Making Science, Technology and Innovation Policy: Conceptual Frameworks as Narratives

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Introduction

In recent years, policy analysts have studied policy as a process of argumentation.[1] Gone are the analyses of politics based on rational choice and instrumental rationality, as well as the study of policy cycles (agenda-setting → policy formulation → adoption → implementation → evaluation), at least among critical authors. Policy-making is conceptual construction, from its very first step – the problem to be addressed – to the last – action.

Policy-makers construct their problem through conceptual frameworks that structure policy action. As E. Goffman (1974:10) suggested, frameworks (or frames) are principles of organization "which govern the subjective meaning we assign to social events", principles that transform fragmentary information into a structured and meaningful whole.[2] More recently, D. Schon put it as follows: a frame is a "way of selecting, organizing, interpreting, making sense of reality", and "provides guideposts for knowing, analyzing, persuading and acting".[3]

[1] G. Majone (1989), *Evidence, Argument, and Persuasion in the Policy Process*, New Haven: Yale University Press; D. Stone (1988) [2002], *Policy Paradox: The Art of Political Decision Making*, New York: Norton & Co; D. Stone (1989), Causal Stories and the Formation of Policy Agendas, *Political Science Quarterly*, 104 (2), pp. 281-300; F. Fischer and J. Forester (eds.) (1993), *The Argumentative Turn in Policy Analysis and Planning*, Durham: Duke University Press; F. Fischer (2003), *Reframing Public Policy: Discursive Politics and Deliberative Practices*, Oxford: Oxford University Press.
[2] E. Goffman (1974), *Frame Analysis: An Essay on the Organization of Experience*, Cambridge (Mass.): MIT Press, p. 10.
[3] M. Rein and D. Schon (1993), Reframing Policy Discourse, in F. Fischer and J. Forester (eds.), The Argumentative Turn in Policy Analysis and Planning, *op. cit.*, pp. 145-166, p. 146. See also: M. Rein and D.

Generally, a frame "[1] constructs the situation, [2] defines what is problematic about it, and [3] suggests what courses of action are appropriate. It provides conceptual coherence, a direction for action, a basis for persuasion, and a framework for the collection and analysis of data". [4] For the purposes of this paper, I define a conceptual framework as a narrative that acts as an organizing principle to give meaning to a socioeconomic situation and to offer answers to a series of analytical and policy questions. Ideally, a conceptual framework:

1. Identifies the problem, its origins and the issues involved;
2. Suggests mechanisms of how changes happen;
3. Offers evidence, often in terms of statistics and indicators;
4. Develops a narrative for explanation;
5. Recommends policies and courses of action

Policy frameworks are often constructed as a narratives or stories that gives meaning to situations. [5] This is not peculiar to policy. Narratives are present everywhere. They are an integral part of the discipline of history, where there is a long-running debate on the role of narratives in the discipline. [6] Narratives are also present in ordinary life, as Goffman has studied, as well as in science: think of theories on the origins of the universe, [7] or the origins of life and humans.[8] Economic theory is also full of narratives,[9] as is sociology. In the latter case, for example, you can think of the discipline as being composed of narratives

Schon (1991), Frame-Reflective Policy Discourse, in P. Wagner et al. (eds.), *Social Sciences and Modern States*, Cambridge: Cambridge University Press, pp. 262-332.

[4] M. Rein and D. Schon (1993), Reframing Policy Discourse, *op. cit*., p. 153. Fischer identifies the three steps as follows: defining the problem situation, identifying policy intervention, anticipating outcomes. See F. Fischer (2003), Reframing Public Policy, *op. cit*., p. 168.

[5] T. J. Kaplan (1986), The Narrative Structure of Policy Analysis, *Journal of Policy Analysis and Management*, 5 (4), pp. 761-778.

[6] H. White (1973), *Metahistory: the Historical Imagination in Nineteenth-Century Europe*, Baltimore: Johns Hopkins University Press; P. Ricoeur (1983), *Temps et récit I: L'intrigue et le récit historique*, Paris, Seuil.

[7] S. Hawking (1988), *A Brief History of Time: From the Big Bang to Black Holes*, Toronto: Bantam Dell Pub Group; H. Kragh (1996), *Cosmology and Controversy: the Historical Development of Two Theories of the Universe*, Princeton: Princeton University Press.

[8] P.J. Bowler (1984), *Evolution: the History of an Idea*, Berkeley: University of California Press; P. J. Bowler (1989), *The Invention of Progress: the Victorians and the Past*, Oxford: Basil Blackwell.

[9] D. N. McCloskey (1990), *If You're So Smart: The Narrative of Economic Expertise*, Chicago: University of Chicago Press.

on modernity. [10] Finally, narratives are present in matters concerning technology. D. Nye, for example, has documented how people appropriated technology in nineteenth century America for community creation, identity and self-representation.[11] M. Hard and A. Jamison have looked at the intellectuals' appropriation of technology in this century, as discourses on modernity.[12]

This paper looks at conceptual frameworks in science studies and science policy, and at the narratives involved. It is based on work conducted over the last ten years on science policy and science statistics. The first section offers a brief *tour d'horizon* of the frameworks developed over the twentieth century and used among governments and the OECD. The second section looks at the rhetoric or narratives involved in the conceptual frameworks. This is followed by a third section on some features of the policy process specific to the OECD. The paper concludes with some thoughts on what ends a framework really serves.

Evolving Frameworks

Science policy is about 60 years old. The first modern arguments for science policy came from V. Bush, followed by the US President's Scientific Research Board.[13] The Organization for Economic and Co-Operation Development (OECD) came next, and the organization started publishing policy documents that have had a major influence in member countries. [14] The policies suggested over the years, at both the national and international levels, relied on conceptual frameworks that furnished a rationale for action.

Over the twentieth century, at least eight conceptual frameworks have been developed in the study of science, technology and innovation, and have been used for policy purposes. These frameworks can be organized around three generations (see Table 1). The first

[10] P. Wagner (1994), *A Sociology of Modernity: Liberty and Discipline*, London: Routledge.
[11] D. E. Nye (2003), *America as Second Creation: Technology and Narratives of New Beginnings*, Cambridge (Mass.): MIT Press; D. E. Nye (1997), *Narratives and Space: Technology and the Construction of American Culture*, New York: Columbia University Press. See also: J. F. Kasson (1977), *Civilizing the Machine: Technology and Republican Values in America, 1776-1900*, New York: Penguin.
[12] M. Hard and A. Jamison (1998), *Intellectual Appropriation of Technology: Discourses on Modernity*, Cambridge (Mass.): MIT Press.
[13] V. Bush (1945), *Science: The Endless Frontier*, North Stratford: Ayer Co. Publishers, 1995; President's Scientific Research Board (1947), *Science and Public Policy*, New York: Arno Press, 1980.
[14] One early and major document was: OECD (1963), *Science and the Policies of Government*, Paris: OECD.

conceptual framework was that on cultural lags, from American sociologist William F. Ogburn in the 1920-30s. [15] According to Ogburn, society is experiencing an exponential growth of inventions but is insufficiently adapted. There are lags between the material culture and the adaptive culture. Therefore, there is need for society to adjust in order to reduce the lags. Society has to innovate in what he called social inventions, or mechanisms to maximize the benefits of technology. There is also a need for society to forecast and plan for the social effects of technology.

Table 1.
Major Conceptual Frameworks Used in Science Policy

- First generation
  - Cultural Lags
  - Linear model of innovation
- Second generation
  - Accounting
  - Economic Growth
  - Industrial competitiveness
- Third generation
  - National Innovation System
  - Knowledge-Based Economy
  - Information Economy (or Society)

The framework on lags has been very influential. It has served as basic narrative to *Recent Social Trends* (1933) and *Technology and National Policy* (1937), two major policy documents in the United States, the first on social indicators and the second on technological forecasting. It was also used during the debate on technological unemployment in the 1930s. Lastly, the framework on lags was part of a series of conceptual frameworks concerned with innovation as a sequential process. It is in fact to

[15] B. Godin (2009), *The Invention of Innovation: William F. Ogburn and the Use of Invention*, Project on the Intellectual History of Innovation, Montreal: INRS, Forthcoming.

this framework that we owe the idea of "time lags" (between invention and its commercialization) and the idea of technological gaps.

The best-known of the sequential frameworks is what came to be called the "linear model of innovation". The precise source of the linear model remains nebulous, as its origin has only recently been documented. [16] Authors who used, improved or criticized the model in the last fifty years rarely acknowledged or cited any original source. The model was usually taken for granted. According to others, however, it comes directly from V. Bush's *Science: The Endless Frontier* (1945). To still others, the model does not exist, but among its opponents. It is a straw man. In fact, however, the linear model does exist, and developed in three steps corresponding to three scientific communities examining science from an analytical point of view: business schools, economists and statisticians.

Few people, including bureaucrats, really believed in this framework. The story behind the framework is rather simple. It suggests that innovation follows a linear sequence: basic research → applied research → development. In one sense, the model is trivially true, in that it is hard to disseminate knowledge that has not been created. The problem is that the academic lobby has successfully claimed a monopoly on the creation of new knowledge, and that policy-makers have been persuaded to confuse the necessary with the sufficient condition that investment in basic research would by itself necessarily lead to successful applications. Be that as it may, the framework fed policy analyses by way of taxonomies and classifications of research and, above all, it was the framework most others compared to.

The frameworks on cultural lags and on the linear model of innovation came from academics. The next generation of frameworks owes a great deal to governments and international organizations, above all the OECD. This latter organization is an influential

[16] B. Godin (2006), The Linear Model of Innovation: The Historical Construction of an Analytical Framework, *Science, Technology, and Human Values*, 31 (6): 639-667; B. Godin, In the Shadow of Schumpeter: W. Rupert Maclaurin and the Study of Technological Innovation, *Minerva*, 46 (3), 2008: 343-360; B. Godin, (2009), *The Linear Model of Innovation (II): Maurice Holland and the Research Cycle*, Project on the Intellectual History of Innovation, forthcoming.

think-tank for its member countries. It is not an advocacy think-tank looking for media exposure and defending partisan or ideological ideas, [17] but rather a research-oriented think tank that feeds concepts to national policy-makers for better understanding of issues in science, technology and innovation policies. Other organizations that have acted as think tanks in the short history of science, technology and innovation policy are the US National Bureau of Economic Research (NBER), the US RAND Corporation and the British Science Policy Research Unit (SPRU). The OECD has a specific role as the source of ideas for national policy-makers. As with most think tanks, and like management gurus, the organization simplifies policy analysis through the use of metaphors and imagery, [18] but as an international organization, it brings immediate (although sometimes relative) legitimacy to discourses and frameworks, partly because the member countries themselves define the agenda of the organization. In this sense, the OECD frameworks are witnesses to national priorities and policies.

From its very beginning, science policy was defined according to the anticipated benefits of science. Because science brings benefits, so the story goes, there is a need to manage science, and management requires data. To contribute to this end, the OECD produced a methodological manual for national statisticians, the Frascati manual (1962), aimed at conducting and standardizing surveys of research and development. [19] The manual offered a statistical, or accounting answer and framework to three policy questions or issues of the time: the allocation of resources to science, the balance between choices or priorities, and the efficiency of research.

One basic statistics among the statistics collected with the manual was a figure on the "national science budget", or Gross Domestic Expenditures on R&D (GERD). The statistics served two purposes. One was controlling the public expense on science, the growth of which was too high according to some budget bureaus. The other purpose, more

[17] D. E. Abelson (2002), *Do Think Tanks Matter? Assessing the Impact of Public Policy Institutes*, Montreal: McGill-Queens.
[18] D. Stone (1996), Second-Hand Dealers in Ideas, in D. Stone (ed.), *Capturing the Political Imagination: Think Tanks and the Policy Process*, London: Frank Cross, pp. 136-151.
[19] B. Godin, B. (2008), The Making of Statistical Standards: OECD and the Frascati Manual, 1962-2002, Project on the History and Sociology of Statistics on Science, Technology and Innovation, Montreal: INRS.

positive, was setting targets for the support and development of science, technology and innovation, and this was used by policy departments. It gave rise to the GERD/GDP ratio as a measure of the intensity or efforts of a country or sector.

Among the benefits believed to accrue from science, technology and innovation, two have been particularly studied at the OECD: economic growth (through productivity) and competitiveness. These gave rise to two frameworks. The framework on economic growth embodies a very simple (and again linear) story: research leads to economic growth and productivity. Consequently, the more investment, the more growth. This story is often framed within an input-output framework: inputs → research activities → outputs (→ outcomes). [20] The accounting framework discussed above is precisely framed into such an input-output semantics. The origins of the framework can be traced back to the economic literature on technological unemployment in the 1930s, in which "technological change" was equated with changes in factors of production (input) and measured via changes in productivity (output). This equation is now known as the "production function". Used extensively by economists in the mid-1950s and subsequently to study science, technology and innovation and its relationship to the economy, the economists' framework immediately offered official policy-makers a useful conceptual framework. This was due to the fact that the framework was perfectly aligned with the policy discussions at the time on the efficiency of the science system.

The issue of productivity in science has a long history. [21] It emerged among scientists themselves (see Table 2). In the nineteenth century, the British statistician Francis Galton, followed in the twentieth century by James McKeen Cattell, the US psychologist and editor of *Science* for fifty years, started respectively computing the number of children scientists had and the number of scientists a nation (or state) produced. The numbers were called

[20] B. Godin (2007), Science, Accounting and Statistics: the Input-Output Framework, *Research Policy*, 36 (9): 1388-1403.

[21] B. Godin, (2009), The Value of Science: Changing Conceptions of Scientific Productivity, 1869-*circa* 1970, *Social Science Information*, forthcoming; B. Godin (2007), From Eugenics to Scientometrics: Galton, Cattell and Men of Science, *Social Studies of Science*, 37 (5): 691-728; B. Godin (2006), On the Origins of Bibliometrics, *Scientometrics*, 68 (1): 109-133.

measures of productivity, or productiveness. Subsequently, productivity came to mean the scientific production of the scientists, above all the number of scientific papers they published. From the 1920-30s onward, historians and psychologists were early producers of numbers on productivity defined as such. However, it was governments and their statistical bureaus that really developed this meaning after World War II. Finally, productivity in science matters came to examine not only the scientists and the science system, but the effects of science on the economy, above all economic productivity.

Table 2.

Evolving Conceptions of Productivity in Science

Productivity as Reproduction

Key authors: F. Galton, J. M. Cattell

Issue: civilization, then advancement of science

Statistics: great men; men of science

Productivity as Output

Key authors: organizations (and their consultants: C. Freeman)

Issue: efficiency

Statistics: money spent on R&D

Productivity as Outcome

Key authors: economists (D. Weintraub, R. Solow)

Issue: economic growth

Statistics: productivity

Economic growth and productivity have been studied at the OECD since the very early years of science policy. However, they got increased attention in the early 1990s, following the Technology and Economy Programme exercise (TEP), and then in the 2000s with the Growth project, where an explicit framework – the New Economy – was used to explain differences between member countries. The United States had the characteristics of a new economy, which means above all that it was innovative and it made more extensive and better use of new technologies, particularly information and communication technologies [22].

The other benefit of an economic type that was studied at the OECD was industrial competitiveness. [23] The story behind the framework is that science and technology have become a measure of leadership among countries. With regard to economic growth and productivity, industrial competitiveness has been discussed at the OECD from very early on. This led to a major study published at the end of the 1960s on technological gaps between countries, particularly between European countries and the United States. Technological gaps were considered signals that Europe was not performing well. The study developed a methodology for ranking countries based on multiple statistical indicators. In the 1980s, the issue of industrial competitiveness gave rise to the concept of high technology and the role of new technologies in international trade. [24] High technology came to be seen as a major factor contributing to international trade, and a symbol of an "advanced economy". Statistics measuring the performances of countries with regard to the technological intensity of their industries were constructed and further developed to measure how countries maintain or improve their position in world trade. Then a framework on globalization was constructed in the 1990s, as was a methodological manual for measuring globalization. Globalization was said to be a source of competitiveness for firms and countries, and gained widespread popularity in science, technology and innovation policy.

We now come to a third generation of conceptual frameworks. These arose through a synergy among academics, governments and international organizations. The OECD, with the collaboration of economists as consultants, developed new frameworks for policy-making. The frameworks were generally constructed as alternatives to the linear model.

[22] B. Godin (2004), The New Economy: What the Concept Owes to the OECD, *Research Policy*, 33, 2004: 679-690.
[23] B. Godin (2002), Technological Gaps: An Important Episode in the Construction of Science and Technology Statistics, *Technology in Society*, 24, pp. 387-413.
[24] B. Godin (2004), The Obsession for Competitiveness and its Impact on Statistics: The Construction of High-Technology Indicators, *Research Policy*, 33 (8), 2004, pp. 1217-1229.

One of the first such frameworks was the National Innovation System. [25] The framework suggests that the research system's ultimate goal is innovation, and that it is part of a larger system composed of sectors like government, university and industry and their environment. Briefly stated, research and innovation do not come from the university sector alone, so the story goes. The framework emphasizes the relationships between the components or sectors, as the "cause" that explains the performance of innovation systems.

Most authors agree that this framework was developed by researchers like C. Freeman, R. Nelson and B.-A. Lundvall. In fact, however, the "system approach" in science policy owes its existence rather to the OECD and its very early works beginning in the 1960s, although the organization did not use the term National Innovation System as such. [26] From the very early beginning of the OECD, policies were encouraged promoting to greater relationships among the component of the research system at five levels: between economic sectors (like university and industry), between types of research (basic and applied), between government departments, between countries, and between the system and the economic environment. The Frascati manual itself was specifically framed in a system approach. As we mentioned above, the manual computed and aggregated the R&D expenditures of the sectors composing a research system into the GERD indicator, but also suggested constructing a matrix for measuring the flows of research funds between the sectors (fund sources and research performers).

Then in the 1990s the OECD launched a research program on National Innovation Systems, with B.-A. Lundvall as Deputy Director. Many studies were published in the same spirit as that of the early system approach. Certainly there were more sources of innovation studied, more types of relationships were examined, and a different role was assigned to

[25] B. Godin (2009), National Innovation System: The System Approach in Historical Perspective, *Science, Technology and Human Values*, 34 (4), Forthcoming; Godin, B. (2009), *National Innovation System (II): Industrialists and the Origins of an Idea*, Project on the Intellectual History of Innovation, Montreal: INRS, Forthcoming.

[26] One can go further back in time, namely to World War I. See B. Godin (2009), *National Innovation System (II): Industrialists and the Origins of an Idea*, Project on the Intellectual History of innovation, Montreal: INRS, Forthcoming.

government. However, the industrial sector and the firm still held central place in the innovation system. By then, the Oslo manual on measuring innovation had become the emblem of this framework at the OECD.

The other new framework is that on the knowledge-based economy or society. [27] The origins of the concept of a knowledge economy come from economist Fritz Machlup in the early 1960s, and the concept re-emerged at the OECD in the 1990s as an alternative, or competitor, to that on the National Innovation System. The latter was believed by many to be more or less relevant to policy-makers. The work at the organization was entrusted to the French economist Dominique Foray. The story on the knowledge-based economy suggests that societies and economies rely more and more on knowledge, hence the need to support knowledge in all its forms: tangible and intangible, formal and tacit. The framework suggests that we examine (and measure) the production, diffusion and use of knowledge as the three main dimensions of the knowledge economy.

In reality, the concept of knowledge is a fuzzy concept, and these three dimensions are very difficult to measure. More often than not, the concept is an umbrella-concept, that is, it synthesizes policy issues and collects existing statistics concerned with science, technology and innovation under a new label. A look at the statistics collected in measuring the concept is witness to this fact: existing statistics are simply shifted to new categories.

The last framework in the third generation is that on the information economy or information society. [28] The information economy was one of the key concepts invented in the 1960-70s to explain structural changes in the modern economy. It has given rise to many theories on society, conceptual frameworks for policy, and statistics for

[27] B. Godin (2009), The Knowledge Economy: Fritz Machlup's Construction of a Synthetic Concept, in R. Viale and H. Etzkovitz (eds.), *The Capitalization of Knowledge: A Triple Helix of University-Industry-Government*, Edward Elgar, Edward Elgar, Forthcoming; B. Godin (2006), The Knowledge-Based Economy: Conceptual Framework or Buzzword?, *Journal of Technology Transfer*, 31 (1): 17-30.
[28] B. Godin (2008), The Information Economy: the History of a Concept Through its Measurement, 1949-2005, *History and Technology*, 24 (3): 255-287.

measurement. The story behind the framework suggests that information, particularly information and communication technologies (ICT), is the main driver of growth.

This preoccupation with information has a long history. The growth and management of scientific publications was the very first step toward the construction of the concept of the information economy. Through time, the concept evolved from an understanding of information as knowledge, to information as commodity or industrial activity, then information as technology (see Table 3).

As to knowledge, information is a difficult concept. For example, it took three decades to develop a methodological manual, or guide to measuring the information economy, at the OECD. What helped finally was politics. First, internal politics, like the efforts of the Working Party on measuring the information society, done to raise its own visibility within the OECD. Second, ministers' interests as manifested during summits and conferences. Ultimately it seems that the emergence of a political issue often leads to its measurement. Measurement in turn helps crystallize concepts and issues.

The framework on the information economy relies on other frameworks. In fact, the OECD policy discourse relies on a cluster of frameworks that feed on each other. One such cluster is composed of third-generation frameworks: information economy, knowledge-based economy, and new economy. Another cluster consists of those of the second generation: accounting, growth and productivity and industrial competitiveness, all three framed into an input-output semantics. Furthermore, this second generation, particularly the stories involved, feeds the third generation, giving the whole discourse a continuity and a coherent rationale. Metaphors often help here. A metaphor has important organizational properties: it is prescriptive and normative in that it generates a vision, and it unifies elements of reality because of its fluidity and flexibility (polysemy). A metaphor is both constructive (of meaning) and productive (of action). Briefly stated, it is both intellectually and socially useful. A metaphor thus serves a variety of worldviews. This is the role played by the information economy. Information and communication technologies are everywhere: it explains the knowledge-based economy, as well as globalization, the new economy and, of course, the information economy: a network of interrelated concepts and frameworks thus feed each other.

Table 3.
Evolving conceptions of information

Information as Knowledge

Key authors: J. D. Bernal, D. K. Price
Issue: information explosion
Restricted definition: scientific and technological information
Statistics: documentation

Information as Commodity

Key authors: F. Machlup, M. Porat
Issue: structural change
Broad definition: information goods and services (industries)
Statistics: accounting

Information as Technology

Key authors: C. Freeman, I. Miles
Issue: technological revolution
Restricted definition: (information and communication) technologies
Statistics: applications and uses

Frameworks as Narratives

I have suggested that conceptual frameworks in science, technology and innovation policies are usually constructed in the form of a story or narrative. [29] A narrative gives meaning to science, technology and innovation, and to policy actions. It helps put science, technology and innovation on the political agenda. A typical narrative goes like this:

0. Premise: science, technology and innovation are good for you and for society.
1. Something new is happening in society (CHANGE) and it is quite different from the past.

[29] I use the term narrative here as including any of the following, which a literary critic would probably distinguish: argument, plot, storyline, story, emplotment, tale.

2. Let's call this change … (NEW NAME).
3. The new phenomenon or event will generate big effects, rewards/returns.
4. Let's collect STATISTICS as evidence.
5. It is essential that policies be developed.
6. Let's imagine a FRAMEWORK to this end.

Let's look at each step. A major premise or assumption lies behind each framework, namely that science, technology and innovation are good for you and for society. This is a premise no official narrative has ever questioned. For example, no one would imagine, and in fact there was never a framework developed that opposed or suggested getting rid of, new technologies and their bad consequences. New science and new technologies are to be placed under control, but never eliminated. As US sociologist William F. Ogburn once put it: "the control of invention (…) is generally interpreted as meaning their promotion not their denial". [30]

A narrative on science, technology and innovation starts with suggesting that something new is happening in the economy, that an important change is underway. This change is then contrasted to the past. Certainly, continuity is usually mentioned, with "arguments from qualification", like "there is a new situation, *but* it is different only from a perspective of scale or form"; "things are changing, *however* it is only a matter of intensity or acceleration". [31] The narrative generally suggests that it is difficult to draw a boundary between the current era and the past. But this specification, or qualification, is rapidly forgotten. Indeed, the newness is less that of a change in society or economy than a change in the interest of policy-makers and politicians. Be that as it may, dichotomies reign: the future will be different from the past. Change is what counts here: its nature, its size, its rate.

[30] W. F. Ogburn and N. M. Nimkoff (1940), *Sociology*, Boston: Houghton Mifflin, p. 916.
[31] This rhetorical move is similar to the "argument from limitations", as discussed in B. Godin (2005), *Measurement and Statistics on Science and Technology: 1920 to the Present*, London: Routledge.

This is exactly what characterizes the framework on the knowledge-based economy. According to the OECD, knowledge and its production, diffusion and use is what defines today's society. Certainly, knowledge has always been present and important in past economies and societies, but today it is more influential than ever: "although knowledge has always been a central component in economic development, the fact that the economy is strongly dependent on the production, distribution and use of knowledge is now being emphasized". [32] How can the organization develop such a vision? With a very broad concept of knowledge, one that embraces things previously separated or put aside in previous analyses – R&D, intangibles, learning – measuring them and adding the numbers together. The effect of the concept is to attract the attention of as many policy-makers (and experts) as possible in the field of science, technology and innovation policies.

Naming and classification are central features of conceptual frameworks. They offer labels, such as knowledge-based economy, that are easily memorized. As catchwords, labels are often "mere labeling without yielding anything but the label", as H. Blumer suggested decades ago. [33] Be that as it may, these labels gain the attention of many people, which helps them to reproduce or diffuse. Such is the role of names or terms given to frameworks, like knowledge-based economy or information society. Such is also the role of concepts like networks, clusters, social capital, as well as technological systems and its affiliates, [34]

[32] OECD (1996), *Science, Technology and Industry Outlook: Part V, Special Theme: The Knowledge-Based Economy*, DSTI/IND/STP (96) 5, p. 5. For similar narratives from academics, see D. Foray (2004), *The Economics of Knowledge*, Cambridge (Mass.); MIT Press; N. Stehr (2005), *Knowledge Politics*, Boulder (London): Paradigm Publishers.

[32] H. Blumer (1930), Science Without Concepts, reprinted in H. Blumer (1969), *Symbolic Interactionism: Perspective and Method*, Berkeley: University of California Press, pp. 153-170. On the fuzziness of concepts, see also: W. B. Gallie (1956), Essentially Contested Concepts, *Proceedings of the Aristotelian Society*, pp. 167-198

[33] H. Blumer (1930), Science Without Concepts, reprinted in H. Blumer (1969), *Symbolic Interactionism: Perspective and Method*, Berkeley: University of California Press, pp. 153-170. On the fuzziness of concepts, see also: W. B. Gallie (1956), Essentially Contested Concepts, *Proceedings of the Aristotelian Society*, pp. 167-198.

[34] Technological regime, technological guideposts, technological or techno-economic paradigms, techno-economic networks.

and many others like the Triple-Helix and the New Production of Knowledge (Mode1/Mode2). [35]

The conceptual framework on the National Innovation System is a recent example of labelling. As we mentioned above, a system approach has always characterized the OECD work on science, technology and innovation since the 1960s. Then, in the early 1990s, a label came to be applied to such an approach – National Innovation System – and a research program developed. Certainly, as we have suggested, differences exist between the early system approach and the latter. Nevertheless, the National Innovation System brought an explicit framework to the field of science, technology and innovation policy, putting the firm at the center of the system, whereas early narratives were instead concerned with the central role of governments and policies in the system. Only historical myopia, however, leads some to think that the framework is new.

A similar rhetorical move (renaming something old for political purposes) also occurred with the concept of "high technology". [36] In the mid-1980s, the term high technology began to be used concurrently with, or in place of, the terms research intensity and technology intensity. Nothing had really changed with regard to the definition of the concept (by way of statistics), or at least not yet. But a valued and prestigious label (high) was now assigned to it. Technology trade had now gained strategic importance in the economic and political context of the time: research or technology-intensive industries were expanding more

[35] For more labels, see J. R. Beniger (1986), *The Control Revolution: Technological and Economic Origins of the Information Society*, Cambridge (Mass.): Harvard University Press. For critical analyses of academic frameworks, see: B. Godin (1998), Writing Performative History: The New "New Atlantis", *Social Studies of Science*, 28 (3), pp. 465-483; T. Shinn (2002), The Triple Helix and New Production of Knowledge: Prepackaged Thinking in Science and Technology, *Social Studies of Science*, 32 (4), pp. 599-614; R. Miettinen (2002), *National Innovation System: Scientific Concept or Political Rhetoric?*, Helsinki: Edita. Some labels, like postmodern science, strategic science, or co-produced science, had much less fortune than the more popular ones discussed. See respectively: S. Funtowicz and J. Ravetz (1999), Post-Normal Science – an Insight Now Maturing, Futures, 31(7), pp. 641-646; A. Rip (2002), Regional Innovation System and the Advent of Strategic Science, Journal of Technology Transfer, 27 (1), pp. 123-131; M. Callon (1999), The Role of Lay People in the Production and Dissemination of Scientific Knowledge, 4 (1), pp. 81-94. These three examples are cited in C. Freeman and L. Soete (2007), *Developing Science, Technology and Innovation Indicators: What We Can Learn from the Past*, UNU-MERIT, Working Paper Series, Maastricht, p. 11 (footnote 6).

[36] B. Godin (2008), The Moral Economy of High Technology Indicators, in H. Hirsch-Kreinsen and D. Jacobson (eds.), *Innovation in Low Tech Firms and Industries*, Edward Elgar, 2008.

rapidly than other industries in international trade, so went the story and its numbers, and these industries were believed be an important policy option for economic progress. High technology would thereafter be the label for these industries, and would become a well-known and much-used label in the field of science, technology, and innovation policy.

As narrative, a conceptual framework generally suggests that the new phenomenon or event will generate big rewards/returns, as well as leadership potential for those at the forefront. It also suggests that if no action is taken, bad consequences could follow. Crisis stands on the horizon! Usually, the narrative is either in the form of hype, hyperbole or utopia, suggesting that enormous outcomes are looming, or in the form of dramatization, with metaphors on disease, defeat and decline, such as that there is too little investment in science, technology and innovation, which imperils economic performance.

One then arrives at the next element of a narrative: statistics. Briefly stated, a narrative suggests that it is necessary to know more about the change – in order to get more from it. More research is needed, particularly statistical work. In the case of frameworks, statistics helped to strengthen the narrative. How does narrative work here? Over the years, the OECD has developed a "formula" in three steps, and the framework on economic growth and productivity is the best evidence to document the strategy. First, the organization looks at academic work and synthesizes the results. These results generally concern specific national economies, and have to be placed in a comparative perspective with other countries. Second, the OECD internationalizes the numbers, more often than not based on the American experience (in fact, the frameworks used at the OECD are regularly those suggested by the United States delegation, like globalization and new economy). This is where the value-added of the OECD lies: internationalizing statistics. The organization is rarely an innovator in the matter of theories and concepts. Generally, the organization has needed exemplars or models that it then standardizes and conventionalizes, generalizes and diffuses. This is the case for its methodological manuals, produced as standards to be used by member countries for the collection of national data. Collecting national statistics and placing them in an international frame is the main task of the OECD.

As a third step, the organization identifies best practices/performers using indicators, rankings and benchmarking. [37] Coming first, or pride of first place, is what drives the exercises in measurement and its statistical comparisons. The results are published in what the OECD calls scoreboards, among others.

Other tools or devices used as evidence in narratives are visual aids like boxes, tables, figures and graphs. Visual devices are essential, since numbers often do not or cannot demonstrate the results conclusively, like the OECD's early work on technological gaps, and the more recent work on the new economy, on globalization and on the knowledge-based economy. In this latter case, for example, the OECD could measure only part of the phenomenon – the production of knowledge, not its diffusion and use (except for information and communication technologies) – because of a lack of data. Equally, the OECD had difficulties "proving" the emergence of a new economy in other countries: "Ten years or so from now, it should be easier to assess, for instance, the impacts on growth deriving from information and communication technologies, other new technologies and changes in firm organization". [38] But at the time, such an assessment was impossible. Nevertheless, the organization concluded that more science, technology and innovation policies should be developed to bring economies closer to a new economy.

Pictorial devices generally help persuade the reader of the seriousness and empiricism of the organization, despite the limitations of the data. The physical space these devices occupy is sometimes even greater than that given to the text itself, as was the case for the project on economic growth and productivity (new economy). It is worth recalling here that as early as 1919 the US economist W. C. Mitchell suggested presenting narratives to policy-makers with statistics precisely as such: [39]

> Secure a quantitative statement of the critical elements in an official's problem, draw it up in concise form, illuminate the tables with a chart or two, bind the memorandum in an attractive

[37] B. Godin, B. (2003), The Emergence of Science and Technology Indicators: Why Did Governments Supplement Statistics with Indicators?, *Research Policy*, 32 (4): 679-691

[38] OECD (2001), *Drivers of Growth: Information Technology, Innovation and Entrepreneurship*, Paris: OECD, p. 119.

[39] W. C. Mitchell (1919), Statistics and Government, *Journal of the American Statistical Association*, 125, March, pp. 223-235.

> cover tied with a neat bow-knot (…). The data must be simple enough to be sent by telegraph and compiled overnight.

Apart from visual devices, an important strategy is black-boxing the limitations of statistics. [40] This is done by using footnotes, appendices or separate manuals (like the so-called metadata), where the limitations are discussed, but without effect on the core of the text and its conclusions. The "argument from limitations" (the form of which is like "the data are incomplete, *but* this does not affect the results") is also a recurrent tool of the strategy.

Let's conclude this section by mentioning that one of the major factors responsible for the success of official statistics is their regularity. Individual researchers rarely have the resources to produce surveys year after year that would enable the measurement of trends. They certainly contribute in the very early development stages, and they originate new statistics and methodologies. But they do not have the resources to conduct the surveys themselves, and many shift rapidly to another object of study, or become simple users of statistics produced by others. Only governments and their statistical bureaus have sufficient resources to conduct annual surveys and produce regular statistics. This gives them a relative monopoly and allows them to impose their vision of science.

The OECD Process

A narrative generally ends with policy recommendations. In order to benefit from the new context, a series of policy objectives is defined, obstacles and conditions are identified, and targets suggested. The policy recommendations conclude the narrative. They, more often than not, are lists of fads, recurring from year to year, like increasing the industrial share of R&D in the national budget, improving the relevance of public research, need for structural adjustment (through adoption of new technologies), and free market. To these, the organization adds a little something new in every periodic publication or review, generally specific to a new technology or to a public issue. Over history, the most popular and regular

[40] B. Godin (2005), Measurement and Statistics on Science and Technology, *op. cit*.

policy formulas were magic ratios like the GERD/GDP ratio of 3% suggested as early as the 1960s, and a basic/applied research ratio of 10-20% basic research, first suggested by the French statistician Condorcet. [41]

In general, the development of frameworks at the OECD proceeds as follows. Work proposals come either from the Secretariat (in collaboration with committees composed of national delegates) or from the ministers (often under the influence of a specific country). Studies are then conducted by the Secretariat, with a view to presentation to a ministerial conference. The conference, in turn, generally under the advice of the OECD officials themselves, asks for more work. This is how projects extend and build on previous ones. To contribute to its work as a think tank, the OECD develops the following activities:

- Organizing conferences and workshops to discuss policy issues.
- Setting up specific committees and working groups composed of national delegates.
- Sharing workload with member countries.
- Inviting or hiring national bureaucrats and researchers to join the organization.

The work is motivated by several factors, two of which deserve mention. Linked as it is to the political process, the OECD has to feed ministers regularly for their meetings. An easy way to do this is to turn readily-available academic fads into keywords (or buzzwords), then into "synthetic, attractive and readily understandable" narratives [42] in order to catch the attention of policy-makers. Buzzwords and slogans help sell ideas: they are short, simple, and easy to remember.

A second factor explaining the OECD strategy is the publication process, or the rush to publish. As think tank, the OECD publishes biannual, yearly and biennial reports, among them those for ministers' conferences, where time frames are very tight. Publication drives policy: there is a need for a new issue at every conference, and in every new publications of

[41] B. Godin, B. (2008), The Making of Statistical Standards: OECD and the Frascati Manual, 1962-2002, *op. cit*; B. Godin (2003), Measuring Science: Is There Basic Research Without Statistics?, *Social Science Information*, 42 (1): 57-90.

[42] OECD (1998), *Possible Meeting of the CSTP at Ministerial Level: Statistical Compendium*, DSTI/EAS/STP/NESTI (98) 8, p. 3.

the organization, such as *Science, Technology and Industry Scoreboard* or *Science, Technology and Industry Outlook*, both published every two years. Umbrella concepts like that on the knowledge-based economy are thus very fertile for producing documents. They synthesize what is already available, what comes from day-to-day work conducted in other contexts and, above all, what is fashionable, often at the price of original work.

Academics are regularly enrolled in these activities. They are consulted or invited to participate in various OECD forums to "enlighten" bureaucrats and share ideas, as researchers from SPRU did in the 1970s-80s. They are also employed as deputy directors by the organization, like D. Foray to work on the knowledge-based economy, or B. A. Lundvall on the national innovation system. In the end, academics are "accomplices". Many of them use the same labels and narratives in their papers, and few of them develop fundamental criticisms of the frameworks.

Conclusion

An interesting way of conceptualizing frameworks is to imagine them as paradigms, like Thomas Kuhn's paradigms in science. A framework is a heuristic and serves as a focusing device for how to think about issues, and as convenient shorthand for how to communicate about them. This is precisely what conceptual frameworks do. However, if conceptual frameworks can be compared, to a certain extent, to Kuhn's paradigms, one has to admit that there has been no revolution or paradigm shift over the last sixty years. Certainly, the narratives have changed (slightly), as the emergence of new conceptual frameworks attests. But there has been no paradigm shift, only more economic obsession – under different guises. [43] The (official) statistics developed over history to support the frameworks are witness to this trend. [44] Most are concerned with the economic dimensions of science, technology and innovation (see Appendix).

[43] On how science policy is always about *how much* rather that *what for*, see: D. Sarewitz (2007), Does Science Policy Matter?, *Issues in Science and Technology*, Summer, pp. 31-38.
[44] B. Godin (2006), Research and Development: How the "D" got into R&D, *Science and Public Policy*, 33 (1): 59-76; B. Godin (2009), What is Science? Defining Science by the Numbers, 1920-2000, *Foresight*,

Authors often contrast science policies between two periods. The first period (policy for science) would have been concerned with funding science for its own sake, the golden age of university funding according to many researchers, while the second period (science for policy), in which we now live, is one where research is supported mainly for political and socioeconomic goals. [45] Such a contrast is not unlike a more recent one constructed by M. Gibbons et al. on the new production of knowledge, where Mode 2 (after 1945) is defined with characteristics contrary to Mode 1 (before 1945).[46] The actual story is quite different. There has never been a "policy for science" period, as many authors argue, only a "science for policy" one, urging all sectors of society to contribute to technological innovation. Science policy has always been concerned with applying science to public goals. And from its very beginning, science policy, whether implicit or explicit, was constructed through reflections on accounting, economic growth, productivity and competitiveness.

Of the many possible outcomes of science, technology and innovation, it has always been, with one exception in the early 1970s, [47] the economic outcomes that formed the core of narratives and frameworks on science, technology and innovation among national governments and at the OECD. The first conceptual framework, developed by Ogburn, studied the many social effects of science: economics certainly, but also culture, health, family, politics, etc. He had few followers. Most subsequent frameworks concentrated on the economics, and the latter really became a doctrine in many governments and at the OECD.

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forthcoming; B. Godin (2008), The Culture of Numbers: The Origins and Development of Statistics on Science, *Electronic Journal in Communication, Information and Innovation in Health* (RECIIS), 2 (1): 7-18.

[45] See, for example, the Piganiol report OECD (1963), *Science and the Policies of Government*, Paris, p. 18, and the Brooks report OECD (1972), *Science, Growth and Society*, Paris: OECD, p. 37. See also: A. Elzinga and A. Jamison (1995), Changing Policy Agenda in Science and Technology, in S. Jasanoff et al. (eds.), *Handbook of Science and Technology Studies*, Thousand Oaks (Calif.): Sage, pp. 572-597.

[46] See B. Godin (1998), Writing Performative History: The New "New Atlantis", *Social Studies of Science*, 28 (3), pp. 465-483.

[47] OECD (1971), *Science, Growth, and Society: A New Perspective*, Paris: OECD.

Appendix
Methodological Documents
from the Directorate for Science, Technology and Industry (OECD)

(First edition)

Manual

*The Measurement of Scientific and Technical Activities: Proposed Standard Practice for Surveys of Research and Development, F*rascati manual) (1962).

Proposed Standard Practice for the Collection and Interpretation of Data on the Technological Balance of Payments (1990).

Proposed Guidelines for Collecting and Interpreting Technological Innovation Data (Oslo manual) (1992)

Data on Patents and Their Utilization as Science and Technology Indicators (1994).

Manual on the Measurement of Human Resources in Science and Technology (Canberra manual) (1995).

Measuring Productivity (2001).

Handbook

OECD Handbook on Economic Globalisation Indicators (2005).

Guide

Guide to Measuring the Information Society (2005).

Framework

A Framework for Biotechnology Statistics (2005).

Others

Bibliometric Indicators and Analysis of Research Systems: Methods and Examples (1997).