Goals conflict and goal alignment in science, technology and innovation policy discourse

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Abstract

Discursive frameworks for science, technology and innovation (STI) policy often emphasize novelty, transition and change. Many of these conceptual models have become influential in recent STI policy discourse by framing fundamental changes in terms of shifting relationships between "science" and "society" (and/or the "economy"), focusing most often on issues of relative distance/integration and responsiveness. This paper addresses aspects of the discourse of fundamental change and novelty in STI policy that are virtually absent from science/society (economy) frameworks: changes that may be described in terms of re-articulation or shifting configurations in the relationship between main ("horizontal") policy goals, viz. social objectives (welfare, equality); economic objectives (growth, competitiveness); security; sustainability. By reference to key passages in some OECD reports that are well-established as particularly central in the history of STI policy discourse, we seek to provide evidence that re-articulations of the relationships – conflicts, complementarities, alignments etc – between overall objectives and goals have played a key role in the (re)framing of overall STI policy frameworks at junctures in the history of STI policy.

Frames and paradigms in STI policy discourse

A cursory view on the analytical literature on contemporary STI policy discourse, indicates the pervasive presence of a number of somewhat different, sometimes competing, but often overlapping and combined, conceptual frameworks, often identified by some catchy term and conceptual opposition: "new mode of knowledge production", "knowledge economy", "systems of [or: systemic] innovation", Triple Helix/"entrepreneurial universities"; and many others. These discourses are articulated to emphasize the descriptive salience and/or normative importance of *change, transition and novelty* in the nature of contemporary science, technology and innovation as well as in their social, economic and political conditions, and, hence, in the policies that need to conform to these developments to be appropriate and effective. To emphasize the radical or fundamental nature of changes and shifts involved, the transition from "old" to "new" frameworks is often described in the terms of "paradigms" and "paradigm shift", drawing on the Kuhnian concept of paradigm and its application in policy analysis (Hall, 1993; Biegelbauer, 2003).

An additional feature of these discourses is that, while they often appear in the guise of analytical meta-accounts of STI (policy) developments, they have also been taken up in, or even been developed as part of, STI policy discourse itself. They not only describe, but also exert influence on STI policy discourse and developments – some more, and more explicitly, than others. Hence, to understand the role and nature of these terms and frameworks is as much about capturing their performative nature and illocutionary impact as it is to assess their analytical accuracy.

Many or most of these discourses are predicated on a fundamental binary conceptual opposition between "science and society" (or more often: the economy), as also framed in terms of production vs application of knowledge, supply vs demand of knowledge, quality vs relevance etc – framing the key challenges facing STI policy in terms of distance and

separation, or – inversely – integration, coordination, alignment etc between the entities of these oppositions. They concern what we will call the vertical, *integrative* dimension of general STI policy: how to set the appropriate level of integration and alignment between producers and users of knowledge to optimize the rate of research-driven or -based change and innovation in society and the economy.

The past 20 years have seen one set of discourses gain influence and, arguably, hegemony in mainstream STI policy discourse: that in which the term and concept of "innovation" form part of the core. The emergence and uptake of the notion of "systems of innovation" in STI policy discourse, as well as the development of innovation indicators, particularly at the firm level (innovation surveys, Oslo manual) has in particular extended and shaped the language and domain of S&T policy. While the term and notion may be seen to have been shaped by academic research, its development and use has, as in particular Reijo Miettinen has showed for Finland (Miettinen, 2002) taken place in collusion with policy actors, and in synergy with policy developments. Of course, the innovation term predates the emergence in the late 1980s of the "systems of innovations" frameworks of STI policy (Godin, 2008). It was pervasively used in STI policy discourse from as early as the 1960s, but it is by being qualified as "systemic" and taken up as official OECD ideology, that the discourse of innovation as we now know it emerged as dominant STI policy framework from the late 80s and early 90s. It belongs firmly within the integrative dimension of STI policy, providing a solution to challenges of effective application of knowledge: it redresses the R&D-biased "linear model of innovation", it emphasizes the key role in effective innovation of interaction, integration and co-determination of a wide set of complementary actors, resources and conditions respectively, and it shifts focus from the producers of knowledge, i.e., researchers and R&D institutions, to its users, i.e., industry. The firm, rather than, the researcher is the center locus of the system.

However, an additional aspect of the "systems of innovation" framework is that it also brings up issues pertaining to another key dimension of general STI policy, i.a., what we will call its *horizontal* dimension. That dimension has to do with the comprehensive cross-sectoral and multi-objective scope of STI policy: STI should be mobilized in all societal domains, to promote all and any societal goals and values. *Prima facie*, the "systems of innovation" framework that has shaped and been dominant in STI policy discourse during the last 15-20 years has arguably been developed primarily, often exclusively, with economic policy objectives in mind: the innovating firm is the primary actor [1], the primary or immediate objective of policy is to enhance the competitiveness of firms in an increasingly competitive economy, and to sustain high growth and productivity of the regional and/or the national economy.

However, a change in the language of STI policy seems to be taking place, most clearly in the quick emergence in STI policy discourse, particularly that of the OECD and the EU, of the term "challenges" – sometimes specified as grand challenges, or as social challenges, or global challenges. It is a noteworthy general feature of these discourses that economic

[1] "The innovating firm is the primary focus of innovation policy", OECD, 2005: 37.

objectives and the well-being and viability of innovate firms are not presented as *prima facie* primary objectives (if they are definitely underlying or secondary objectives: while governments and policy must in pro-active and directive, rather than facilitative, roles in addressing such "challenges", there is also salient concerns in this discourse with the creation of "business opportunities").

This raises the issue of how this "system of innovation" framework articulates the relationship between economic and other objectives that STI policy is supposed to promote, and how ongoing changes may imply that these relationships may be under some form and degree of re-articulation at a potentially fundamental level. This is our aim in this paper: to characterize main STI policy frameworks or "paradigms" in terms of changes in the horizontal, *goal* dimension of STI policy, where the analytical literature and policy debate about paradigms, shifts and transitions in STI policy have most often been defined in the terms of the vertical dimension, as changes in the forms and degrees of integration, responsiveness and cooperative alignment between "science" and "society" (the economy). [2] We think that it is necessary to bring to the fore the role of this dimension in STI policy in order to conceptualize contemporary changes in STI policy in terms of (*possible*) shifts in overall policy frameworks, and to phrase hypotheses about whether or to what extent it is change of a radical ("paradigm") kind that is actually at stake in the perceptible contemporary changes in language and vocabulary of STI policy.

Vertical and horizontal dimensions of STI policy

Let us start with a brief outline of the way the vertical and horizontal dimensions may be seen to define and circumscribe the *general* domain of STI policy. One may argue that modern, i.e., post WW II science – and, in the final analysis, STI – policy was constituted as the separate, *sui generis* policy that it has become during this period by the emergence of the notion of a *general* ("national") policy. This "national" policy for science should supersede the *particularistic* type of science policy(-ies), consisting of a disjointed multitude of unconnected science policies within various policy domains, to promote the particular purposes and goals of that domain separately. It is in this respect that the 1945 report "Science – the Endless Frontier" may be seen to have coined the *new* notion of science policy that opened up for or facilitated ulterior developments. The report was commissioned to develop the perception and idea that the notable successes of mobilizing science and technology during the war could be extended to civil purposes (NSF, 1945). [i] [3] The experiences of one particular policy for science – for defense and war-making purposes – should be generalized and transferred to other, in principle *all*, societal domains and objectives, giving rise to the notion of what the report calls "*national* science policy" [ii]. Hence, it is by defining its

[2] One notable exception is Elzinga & Jamison, 1995, where the horizontal goal dimension is captured in terms of the shifting power relationships in STI policy between four distinct policy cultures which in their account (partly) explain the shifts of STI policy "paradigms".

[3] Notes i – xvii are endnotes with quotes of key passages from the reports analyzed

comprehensive, cross-sectoral scope that science policy may carve out a separate domain of its own within the structure of government policies and institutions. [iii]

Hence, the ”separateness” of science policy is the outcome of the movement by which science policy defines its overall objective and “mission” – to serve all and any societal sector and objective – and should thus be seen and managed as a general *national resource* on those terms. From this emerges a host of new concepts and practices to deal with “research” as one unitary object and resource: the notion of the (national) “research system”, new symbolical (statistical) household practices by which it becomes possible to account for and manage national R&D resources under one coherent overall perspective, and thus make research amenable to political monitoring, assessment and intervention. To complement the new “object” – the research system, national R&D resources – of the new policy, new (institutional) “subjects” are created to monitor (advisory science policy bodies), intervene on (science ministers) and channel resources (research councils) to the new domain/”object”.

This emphasises the co-origin and complementarity of, on the one hand, the so often deplored “separateness” of science policy, and, on the other hand, the core idea, project and “mission” of modern science policy that science (and science policy) should be funded and managed in view of its potential to effectively promote societal goals, serve political objectives and become integrated in all societal domains and policies. The criticism of science policy as (too) separate, set too far apart from society, from (the agents of) applications and innovations, is a self-criticism built into the very concept of modern science policy by the idea that science policy is both “policy for science” and (policy for) “science in policy” in one. [iv] [v] Thus, the criticism of science policy as too narrowly focused on “policy for science” issues and underdeveloped along the integrative, “science in policy” dimension is an integral, standard figure of general STI policy discourse, and one that surfaces quite early in its history. [vi]

While the basis of the self-perception and -criticism of STI policy as incompletely developed along the vertical dimension is inherent in the original notion of science policy as (policy for) “science in policy”, a parallel self-perception and –criticism follows from the idea that it should address and serve all goals and societal domains on an equal footing: that science policy faces *imbalances*: the provision of research resources and the integration of science into policies is at any particular point in time uneven and imbalanced between the various goals and domains that science should and could serve. Thus, a fundamental idea is built into the concept of STI policy, potentially seeking to redress any form of particularistic bias and imbalance that impedes the optimal distribution of research effort.

Despite the idea of generalizing and transferring experiences from the military to civilian domains, the development of science and science policy remained firmly linked to the military for decades after the end of WW II. The imbalance in R&D expenditure between military and civilian (social and economic) purposes was a core idea that sustained the OECD initiative to make member countries more aware of the potential of science to promote

economic growth and social welfare. [4] The observation and criticism of the skewed distribution of R&D resources in favor of military (and prestige, i.e., space) objectives form key parts of OECD discourse from early on. [vii] However, the early OECD approach was developed in explicit awareness of the particularistic nature of *its own* initiative to promote science. This awareness can hardly be seen to be reflected as clearly in OECD discourse since at least the late 1970s. At an early stage, i.e., the early 1960s, the distinction is explicitly made between the "two streams" of "science in the context of the OECD" and "science policy in general" (OECD, 1965: 30), between policy for "science and economic growth", and "science policy *per se*". [viii]

One finds at this stage several reflections on the classification of main objectives that science policy should serve. Defense and prestige are sometimes listed as separate, sometimes as linked (as part of "political objectives"), social ("welfare") objectives are defined as a set of objectives of its own, distinct from economic objectives, while "science for its own sake" is also listed as a separate objective of science policy, but is, in the OECD context, most often seen as of marginal importance in overall science policy. [5]

These explicit distinctions between overall objectives of STI policy notwithstanding, and despite one singular OECD report (OECD, 1971) (see section 4 below), there is hardly much doubt about the adherence of official OECD discourse to the "science and the economy" stream of STI policy. In this discourse, with the one exception mentioned, the primacy of economic objectives and the quasi-conflation of economic and social objectives are sometimes implicit, taken for granted, sometimes argued explicitly.

Frame I – Confluence of social and economic policy objectives

We find an explicit discussion of the relationship between social and economic objectives of science and technology policy in the initial and seminal OECD report from 1963 (OECD, 1963) on the overall structure and tasks of science policy. As the then OEEC took initiatives towards the end of the 1950s to strengthen the role of policies for the support of science in economic policy of its member countries, the role of R&D was justified in terms of economic theory, as a core part of the "third factor", alongside labour and capital that determines the rate of economic productivity. As an organisation for economic collaboration, the OECD saw it as its primary task to expand the role of science and technology for economic development, often phrased in strong criticism of the imbalanced and sub-optimal distribution of national science and technology resources between economic and social objectives on the hand, and, defence and prestige (space) objectives on the other. As the OECD developed the general template for national science policy it strongly advised its member states to adopt, this was a policy for "science in *economic* policy".

However, the development within the OECD of the new policy framework for science to further economic growth in particular takes place in an ambiguous recognition that economic

[4] As, i.a., reflected in the statistical classification of national R&D expenditure, where the distinction between defence and non-defence or civil objectives plays a key role.
[5] See e.g., the presentations/chapters by Freeman and Spaey in OECD, 1967.

development may both be seen as a *particular* domain for which a policy to support, integrate and exploit science should be developed, and on the other, economic development and growth of welfare benefits as a placeholder of, as encompassing all and any (significant) form of societal benefits to be derived from the support of and utilisation of science and technology.

Even so, the debates that took place within the OECD at the time when the Pigagniol report was produced and discussed, reflected awareness that science policy is policy for the mobilisation of science to promote social development in society in general, and not economic growth only. In key documents from that process (including in particular OECD, 1965), it was repeatedly emphasised that industrial development and economic policy is, despite their key role in social development, but some of the sectors and policy areas in which science and technology may contribute to growth, welfare and progress. While the OECD is obviously more than anything else committed to the role of science for economic growth and industrial development, it is also recognised that "science policy *per se*" is wider in scope than policies for "the relation of science to economic growth" (see endnote viii).

However, while this distinction is explicitly made in the minutes from discussions in the Ministerial Meeting, it is not generally strongly emphasised, and appears more as a analytical distinction in principle, with few material implications for actual STI policy. The Piganiol report touches itself upon the issue, but then as a distinction between economic objectives in a narrow and broad sense respectively, and where the latter is seen as more or less a synonym for social development in general. [ix]

Thus, within the broad view on economic policy, social and economic objectives may for all practical purposes and intents be seen to coincide or coalesce. At the time, it was hardly controversial to assume that economic growth was the essential and main pre-condition for meeting most or all social and economic challenges facing the post-war Western societies. Thus, technological development and economic growth were essential to achieve any form of welfare and "quality of life", and economic policy could be the comprehensive *pars pro toto* type policy, holding the key to all effective instruments for growth, progress and social development. Hence, while the distinction between science policy *per se* and policies concerning science's relation with the economy indicates that the two are not co-extensive, nor necessarily always compatible, these differences and potential incompatibilities remained at this time largely latent.

Frame II – Difference and opposition of social and economic objectives – "the social priorities paradigm"

The relationship between economic and social policy objectives was, however, turned on its head a few years later when another OECD report on the general framework of science policy was published (OECD, 1971). The committee preparing the report was asked to re-assess and re-articulate the general framework of science policy, which had become increasingly incommensurate with the emergent political realities of the late 1960s. This so-called Brooks report took its point of departure from the mounting public disenchantment with the growth policies from which science and technology had up till then benefited immensely. With the erosion of general political and public support for these policies, the political foundation of

policies for science and technology would have to be re-assessed, overhauled and re-articulated. A framework for ‘a new type of science policy’ (OECD, 1971: 12) would have to be developed, to take fully into account the new social, political and economic conditions that had emerged towards the end of the 1960s. What had foundered was in particular what was now perceived as the single-minded focus in general policy as well as in STI policy in particular on economic growth objectives alone. The report starts from a quote from a OECD Council communiqué in 1970:

> *”Ministers stressed that growth is not an end in itself, but rather an instrument for creating better conditions of life. Increased attention must be given to the qualitative aspects of growth and to the formulation of policies with respect to the broad economic and social choices involved in the allocation of resources (OECD, 1971: 25)*

This simple statement marks, if pleonastic in appearance, no less than ‘both the end of one era and the faltering start of another’ (ibid), indicating the gap and conflicts which had opened up between policies for economic growth and policies for the broader set of goals and values of social development. The dominant policies for economic growth had been phrased too narrowly in terms of quantitative growth of material benefits alone, and would now have to be completely rephrased, not because they had failed, but because of the side-effects of their immense success. The industrialised countries had achieved ”high levels of economic achievements based on technological advances” (p. 11), but if these achievements have ”produced widespread prosperity… they have also altered man’s environment and his working conditions, thus leading to what may be regarded as a deterioration of the quality of life, especially in the cities” (p. 11). Fundamental social needs and political goals have not only been neglected and incompletely fulfilled through the economic growth of the 1950s and 1960s, but also suffered the deleterious effects of policies myopically concerned with growth only; ”the recent emphasis on protection of the natural environment and the quality of life are good examples of such goals” (p. 12). What defines the emergent new era, is thus that ”[f]aith in economic growth has been replaced by a feeling of unease in the face of the prospects opened up by it and has been shown to be insufficient in itself to respond to the aspirations of mankind for a better way of life” (s. 26).

Thus, the Brooks report not only avoided the conflation of economic and social objectives, it starts from the very disruption of this unity, from the observation that differences, gaps and conflicts between social and economic goals have emerged, as economic growth policies have too long remained blind to its negative externalities and neglected objectives which cannot adequately be achieved through or captured by narrow ‘National Gross Product‘ terms. Thus, the framework of science policy needs to extend its scope to include a much broader and more multifarious set of social objectives and sectors, emphasizing the particularistic character of policies predicated on economic growth objectives only. Thus, the reformulation of the task of science policy to broaden its scope of include all social objectives and sectors, is made in a context where the move beyond the hegemony of military and space objectives, at the detriment of ‘social and economic development’, has to take into account the perceived economic objectives – narrowly defined – and social objectives are both different, often opposite and sometimes contradictory.

While this is phrased in terms of a fundamental reassessment of the framework of science policy, it draws on the idea and ideals inherent in the notion of a national, generalised science policy: to realise the full potential of science for contributing development in *all* societal domains and policy areas. Such criticisms of 'real' science policy in terms of imbalances in the distribution of the national research effort in the first-generation science policies of the immediate post WWII period, had underpinned – and still do so – criticism by, mostly, economists, that the particularistic hegemony of defence and space objectives in science policy is at the detriment of optimal exploitation of science and technology for civic, 'social and economic' purposes. In this second round of criticism and re-assessment of established science policy, it targets the particularistic imbalances of hegemonic economic growth policies themselves. Hence, the turn to the "social priorities" regime which the Brooks report advocated, represents a next step in science policy's realization of its imperative to realise its full societal potential: "In many countries, science policies have tended to neglect the potential use of science in many sectoral activities." (p. 94) Lack of customized science policies for services in general and public services in particular are but some of the effects of imbalances in previous incarnations of science policy. Now, new domains and objectives neglected in growth policies will have to be incorporated in science policy, in order to be addressed in their own right, and not only as *a priori* and *eo ipso* congruent with economic objectives.

Frame III - Re-economisation of STI policy – "the innovation framework"

The impacts of the Brooks seem to have been relatively short-lived, in particular in OECD discourse, if it does provide a conceptual framework that can be seen to sustain and capture subsequent developments by which national science (or research, or R&D) policies expanded to encompass new policy objectives, new societal sectors, and new governmental departments. The social, political and economic conditions for pursuing STI policies according to social priorities paradigm were, however, soon seen to become undermined by fundamental problems in the economies of developed countries – energy crisis, slowing productivity growth, stagflation. The golden age of these Western economies had already passed, calling for a re-assertion of policy responsiveness to the iron laws of economic productivity. This shift in perceptions about the pressing policy needs to redress the structural flaws of Western economies marks the beginning of modern innovation policy as a framework within which we have since been thinking about science, technology and innovation for economic growth and competitiveness. Some aspects of that shift may be reconstructed from another OECD report, published in 1980, the so-called 'Delapalme report' (OECD, 1980).

Its point of departure is the recognition that the economies of OECD countries were facing *structural* problems, as the strong productivity increase and the economic growth up till the early 1970s had levelled off; the rate of technical change had declined, particularly in the service and public sectors, which had become an increasingly large part of the economy, and had hence become the cause of increasing inflationary pressures. Given the structural nature of the problem, policies are required to increase both the supply and demand for technological

innovations, and thus to increase the rate of technical change, particularly in sectors with low rates of innovation.

This marks in fact a remarkable and very specific re-articulation of the relationship between economic and social objectives as policy objectives for STI policy. Elements that were strongly focussed in this report, and which will remain core parts of subsequent conceptions of innovation policy, are the primacy of economic growth objectives, the notion that science-based technologies are privileged sources of technological change and innovation, the emphasis on the need to integrate more closely STI and economic policies, stronger coordination and alignment between innovation/economic and other policies and policy areas (p. 96). These assumptions will later underpin, in somewhat shifting configurations and emphases, the conceptions of '(national) systems of innovation' and 'the horizontal integration of innovation policy'.

The early 1980s is often identified as the time when a major shift took place in science policy, often described as a shift from "R&D" to technology, and later innovation, policy. From our reading of the Delapalme report, we relate this shift to the emergence of a new conception of the role of economic objectives in science or R&D policy, following from the acknowledgment of the *fragility* of the dynamics that underpins productivity growth through a high, sustained rate of technical change. As long as this dynamics seemed to work to satisfaction "by itself", as long as sufficient resources were allocated to R&D, economic and social objectives could coexist on an equal basis. But as the underpinning of previous growth policies were falling apart, new priority issues emerged.

The Delapalme report links explicitly to the Brooks report, presenting itself as a report that addresses the problems of STI policy on the same fundamental and epochal level as the Brooks report did. [x] Both reports re-assessed the overall framework of science policy at the time when fundamental incongruities between this framework and new social, political and economic realities had become evident. While the Brooks report phrased the economic growth problem in terms of the increasing tensions between narrowly economic goals and broader social values and aspirations that had to be redressed and balanced, the core problem of the Delapalme Report is how to deal with the 'slow-down of world economic growth' as caused by deep-seated structural problems in the economies of OECD. While the Brooks report reflected the general reorientation towards "social objectives" in the science policies of OECD countries at the turn of the previous decade [xi], and while "there is much in [the Brooks] report which remains valid today and to which we would still subscribe" (s. 11), the Delapalme group finds that the situation has changed fundamentally in three main respects: the "problem of the world energy supplies, the changing role of the developing countries and the slow-down of world economic growth with its concomitant threat to employment" (p. 11). From this new vantage point, the science policy outlined in the Brooks report now appears as utopian, based on assumptions that had been invalidated with the economic slow-down in the years that followed its publication: "[i]t was as though there were in such expectations [as phrased in the Brooks report] the image of a promised land which we were gradually approaching" (p. 14). In between the Brooks and the Delapalme reports lie experiences that have shattered the assumptions that underpinned the "social priorities" conception of science

policy, experiences that mark the unexpected eruption of a new and much harsher reality: “the calm waters still to be crossed were suddenly shaken by a storm” (p. 14).

Among these disruptive experiences, the report focuses on the structural causes of the economic slowdown only, since this is the one issue among the three listed that ‘cannot be solved without taking into account policies for science and technology”. This is also the only thing new since the Brooks report: “We have addressed ourselves to the third of these issues, namely the slowdown in economic growth, believing that here we had something new to say since the ‘Brooks Report’” (s. 11) [xii]. Thus, while the Brooks report envisaged a science policy less dominated by economic growth objectives, more capable of sustaining a wider and more heterogeneous set of social objectives, the Delapalme report re-asserts the primacy of economic growth objectives, and in particular the necessity to design science policies that may “increase the rate of technical change”, upon which sustained productivity growth depends. If the Delapalme report subscribes to “almost everything” in the Brooks, it departs from it on one point, and that single point changes everything.

The diagnosis proposed by the Delapalme report is optimistic in its confidence about the availability of new technological opportunities, as well as about the prospects for creating a reinvigorated scientific and technological basis for sustained productivity growth. A supply oriented technology policy may counter the tendency that “part of the stock of innovations that are easy to apply have shrunk” (OECD, 1980: 77). The potential of some *generic* technologies are in particular emphasized: “Not only in the obvious fields of micro-electronics, communication and information systems, but in other areas too, such as biotechnologies, energy technologies, and materials technology, there is continuing scope for rapid technical advance” (p. 93). As technologies that are generic in scope, they are seen to create a wide range of new opportunities for the pervasive and radical kind of innovations that may sustain the ‘reindustrialization’ and ‘industrial restructuring’ (p. 62) required for bringing these economies back on the track of high productivity and sustained growth. Since that time, these technologies in particular have played a key role in the framing of policies for science and technology, forming the core of the supply side of the new policies to increase the rate of technical change and productivity throughout the economy.

However, the problems lie not only on the *supply* side. Issues also need to be addressed on the “demand side”, issues that are even more complex and difficult, viz. issues which concern the capacity of society to realise the potential of science and technology’, i.e., “to translate knowledge into commercial products”: “The most intractable problems lie not in the potential of science and technology, but rather in the capacity of our economic systems to make satisfactory use of such opportunities” (ibid). This indicates that policies need to extend beyond its traditional focus with “R&D”, to become less science and R&D-biased than in earlier phases of STI policy; it would even need to extend its scope beyond *technology* policy which came to characterise subsequent policies during the 1980s, a core or even main ingredient of which was their support of generic technologies. Technology policy would have to, and soon did, become *innovation* policy.

Thus, the Delapalme report lays the broad outline of a policy framework which would successively incorporate an increasingly large number of forms and determinants of innovation, which will subsequently be articulated in the terms of *innovation* policy. Innovation policy is less confident than traditional R&D and STI policy that R&D capacity, the production of scientific knowledge and technological opportunities will readily and more or less in and of itself translate into innovations in the form of successful commercial products in the market. Hence, innovation policy differs from R&D and technology policy in, i.a., its stronger emphasis on distributive (transfer, diffusion) and absorbtive capacity (application).

The return to economic growth as the core concern of science and technology policy, is, then, not a return to narrowly phrased policies concerned with economic growth alone. While economic growth has become *the* core concern of STI policy, this issue has to be addressed in structural terms, encompassing a large range of conditions and constraints: The new policies needed must acknowledge from their inception that "the changes which constitutes the new context, and the relations between them, are so vast and far-reaching that they can neither be reduced to their strictly economic aspects nor explained in purely conjunctural terms" (s. 14)

At this point, however, the Delapalme report frames the challenge of innovation policy at an even more fundamental level: it is not only about the sustained creation of technological opportunity, or the capability of firms to produce new and/or improved/cheaper products in the market; it is also about *social acceptance*: this is where "society" emerges as actor (or: actant) in the narrative of STI policy, seen as conducive or "environment for technical change and innovation". These passages make it unique among the numerous OECD reports to be published over the next 25 years on science and innovation policy, including reports from the TEP/TIP projects, the "growth project", 'national innovation system", and reports on the 'knowledge-based economy'. While many of the key ingredients of later conceptions of innovation policy advocated by the OECD – including the primacy of innovation over science and technology policy, the 'systemic' nature and horizontal scope of innovation policy, the importance of innovation in services and the public sector – these later reports hardly address head on the issue of social acceptance and legitimacy of STI policies. Here as in the later reports, it is emphasized that STI policies should sustain scientific research and enhance technical change through provision of sufficient resources, appropriate incentives and generally conducive conditions. But while these later reports have explored and expanded in much detail the relationships between the production of scientific-technological opportunities on the one hand and their application, i.e., innovation, on the other, this early report notes that: "Even more paralysing [than lack of resources, lack of incentives, and the burden of disincentives] can be the rigidity of social institutions, which may maintain a framework in which it is virtually impossible to take advantage of the potential of science and technology" (ibid). Hence, the scope of science and innovation becomes extremely wide, as it is realized that the successful implementation of policies to increase the rate of technical change is that *society itself* needs to be changed in terms of its role as environment which may impinge negatively or positively on technical change: "In many areas, accompanying social changes may be a necessary condition for the effective applications of technology" (ibid). Thus, the policies advocated are predicated on the assumption that "when society provides an

environment appropriate to the encouragement and adaptation of technical change, there is vast potential for new useful technologies and related scientific activities" (ibid: 93-94). [6]

This does seem, despite the disclaimer (p. 103), to be a policy for which technical change or innovation have apparently become 'an end in itself', forming the core and highest priority of a policy whose major concern is how to resolve most effectively the structural problems of declining economic productivity. While, however, the imperative to increase the rate of technical change is derived from a structural necessity, it must nevertheless be, as objective for policy, implemented within the democratic process, in accordance with the rules and rhetorics of democracy. Hence, large parts of the report focus on how it may be possible to create a "widespread social sanction and commitment" (ibid: 103) to policies to increase the rate of technical change, acknowledging that a large part of the 'new social values and aspirations' – increasing demand for public services, higher standards of environmental protection, heightened expectations on work security and quality, and emergent risk-averse attitudes and anti-technological sentiments – work against such policies. A policy for technical change must, in our democratic societies, "find its ultimate legitimation and political support in a high degree of correspondence with the aspirations and decisions of the populations of our countries" (p. 103). As, however, there can be no pre-established harmony between the policy objectives of STI policy and the immediate aspirations of the public, it is part of STI policy itself to try to minimize that gap through information, education and open public debate. While this process must take place in accordance with democratic standards of openness, truthfulness and wide public participation, it is pervasively assumed that it is a process of aligning public perceptions about their real, long-term interests with the 'necessities' of innovation policy, making people understand the 'real stakes' of and accept the need for a high rate of technical change. A *democratic* discourse, emphasizing open debate, public participation and correspondence between public aspirations and innovation policy objectives, is – often in the same sentence – overlain and combined with an educational discourse about convincing people about 'necessities' that really is or should be outside the scope of democratic deliberation and decision:

> *"[E]ducation and information policies are necessary to assist those affected by technical change to choose between what is necessary and what is desirable, the importance of the stakes at issue, and the alternative options being clearly put forward without reserve or ulterior motive. In this regard truly democratic participation is the only guarantee for our societies to overcome the resistance (sic) inevitably generated by the technical changes upon which their survival depends" (ibid: 105).*

This report may thus be seen as the "epochal" OECD report which aims to articulate the 'paradigm shift' in science and innovation policy of the late 1970s, in explicit opposition to the "social priorities paradigm" of the Brooks report. As we have seen, this report puts in place many elements on which much mainstream, contemporary STI policy still build: the primacy of economic imperatives and growth objectives, the role of science-based technologies as privileged sources of technological change and innovation, the need to integrate more closely science, technology and economic policies, stronger coordination and

[6] The notion re-appears pervasively in recent EUD innovation policy reports with the term "innovation-friendly society".

alignment between innovation/economic and other policies and policy areas, (p. 96). These assumption will later be developed and re-phrased in the terms of, in particular, 'systems of innovation' and 'horizontal integration of innovation policy'. It is however also a text which explicitly addresses ambiguities and tensions at the core of policies that are framed to encompass the dual, potentially contradictory requirements, that follow from at the same time responding and adapting to structural, necessities in the economy *and* comply with public needs and perceptions, as well as with rules of democratic priority-setting. This issue is either totally eclipsed in virtually all subsequent innovation policy documents, or addressed in terms which indicate that – in the words of another contemporary OECD report from the turn of the same decade – "the objective of information, dialogue and consultation is to alleviate the fears of the consequences of technological changes which are 'essential' and 'inevitable'", rather than to "reach[…] a social consensus upon the desirability of particular changes and on the direction which change should take" (OECD, 1981: 57).

The Delapalme report may be seen to provide the general outline of an approach to STI policy that indicates the general direction of ulterior developments in STI policy, characterised by an increasing focus on economic objectives, in particular on the competitiveness of firms and economies and on the wider social and political conditions for translating technological progress into commercial commodities and services. Many elements have been added and changed during the more than two decades that the "paradigm" of re-economized STI policy has prevailed. The notion of "innovation policy" and of "systems of innovation" arguably go far beyond any element explicitly introduced and discussed in that report, but many of those elements point towards them, and the novelties ands changes have deepened and extended the "innovation for growth and competitiveness" approach. Within the line of major OECD reports, this may be seen in, i.a., the Sundqvist report (OECD, 1990), which in particular emphasized even more strongly the social character and determinants of innovation, while also retaining the strong emphasis on some key, generic or pervasive technologies, in particular ICT. In emphasizing the social nature of innovation, the Sundqvist report also revisits the issue addressed in the Brooks and Delapalme reports on the role of the democratic process and the importance of ensuring that distributional objectives are met beyond what can be achieved through the market alone. [xiii] It can be seen in the first TIP/TEP report (OECD, 1991), which under the heading "new rules of the game" added in particular the increasingly global nature of the economy ("techno-globalism"), including the rapidly increasing role of MNCs, and the anti-neo-classicist point that the innovativity of economies of depends essentially on "the cumulative, increasing-return features of technological advance in many areas" (p. 127).

Issues of g*overnance*, i.e., the implications on the policy level of the systemic nature and determinants of innovation, remained largely in the background in these reports, but became increasingly thematized towards the end of the 1990s, with in particular the "Managing Innovation Systems" report (1999), the analytical precursor to the "Dynamising National Innovation Systems" report (2003). The latter articulates a firm-centered (p. 19) systems approach to innovation policy at the governmental level, emphasizing the need that follows from the establishment of innovation policy as a policy in its own right, to enhance co-

ordination of sector policies in terms of how they impinge in the innovative capacity of firms, and take more explicitly into account "the possible interaction of [innovation policy actions] with policies pursuing other primary objectives" (p. 71). Hence, it calls for "comprehensive, coherent and customized" (ibid) innovation policies, providing criteria for assessing national political systems' capabilities to deal with crosscutting policy issues in terms of how they promote or hamper the innovative capacity and performance of firms and clusters as well as regional and national economies ("innovation systems").

Frame IV? - A "new" paradigm through horizontal policy integration?

It may seem as a paradox that while major OECD reports start from the late 1990s on to address more explicitly "governance" implications of the "systems of innovations" conception, they indicate decreasing sensitivity to the democratic dilemmas raised by the development and implementation of innovation policy, i.a. in terms of potential conflicts between innovation policy objectives and such issues as social acceptance and (re)distributional equity that were at the core of the Brooks report and were, at least to some extent, taken explicitly into account in the Delapalme and Sundqvist reports. The suppression of *the political* in innovation policy has been a core feature of the concept of policy and governance that has emerged from the concept of systemic innovation.

However, the emergent "return of the repressed" can be detected in a subsequent OECD report (OECD, 2005). It brings together results from a project – the MONIT project – which was set up to develop further lessons for governments in developing effective, comprehensive and coherent cross-cutting ("horizontal") innovation policies.

By articulating the challenge facing the development of integrated, horizontal policies by comparing and confronting *two* policies that are both horizontal in nature and both lay claim to strong influence in, or over, sectoral policies – innovation and environmental policy, the challenge of developing "integrated horizontal policies" moves beyond that of aligning single-sectoral and horizontal policies and policy objectives, to become an issue of how to align and reconcile two different and often opposing *horizontal* policies and policy objectives. The MONIT report explicitly recognizes that the core "imperatives" of these two policies differ,[xiv] and also make observations about the possibilities of conflict between innovation (for growth) policy objectives on the one hand and social or distributional policy objectives on the other [xv].

Thus, the explication in the MONIT report of the notion of comprehensive, horizontal policy led to explicit recognition that innovation policy is but one of several horizontal policies, that its policy objectives are not only essentially different from the others and often in conflict with them, and also that these policies are most often, and essentially, *inextricably entangled*. Hence, developing such policies involves extensive efforts of reconciliation, alignment and integration, that often, and for essential reasons, *fail*, and where even "success" involves wide margins for solutions that are imperfect, the result of compromise, developed under conditions where one set of objectives dominates the other(s), etc.

Dealing with conflicts may require the application of various strategies of reconciliation, alignment and/or integration. One is disentanglement, as seen in OECD notion of *de-coupling*

economic growth from environmental degradation. Another may be (seamless) *integration*, as seen in many references to "win-win solutions", including in the MONIT report, by which growth and environmental policies become mutually supportive. This is, from the environmental policy side, also conceptualized as *re-coupling*, in line with the eco-modernist notion of sustainable development.

The relevance of these reflections on the tension between STI policies predicated on economic objectives alone, and ones aiming to encompass and integrate both economic, environmental and social objectives may be brought out by some observation on EU research and innovation policies in the wake of the 2000 Lisbon agenda. It may be seen to have both re-confirmed and channeled the innovation policy framework: it framed its ambitious agenda to "create the most dynamic knowledge-based economy in the world", but did so by framing a broad multi-objective, "balanced" policy by which the objectives of growth and competitiveness should be aligned, combined and made compatible with social ("social cohesion", "the European social model") and environmental objectives ("sustainability"). Hence, the Lisbon agenda is explicitly a "multi-objective" agenda, where three overall policy objectives should be pursued. Hence, it is a framework within which the general conditions could have been in place for the framing of STI policy agenda. It also envisages, in principle, the possibility that social and economic objectives may be reconciled and aligned. Thus, the "eco-modernist" or "sustainable development" model of win-win policy is extended to encompass policy objectives that fall under the "social cohesion" category. [xvi]

However, European *STI* policy has almost exclusively been developed in response to the knowledge economy pillar of the Lisbon agenda – the economic objectives of competitiveness and growth in the knowledge-based global economy, while environmental and social cohesion objectives are pursued within other policy domains, the Gothenburg process and social policy respectively. By *inter alia* making the target of increasing gross national R&D investments (GERD) to 3% of GDP the main objective of its STI policy, the EU opted for a strongly economy-biased STI strategy. EU policy statements indicate pervasively that economic objectives prevail. [xvii]

The concept of innovation and the conception of innovation policy may thus remain an instrument for achieving economic policy objectives, and thus hold back, rather than encompass and stimulate, the policy innovation required and called for by the terms of the Lisbon agenda and its call for a "balanced", "social model" of policy for innovation, development and growth. The possibility of an integrated model of STI policy has, in the European debate, i.a., been addressed through debates on the "Nordic model", which – contrary to neo-liberalist dogmas and neo-classicist assumptions – have combined successfully a strong emphasis on social objectives (equality, social security, high welfare costs) with high economic growth, productivity and innovativity. The integrated model is indicated by arguments that the strong emphasis on social objectives is an *asset* and not a liability in (economic) innovation policy: these economies are innovative *because* of, not despite, the high priority in these societies accorded to social objectives.

Towards the end of the first decade of the 21st century change is again "in the air" in the discourse of STI policy. The terms *grand, global and/or social "challenges"* has gained salience in authoritative STI policy discourse, including and in particular, in EU and OECD discourse. This shift awaits its authoritative and comprehensive formulation [7], but a few references to less comprehensive and/or conclusive reports may indicate what may be involved.

The so-called "Rationale Group" set up in 2008 by the EUC to review the rationale of its ERA policy proposed to "focus continued effort on ERA by engaging with a series of Grand Challenges that capture the political and public imagination and connecting ERA with these challenges" (EU, 2008: 40). The rationales for European policy has focussed too much on deficit (Europe lags behind the US) and remedial measures (fragmentation and duplication of European research); a Grand Challenges approach may promise more success in terms of "captur[ing] the imagination of the research community and its stakeholders", and can "shift perceptions from deficit to opportunity" (ibid). Within this approach it is also "artificial to separate economic, social and environmental opportunities", if one can "for convenience of discussion [...] categorise them by their centre of gravity" (ibid). Thus it links ERA (and STI) policy to all three pillars of EU policy as framed by the Lisbon agenda. [8]

The terms has also to some extent entered OECD discourse, and work is underway to develop a new framework for promoting an active role for the OECD in the new approach to international collaboration required for "global challenges" be addressed effectively by STI. Its recently published "Innovation Strategy" (OECD, 2010) has, alongside the well-known "systems of innovations"-based policy observations and proposals, a separate and for OECD documents new type of chapter: "Addressing Global and Social Challenges through Innovation". No clear definition of the concept, nor a coherent framework for addressing them, are provided, but steps are taken to distinguish these new types of tasks for STI policy from the old. These challenges include the reduction of green gas emissions, developing and distributing new medicines for infectious diseases and dealing with issues of food security worldwide. They are "defined by the need to target essentially public goods (mitigation of climate change, health) or protect the global commons (the environment, the fisheries" (p. 165) – i.e., they address what we have in this analysis assigned to the domains of environmental and social policy objectives. They address "market failures" (p. 170) that originate in mismatches between (social) needs and (market) demand, rather than in the "sub-optimal private investments in R&D" type of market failure that looms large in conventional STI policy. The report also calls for a reassessment of the concept of innovation itself:

> *Traditional innovation concepts and models are inadequate for distinguishing socially driven innovation from profit-driven innovation. The small size and fragmentation for social goods also discourage firms from investing in and committing resources to these areas. This does not necessarily mean that socially and*

[7] E.g., in the type of major reports found in the history of OECD policy discourse.

[8] The uptake of the term in official policy statements is pervasive, see e.g. the July 2009 Lund Declaration (http://www.se2009.eu/en/meetings_news/2009/7/8/declaration_from_the_research_conference_in_lund_european_research_must_focus_on_the_grand_challenges)

economically oriented innovation at odds. They can in fact be complementary, but this will require changes to the way policy makers promote innovation, for example by involving stakeholders so as to link social demands with research agendas" (OECD, 2010: 182)

This may then, be seen to indicate a novel and as yet incompletely articulated STI policy agenda and framework. The core issue is, however, not quite new: it is, as we have tried to document, part of that particular vein of STI policy where it has, at important junctures in history, re-articulated its fundamental nature as a multi-objective, horizontal type of policy. How economic, social and environmental objectives are to be articulated and aligned remains one of its core issues, and it may be in this horizontal goal dimension (rather than the vertical "science/society"-dimension) that anything similar to a "paradigm shift" may presently be taking place.

Concluding remarks

The rhetorics of novelty, change and transition has been, and is, a salient part of contemporary STI policy discourse. It has also been used extensively at earlier junctures in the history of STI policy discourse. Issues concerning vertical science-society (economy) relationships – i.e., the autonomy and "separateness" of science and science policy vs its integration into - and participation in - society/the economy, cooperation and networks with use(r)s, applications, responsiveness to social and economic needs etc – has loomed large in this discourse. We have proposed, analyzing some key moments in the history of STI discourse, that such transitions and re-articulations of fundamental relationships in the general formation of STI policy also take place within its horizontal, goal dimension. We have in this (i.e., OECD) history of STI discourse reconstructed three different – and a possible fourth – "paradigms" or configurations as defined by how they articulate the relationship between economic and social policy objectives, here rephrased by paying some lip-service to the language of Hegelian dialectics:

- a first configuration defined by the *immediate* unity economic and social objectives (Piganiol report, early and mid-60s); this gives way to
- a second configuration where that unity *falls apart* into two different and (partly) opposite moments, and where the social (including environmental objectives) pole of the conceptual pair is defined as the dominant ("social priorities paradigm", Brooks report, late 60s and early 1970s); this configuration is displaced by
- a third configuration, which retains the difference and tension between the economic and social moments of the conceptual pair, but reverses the hierarchical order of the poles, and (re)defines economical objectives as primary and dominant. While extensive developments take place within that configuration over the two - three decades that this configuration remains hegemonic, its key elements based on the priority of economic objectives remains largely stable ("the innovation framework"; late 70s/early 80s to mid-2000s); however, a different discourse emerges within this configuration, indicating the possibility of
- a fourth framework, which envisages a *mediated unity* between economic and social objectives, where, however, environmental emerges as a distinct horizontal objective

of its own, providing with the notion of sustainable development a model for the win-win and mutually supportive type of policies envisaged within this framework.

We see some indications that the emergent "grand/social/global challenges" discourse that has emerged in the wake of the financial crisis during the late years of this decade seems to draw on elements from this framework: addressing such "challenges" requires extensive collaborative effort from all concerned parties, including by harvesting the innovative capacities of private actors and exploiting the working of innovation systems. But there may be shift in emphasis that in some respects are similar to the order of priority in the "social priorities paradigm": STI efforts needs to be *targeted* at challenges that cannot be resolved by the market and within the logic of innovation systems, and through innovation systems governance, only. It opens up a *goal directive* function for policy, and politics, beyond the mainly *facilitative* function of policy within the innovation framework. Priority issues may again be discussed without falling into the "picking winners" trap.

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Endnotes:

i *From President Roosevelt ,s letter that precedes the report:*
"Dear Dr. Bush, The OSRD of which you are the Director, represents a unique experiment of team-work and cooperation in coordinating scientific research and in applying existing scientific knowledge to the solution of the technical problems paramount in war. .... There is, however, no reason why the lessons to be found in this experiment cannot be profitably employed in times of peace. The information, the techniques, and the research experience developed by the OSRD and by the thousands of scientists in the universities and in private industry, should be used in the days of peace ahead for the improvement of the national health, the creation of new enterprises bringing new jobs, and the betterment of the national standard of living"(Bush, 1945[1995]: 3).

ii *" Government scientific agencies have splendid records of achievement, but they are limited in function.*
We have no national policy for science. The Government has only begun to utilize science in the Nation's welfare. There is no body within the Government charged with formulating or executing a national science policy. There are no standing committees of the Congress devoted to this important subject. Science has been in the wings. It should be brought to the center of the stage – for in it lies much of our hope for the future.
There are areas of science in which the public interest is acute but which are likely to be cultivated inadequately if left without more support than will come from private sources. These areas – such as research on military problems, agriculture, housing, public health, certain medical research,, and research involving expensive capital facilities beyond the capacity of private institutions – should be advanced by active Government support. To date, with the exception of the intensive war research conducted by the Office of Scientific Research and Development, such support has been meager and intermittent ((Bush,, 1945[1995]).

iii *[…] the idea that the fruits of science and technology make a difference in a wide variety of the policies that a country pursues for its general welfare and progress is not a new one. Certainly in the advanced countries at least, scientific agriculture for example is an old story, and technological innovation has been pursued by industry since the days when the earliest innovations in effect gave birth to industry as we know it today.*
What is relatively new is the idea that government policies in every field are in principle at least subject to improvement and refinement by the impact of science, and that some cannot be adequate to their purposes unless they explicitly and deliberately take account of that impact in their form" (OECD, 1965:30).

iv *[t]he term 'science policy' is ambiguous. It too often connotes only a policy limited to the needs of science per se, and excludes the effects of science and technology on the full spectrum of national policies in such disparate fields as agriculture and industry, defense, education, and domestic and foreign political affairs. Maximum exploitation of scientific opportunities requires programmes that combine concern for the growth of science itself and provision for the rapid, deliberate application of its fruits to human welfare. That is the substance of science policy in the full sense, as denoting consideration with of the interaction of science with policy in all fields. (OECD, 1963: 18).*

v *"There is one distinction that Science and the Policies of Government [OECD, 1963], not only did not blur, but made more clearly and explicitly than had been done before. To judge only by the number of references to it during the preparation and course of the Ministerial Meeting, one must conclude that the report performed a useful intellectual service in distinguishing between 'policy for science' and 'science for policy' – the two together being constitutive of the overall concept of science policy (OECD, 1965: 29)*

vi *"a new concept of may well have to extend greatly the current boundaries of science policy as it is presently understood. It may be that the interactions of science policy with other policies will prove to be more important than its own internal objectives" (OECD, 1971: 12).*

"During the 1960s, science policy in the OECD countries was considered as an independent variable of policy, only loosely related to the total social and political context. ……In effect, science policy in most countries comes down to research policies. The only fields in which there has been an effort to develop different aspects of national or international policy by the use of science and technology are military, nuclear, and space research; efforts to link the scientific and technical venture to growth policies have been essentially confined to a policy of financing research regardless of the aims it may serve. It is not surprising that a series of difficulties should have arisen from this partial approach" (ibid: 45).

"In effect, the science policy of most countries is as yet [1975] research policy and is confined to the financing of research considered as generally useful, but with little sense of the need for articulation with other elements of policy and hence with little direct impact on them. It is only in military, space, and nuclear research – fields which are in any case excluded from central science policy consideration in many countries – that real efforts have been made to link scientific and technical activities within a coherent perspective of policy, and hence where policy itself can be influenced through appreciation of hitherto ignored possibilities offered by new discovery. The generalization of such an effort will be the beginning of a true science policy (King, 1975: 51).

vii *"The predominance of sectors such as military, nuclear and space research that respond to goals imposed by considerations of defence or national, prestige, leads in some degree to the unbalanced development of research fronts, but much more to the unbalanced exploitation of research results. The way these programmes have been conducted has led to bottlenecks (.....) and the sacrifice of sectors, particularly in technology, that could make better contributions to economic and social development (OECD, 1971: 46) .*

viii *"It was in the course of preparing the Ministerial Meeting [in October 1963] that the country representatives, the Secretariat of the Meeting and the OECD itself came to realize clearly that they were dealing with two problems. The first was that of the relation of science to economic growth, the responsibility of governments to exploit the relation for their national economic welfare, and the need for the OECD to tailor its own scientific program to its over-all economic objectives.*

The second problem was that of science policy per se. The relation of science to the economy was clearly an important part of any government's general science policy, but it was not the only part. Science and military policy, for some countries, was even more important – or at least had been in the period since World War II. Then there was the impact of science and technology on educational, manpower, social, and foreign policies that also demanded attention. It was clear that "science policy" was a broader concept than "science and economic growth". (OECD, 1965: 28).

ix *"Economic analysis that approaches problems of growth from this fundamental and long-term point of view takes a breadth of character not alien to the classical concept of political economy. Economic growth is now more than synonymous with increases in national income. It is seen as a part of general social development. ….. A broad view of economic objectives can therefore provide a fruitful context for formulating comprehensive national and international policies designed to derive maximum benefits from the resources devoted to science" (OECD, 1963 160).*

x *"neither the objectives nor the recommendations of this report [the Brooks report] appear to us to be out of date. On the contrary, they should be considered as pointing in a direction which subsequent events have not called in question: in particular, towards the reformulation of science and technology policies for economic and social ends*

(as opposed to military and prestige objectives), improved anticipation and control of the consequences of technical progress and fostering innovation in the service sector. (OECD, 1979: 14)

xi Statistics and policy analyses show that, at the end of the 1960s, all OECD members countries were beginning to reorient their R&D, and take more account of the social dimensions of science and technology: research applied to the environment in general, the social assessment of technology, more extensive research in the fields of health, transport and the urban environment, and research associating the social science more closely with the natural sciences and with technology. (OECD, 1979: 14)

xii Although the objectives of the Brooks report are still in our view worth pursuing, attaining them has been made more difficult by constraints of a very different nature. The disarray reflected in the [Brooks] report – a disarray related to changes already apparent in the aspirations of society – is today increased by new problems. It is these which have determined our methods of work, the orientation of our research and the organisation of our report (OECD, 1979: 14).

xiii "Individuals, institutions and societies do adjust to technological change[….] but there is more at work here than a simple cause-and-effect relationships. That complexity extends to the problem of cost-benefit sharing and is the main reason why technical innovation must be accompanied by social innovation if it is to succeed. In confronting this problem it is important to draw up "rules of the game„to ensure that adverse effects are less harmful than they would be if everything were left to the market – and to establish such rules early on, before vested interests, acquired privilege and the fierceness of competition jeropardise their application" (OECD, 1988: 120)

xiv "Innovation policy typically obeys an economic growth imperative. There are no system limitations to the innovation-driven economy as defined in the NIS [national innovation systems] approach or in innovation policy as such. This is a serious challenge when innovation policy is supposed to be merged, co-ordinated or integrated with policies as environmental policy. The latter, or its modern version, sustainable development policy, contains imperatives linked to system limitations, such as the carrying capacity of the globe's eco-system" (OECD, 2005: 8).

xv "Tensions and interactions in policy systems may be more substantive in nature. Although an innovation policy promoting economic growth is assumed to increase general welfare in a society. it may include or lead to distributional effects that run contrary to a country's traditional value system. For example, innovation policy may stimulate growth in certain industries, e.g., to develop a knowledge-based economy, but at the same time leave or reinforce significant structural problems involving high levels of unemployment" (OECD, 2005: 38).

Such concerns bring out the issue of policy hierarchies: To what extent should one policy take preference over another? If the carrying capacity of the Earth is of existential importance, should not environmental standards take priority over economic growth? Or if the general quality of life and welfare of a society is of greatest importance, should not innovation be subsumed under such wider concerns? (OECD, 2005:40).

xvi "A high level of R&D spending and a good innovation performance contribute to more and better jobs. In addition research and innovation are needed to make the EU economy more sustainable, by finding win-win solutions for economic growth, social development and environmental protection" European Commission (2005) More research and innovation – investing for Growth and Employment: A Common Approach (COM(2005) 488 final, p. 4. xvi.

xvii "So the challenge for European innovation policy is: first, to develop increased awareness of the significance of innovation across all policy fields; and second to develop effective and efficient means of co-ordination through which we can ensure that conflicting policy aims are reconciled to the overall benefit of innovation and economic objectives. (Innovation and Technology Transfer, EUC, Sept 2003: 6). xvii