reality in Southern Italy.

In a recent regulatory effort, collective lanes were introduced in Naples. Volunteers were called in to guard the new lanes and ensure only buses and taxis used them. For a few days in the spring of 1996, traffic allowed buses to pass. Even the notorious 185 from Vomero to Stazione Garibaldi was allowed to pass along the busy streets. But the effort failed. After a week, the Napolitans got tired of "il traffico", and started using all lanes again. The whole regulatory effort became publicly ridiculed. In fact, the locals used it to reestablish their identity. Napolitans are the best drivers in the world. No one tells us what to do. "Tutt'à posto - niente in ordine" - "All in place, nothing in order", as their famous saying goes.

The introduction of automated zone access control in Bologna seems to have been more successful, reducing air pollution significantly (Hoogma, 1998). Although there was a lack of communication between regulators and car-owners, the project is only partly successful. The project is a city initiative, and will probably not be enforced on the national level. The

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[11] http://www.ics.trieste.it

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ministry of the Environment is probably too weak, and other ministries do are not interested (Hoogma, 1998:6).

The Ministry of Transport deals with R&D and policy issues in the transport sector according to the General Plan for Transport. Investment is high, but innovation is slow, because most of the money is used to buy foreign technological solutions (Otero Hidalgo, 1997:231). There is, however, the Experimental Institute, founded in 1905, an organization associated with the state railways in charge of transportation research. At the federal level, the responsible authority is *Federtrasporto*.

The first research programme on transport dates back to 1982, dealing mainly with national distribution of know-how, also across disciplines. The second program of 1992 ran through 1996 and had 6 subprojects:
1. Mobility management and planning tools
2. Vehicles
3. Technological systems and infrastructures
4. Urban and Metropolitan Transport systems
5. Freight Transport
6. Participation in International Transport Programs
(Otero Hidalgo, 1997:252).

The organization of transport is especially weak in areas related to the business sector. This has two major reasons.
- the low cost of transport, the decentralized location of productive businesses and the structure of the Italian business sector, to a large degree based on SMEs.
- poor organization of logistic processes[12]

These two elements lead to a strain upon road transportation. Less than one eight of all goods moving in Italy is shipped by rail, although trucking costs three times as much.

Although Italy has a well-developed highway system, its rail system is shallow. Passenger transportation carries on, thanks to the Italian love of their *macchina*. With 490 cars per 1000 inhabitants, Italy is at the forefront of car ownership in Europe, and the effective transportation of goods suffers accordingly (Pucher & Lefèvre, 1996:104). Postal services are incredibly inefficient, showing signs of a tired bureaucracy. The motor

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[12] "Scenario attuale e previsioni di traffico per il medio e lungo periodo". Intervento del Presidente della Federtrasporto dott. Giancarlo Tesini alla CONFERENZA NAZIONALE ENERGIA E AMBIENTE - ENEA
Verso la sostenibilità del sistema nazionale dei trasporti - 27/28 ottobre 1998. Seconda sessione: Trasporto di media e lunga percorrenza di passeggeri e merci. http://www.federtrasporto.it/Enea.htm

vehicle industry does not receive any innovation flows from the government. This hints that the industrial policy of the Italian public sector privileges other types of intervention than innovative ones, but the EU has often put forward accusations of protectionism (Leoncini, 1996:428).

Mobility in Italy is largely private, with public transportation systems working efficiently only in the North. Inner city bus lines suffers general strikes on a regular basis, *lo scioperismo,* accounting for incredible delays in daily routines. Italian fares are the lowest in Europe, and there is no connection between the tariffs and the cost of producing the services (Pucher & Lefèvre, 1996:115). In the city, congestion, pollution and lack of safety are major problems, but less of a policy concern. Underground systems exist only in Milan and Rome, and there is also a 4.5 kilometer long line in Naples. It has been said that Italy has cities without policies, since no comprehensive data on public transport is to be found. Lack of coherence, an absence of coordination and planning is the result when laws and policies never are implemented. Nobody is responsible for area-wide public transport policy (Pucher & Lefèvre, 1996:116). "If anything mobility is understood as erratic, meaning that people's movements in time and space are unpredictable" (Pucher & Lefèvre, 1996:103). Whether this is an informed policy answer, given the Italian culture, or it is just a lack of understanding, remains to be proven.

Telecommunications policy

The area of telecommunications has come at the forefront of technological, industrial and societal discussions on the information society. Typically governments strive to regulate, promote, even to understand the developments in this sector, as the speed of change exceeds common boundaries in time and space. Although it has been claimed Italy is poorly coordinated also in this sector, some regions manage better than others. Taking a look at Piemonte we can see this at work.

The Region of Piemonte has an important tradition in the world of telecommunications. The two main national firms of this sector, RAI and Telecom Italia, were born in Piemonte. It has to be underlined, furthermore, that Telecom Italia was born from SIP (Piedmontese Hydroelectric Society), and has become the national manager in the Telecommunications sector. Both RAI and Telecom Italia maintain their laboratories of advanced research and experimentation, CSELT and Centro Ricerche RAI in Piemonte.

CSELT is, with about 2000 employees, a laboratory of considerable importance on the international stage, with researches in all the strategic sectors (ISDN, ATM, GSM, satellites, intelligent networks, services engineering, etc.). The Centro Ricerche RAI is in the forefront in the television standards sectors, both satellite and terrestrial, with experimentations in the field of pay-TV.

Piemonte is very well covered by satellite footprint, unlike the other Italian Regions. The mobile telephone network is capillary. Besides the strong exploitation of optical fibres, radio links still have a relevant role, because of the orographically inaccessible nature of a good part of the regional territory. Moreover, Piemonte is served by three mobile networks, one in ETACS technology, managed by Telecom Italia and two in GSM technology, one owned by Telecom Italia, the other by Omnitel. Omnitel is a private company, born in Piemonte as an emanation of the Olivetti Group, and acting more and more as a global telecommunication manager, thanks to the recent agreements with France Telecom and DBP. Albacom is active private provider of data networks, born from a co-operation between British Telecom and Banca Nazionale del Lavoro.

The presence of Telecom Italia in Piemonte has always been important. There is good coverage by ISDN, which has recently been made price-competitive with the national telephone service. Torino has become the first Italian city to have a Metropolitan Area Network (MAN). It has also become one of the first cities to participate, through CSELT, in the national and international experiments in the ATM technology, and is today fully involved in the two national projects by Telecom Italia on ATM, named ATMosfera and Sirius. Moreover Torino is the seat of the infrastructure National Host, planned and established by the DGXIII of the UE.

Piemonte is connected to the Internet through CSI (Consorzio per i Sistemi Informativi), providing the service to the Public Administration, the CSP (Centro di Supercalcolo Piemonte) offering connection to private users, and, of course, by the presence of the IP service by Telecom Italia, named Telecom Online. Networks to improve the efficiency of the Public Administration and make easier information exchange with citizens and enterprises also have been put in place. In particular this is seen in two important projects: Torino 2000 and Piemonte IN Rete.

Torino 2000 is an agreement between the Municipality of Torino and STET (the financer of Telecom Italia) for the delivery of 500 high-speed access points on the territory of the Municipality of Torino, to be built with

innovative technologies, mainly with ATM. Piemonte IN Rete is a project driven by the Regional Majority to achieve a capillary service of IP interconnection on the territory of the Region. About 350 access points will link the Region offices, the Province offices, the USL (Local Health Care Districts), the University seats, the technological parks and the foundations with Regional participation. Finally, the commitment of Piemonte to the telecommunications sector is testified in the important agreement between the Ministry for Education, the Municipality of Torino, the Province of Torino and the Region of Piemonte, to bring the Internet to every school. This type of regional initiative is lacking in other regions.

»This document analyses the foreseeable transformations globally induced by the diffusion of the Information and Communication Technologies (ICTs), connected to the so-called Information Society. It focuses this analysis progressively to Europe and, finally, to the Region of Piemonte; it illustrates, in the second part, the strategic lines of intervention of the Region in the productive and social tissue to best support the transition to different and new ways of living and working».[13]

Piemonte has made a joint effort, involving the Public Administration, universities, major enterprises »characterized by advanced technology», associations of industry as well as other actors. Let's just pause for a minute and reflect upon the expression »characterized by advanced technology». Why don't say enterprises *using* advanced technology? Apparently, the very essence of the enterprise is technology, to the extent that it has become *the* characterizing trait. The Information Society Project has strong elements of ideology. In fact, one might say it reflects a *religious* vision of technology.

The regional dimension cannot be overlooked when assessing Italy. The industrial districts of Northern Italy have received much attention. Apart from the traditional districts clustered around Milan, and the southern agricultural districts (Mezzogiorno) there is also the "third Italy", circled around Modena in the North central parts of Italy. Based on community based networks of trust and municipal cooperation, this region seeks to develop sector strategies that encourage inter-firm cooperation (Best, 1990:250). This is only possible when the local culture supports it. Modena is characterized by community-based institutions that are part private and part public. The binding power of such institutions is seen in its capacity to

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[13] http://www_iris.polito.it/ then click on **Regional web-sites**

create in-groups with substantial benefits, and severe honor codes, punishing possible economical free-riders (Best, 1990:239). Internationally competitive independent small firms, strong unions, leftist political parties, and an active citizenry at the local level contribute the essential multilevel interactions in this particular version of the network society.

To a large degree, Italian S&T measures carefully follow the EU initiatives, but as we have seen, some Italian regions, like Piemonte, have shown proactive moves in this direction. In particular, it has embraced the visions of the information society discourse.

The Regional Information Society Initiative (RISI) is a European Commission Pilot Scheme. RISI aims at integrating the concept of the Information Society into regional development policies. Six regions take part: the North West of England (UK), Saxony (Germany), Nord-Pas-de-Calais (France), Piemonte (Italy), Central Macedonia (Greece) and Valencia (Spain). These regional players develop regional information society strategies and action plans together[14]. »Like all the strategic plans, it should not be considered as a closed document, but as a working instrument to go through periodical revisions. The document makers hope to have made a useful and exploitable work»[15]. Now, what does this amount to? Is this really interactive technology policy? In many ways it only tries to save the few who already are saved. It is available on a curious net-site of the European Commission, available only to the extremely dedicated.

Conclusion

The Italian S&T system differs from other European S&T systems in several ways. Italy has a considerable regional divide between North and South, has a thoroughly bureaucratic and poorly coordinated central organization of S&T policy, spends a relatively low proportion of BNP on R&D, and is a net importer of technology. In spite of this, some of the Northern clusters, notably around Milan and around Modena, are competitive industrial regions with considerable international success. However, little is due to centralized efforts. Rather, it could be attributed to cultural features as well as innovative municipal and semi public efforts.

Innovation is a cultural phenomenon, and can only partly be explained by the attention given to this issue by the state. Thus, Italy's late

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[14] **Feil! Bokmerket er ikke definert.**
[15] **Feil! Bokmerket er ikke definert.**

industrialization is only one reason why real innovation is low in Italian industry. The importation and integration of technological solutions from abroad is an another important feature.

Tracing technology policy in Italy is a bit like archeology. You need to excavate carefully, and study the few artifacts you find. There is a deep concern over a certain "cultural deficit" in Italian society with respect to technology. Making technology a common concern to the population at large is at present extremely important to Italian S&T policy. This is, however, an aspiration that cuts across several ministries, and would need national attention. There is hope that the new Ministry of research, the MURST, will improve central measures significantly. However, at present the overall system is considerably weaker than other Western countries.

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