Reflections on OECD Studies on Knowledge Management and Related Issues: Implications for Schooling for Tomorrow

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Introduction

The time is now ripe to reflect on the diverse analyses and ideas being generated by a number of OECD studies that relate to Schooling for Tomorrow. The purpose of this note is to extract from this "thick literature" a certain number of ideas of relevance to the next stage of the project. A subsequent paper will examine specific examples of approaches to knowledge management that might serve as the basis for particular entries into the Toolbox, as it is compiled after the June 2004 Toronto Forum.

OECD analyses dealing with knowledge management issues, R&D, ICT, the knowledge economy, and social capital have been flourishing for several years. At the beginning, OECD's Directorate for Science, Technology and Industry (DSTI) responded to the need for a better understanding of what was labelled the "knowledge economy" and identify indicators that might measure knowledge stocks and flows. In Education, specifically CERI, a major programme was launched on knowledge management, in the economy at large and in education in particular. The Public Management section (PUMA/GOV) then launched its own work on knowledge management, this time in comparing public administrations with the private sector, resulting in a published report in 2003.

Some of the key reports from these different programmes are discussed separately below to identify main arguments, with comments also provided in response to two broad questions:

a) What does the corpus of OECD work on knowledge management tell us about the broader environment in which schools are located and the major trends already visible? In what ways is this environment changing what schools are expected to do and how they operate?

b) Specifically in relation to the scenarios, what light does this analysis shed on the different main models that underpin them - bureaucratic systems, focal points for community action and influence of diverse social interests, networks of learning organizations, markets of diverse agencies and providers? Of particular interest, given the centrality of knowledge management ideas to the re-schooling scenarios, (especially "Schools as focused learning organizations"), is whether these different analyses suggest that school systems are already moving in these directions and what the constraints are of doing so.

Knowledge Management in the Learning Society (*CERI, 2000; 257 pp.)*

CERI has explored a defining assumption about the future and the characteristics of OECD economies: that they are now facing a transformation of a magnitude comparable to the major shifts in recent centuries. In this, knowledge has become the principal resource as the source of wealth. Knowledge economies are economies where knowledge applies to itself and the learning process is a specific mode of production.

To posit that knowledge produces knowledge may seem trivial at first glance but it is not at all trivial in its consequences for the economy and society. The report recalls the "corn economy" in which corn produced corn; however there is important difference in the two cases. Corn, used as a seed, vanishes in the growing process; in contrast, the more knowledge is used the more it is developed. As learning becomes a critical means of production, the learning function will be strategic one for the foreseeable future.

Thus it is at the beginning of the 21st century, one can understand why, at the *firm* level, knowledge *per se* is studied by management. Knowledge is to be managed purposely through specific tools, especially through batteries of indicators. This is what "knowledge management" is about. The comparison can be drawn with the factory work that has been studied through scientific management tools (time motion studies, etc.). Scientific management experts sprang up and developed new skills and approaches unknown hitherto.

Is "knowledge management" as a label a fad, shortly to be swept away by some new seductive catchword? This report suggests the contrary. Because of the increasing complexity of tasks to be performed, an important issue for firms is how to combine and manage more and more pieces of knowledge that are scattered everywhere. An individual engineer or group at Boeing or Airbus does not know how to design, produce and market an aircraft: fragmented pieces of knowledge have to be co-ordinated through specific organizational channels. Increasingly, organizations are aware that they do not know what they know or don't know (e.g. the Hewlett Packard CEO's remark *"If HP knew what HP knows..."*). It has quickly become conventional wisdom that organizations need to create a knowledge culture and design a corresponding infrastructure if they are to effectively to use the knowledge within and outside their own institutional boundaries.

The CERI project sought to compare education as a sector with other sectors regarding their knowledge management. Two in particular provided the focus: engineering and medicine. Regarding these sectors, a picture is built of a quiet revolution that has taken place. Successful organizations are increasingly characterized as knowledge-rich with intangible assets. Their success is a sustainable advantage gained by learning faster than their competitors; learning capabilities become a competitive distinction. But this comparative advantage is fragile: the key to success is to build up a learning environment, which fosters the use and re-use of individual skills and collective knowledge. At the individual level, a robust taxonomy distinguishes between 'know what', 'know why', 'know how' and 'know who'. This can usefully inform the Schooling for Tomorrow project as regards the organizational model underpinning each scenario.

The report also discusses the concept of "sticky knowledge". This is defined as know-how/ competence that cannot be separated from the person or organisation possessing it. Tacit knowledge is embodied in individuals and embedded within the organization. Where potential users of innovative techniques or products have a high level of tacit knowledge about their use, they have a strong interest in participating in such an innovation because they know from experience how to improve these techniques/ products. This effect has an important effect on the relationship between users and product developers. In the information technology sector, for example, advanced users are increasingly taking the lead in creating applications that best suit their own specific and hard-to-codify needs. In medicine, many of the uses of prescription drugs are not those formally specified on the label, but are adapted by doctors to new uses based on their experience.

Major questions then are, for these and other sectors: how "sticky" is knowledge and how to identify "stickiness"? In market situations where industrial or professional users of products are the clients of product developers, these questions are partly answered through practice: the more those clients know what they want, the more they will participate in developing new products and processes. Yet this assumes an approximate equality in the relationship between user and knowledge producer, which may not be the case for, say, a small computer supplier buying from a large software developer, still less for a general medical practitioner relative to a large drug company. A parallel example is the individual teacher relative to a university education department. Hence, is suggested the value of the question of the extent of the involvement of a user of knowledge in its development. That in some commercial relationships practitioners with high levels of tacit knowledge choose to play this role helps to underline that pure knowledge producers do not always "know best".

In addressing the embodiment of knowledge in individuals it is also important to understand ways in which it is mediated and transmitted. Knowledge workers operate as *go-betweens*: by moving from university to industry or from one company to another, and in so doing they help to cross-pollinate knowledge that may otherwise not readily transfer. In the bio-technology sector, for example, a key driver is the skills, knowledge, problem-solving capabilities, and adaptability of highly trained personnel, who are also mobile. Often small bio-tech companies rely heavily on those with recent experience in research institutions, and rapidly developing science and technology applications are brought to the market as a result of this individual mobility. This may be a special case, given that the bio-technology industry is still very young, but it illustrates the potential for the movement of people to support technology transfer. Thus, information on personnel characteristics is an important component of sectoral indicators of the knowledge economy.

Firms in the health and engineering sectors are thus often "firm knowledge dependent." These firms manage their knowledge differently, some provide a high quality information system infrastructure by reusing codified knowledge, others rely more on person-to-person relationships through meetings, e-mails, videoconferences etc.. Learning becomes a core corporate business process as the means to raise the “good” questions and to have the cognitive basis to map “smartly” the competitive environment (coined by consultants as “cognitive mapping”).

The report raises questions for education and its capacity to engage in such a knowledge management strategy approach. Are there organizational processes which can culturally transform universities, with corresponding incentives to do so? Is there a shift from a supply-dominated approach to one based on demand, tailoring adult learning programmes to specific needs expressed not by firms but by individuals, and if so what are the consequences for the suppliers of continuing education? How to assess the increasing competition and advocacy coalitions among different knowledge producers and mediators and its consequences for education? An underlying question for the CERI report is whether the education sector can produce, disseminate and use knowledge in ways to help transform its productivity. Education systems are often under fire for failing to improve their performance, as are educational researchers for failing to provide practitioners with the tools to do so. Some question whether educational research and knowledge can meet such criticisms asserting that they cannot create laboratory conditions that replicate sufficiently the complex and context-specific classroom situations in which innovations are applied.

While there is no consensus about the degree to which education can realistically pursue an improved "production function", this challenge helps point to some of the conditions needed for it to do so. First and foremost, a greater proportion of research would need to be scientifically validated and made more relevant for practice. An investigation by the United States government identified just 400 out of 20,000 academic papers that even potentially have practical applications, i.e. just 2% of the total. [*OECD/NSF Forum, May 1999*] The fact that the number of medical papers that were both scientifically robust and clinically relevant had been estimated at only 3% is more surprising perhaps provides little consolation.

At both the political and the practitioner level, there is nevertheless a strong desire to base educational research on good evidence. The risk is that if good evidence is not available, bad evidence will be used instead. So there needs to be rigorous means of validating, classifying and reporting knowledge as in ways that are better established in other fields with a natural science foundation. An important element of this is how existing knowledge is classified and accessed. In health care, comprehensive taxonomies are being developed to help practitioners find their way to reliable research evidence. In education, the ERIC system notwithstanding, there is not even a common way of describing and classifying problems and solutions.

Even more fundamental for education, perhaps, is the question how evidence can be improved in terms of reliability, thoroughness and accessibility. As noted, there is less room for basing evidence on controlled experimentation in education than on the experiences of individuals, organisations and networks. A major challenge is thus to develop and disseminate this form of information and create effective knowledge systems, rather than to emulate the model of pure science. In this, validation is especially difficult.

Conclusions of Interest for Schooling for Tomorrow:

a) The major trend is irreversibly towards a learning economy. The knowledge economy favours firms that are rapid learners and firms select employees who are also rapid learners [good news for them but bringing possible exclusion for slow learners]. "Know how to learn" thus becomes much more than a mere slogan for schooling, and structures matter insofar as they foster or inhibit this form of knowledge.

b) The role of ICT in the learning dimension is critical. Not only is ICT used in the learning process - requiring teachers to be comfortable with its use for storing data, researching through the Internet, creating new pedagogical materials etc - but also has a important ramifications for the logistics of school life. Apart from other things a school may be, it is a workplace and should be managed as such.

The Well-being of Nations - the role of human and social capital *(2001. pp. 118)*

This report provides a further useful backdrop for the Schooling for Tomorrow project. It raises challenging questions about definitions of well-being for OECD countries. What should it cover? Quality of growth vs. quantity of growth? Growth of what, for what? What interpretation can be given to GDP? These questions can stimulate discussion of the scenarios by asking what education is for; with different answers posing different possible futures for schools.

The report focuses on measurement issues for capturing this complex notion of well-being. This cannot be limited to GDP, which is a measure of economic output and excludes non-market household activity such as parenting. Parenting is a critical support function for the school, but while the mother who helps her child with homework does not increase GDP, a private firm that delivers such a service, even to the same child, does raise GDP. This OECD report is a call for new, more comprehensive indicators of well-being and the Osberg index (page 75) is a good example as devised by an economist of what could be an index of well being. One severe criticism of GDP for these purposes is its failure to reflect social preferences concerning *equity* goals, which is attracting considerable attention from a new generation of economists. The World Bank is engaged in setting up indicators of change in poverty levels, income inequality, environmental degradation, health. This OECD report goes on the same direction, examining the interrelationships between well-being and human and social capital.

On human capital, the report refines the definition given by economists during the 1960s, who, under the influence of Gary Becker and others, considered education *as an investment as such*. This means that, from an individual‘s point of view, it is possible to calculate the costs and benefits of a decision such as enter the higher education system and also to measure the return on investment in relating the diploma to associated salary levels. Education is an investment with a pay-off time that depends *inter alia* on the nature of the labour market. The concept of human capital is enriched beyond Becker‘s definition:

> Human capital is the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personnel, social and economic well being (p.18).

It cannot be reduced to a diploma which is certified by a school system; human capital is developed *in a context*. Formal education obviously is one important place for learning but there others such as with on-the-job training, civic participation, even daily living. The report uses Lundvall‘s typology from 1994 - knowing what, knowing why, knowing who, knowing how - to illustrate the multi-faceted nature of human capital.

On social capital, the report rehearses different definitions and approaches. One definition is proposed: *networks together with shared values and understandings that facilitate co-operation within or among groups*. Three basic forms of social capital are identified social bonds, bridges and linkages. It may be also approached through its absence - the report suggests how lack of social capital may be measured through social dysfunction such as crime levels or lack of civic behaviours. Eight sources are identified for the development of social capital: 1) the family as the primary building block; 2) schools; 3) local communities; 4) firms; 5) civil society; 6) the public sector; 7) gender; 8) ethnicity (page 45). Regarding schools, “[they] can foster values for social co-operation as well as providing “meeting places” where various social networks can intersect. To the extent that teachings methods and organisation of learning encourage shared learning and teamwork as well as openness to new ideas and cultural diversity, the more schools can underpin social capital which bridges across different group of the society”. In so describing the socialisation function of the school the report usefully identifies that it is not alone as a source of social capital.

The report reviews trends in terms of growth or decline in social capital. While it summarises the Putman thesis about the decline of social capital as social engagement, linked especially to the impact of TV, such strong conclusions are not supported in all countries. There is in general, however, a shift from traditional civic, religious and trade union activity, and a growth in leisure and individualistic activity. The report mentions the well known controversy about the role played by the Welfare State in relation to social capital. Some researchers argue that Welfare State policies are crowding out voluntary activity, whereas other findings from the Netherlands and Sweden point to the contrary as they have the highest levels of unpaid work in voluntary associations. These findings suggest a degree of fragility in the “social capital” concept. The report notes also the *positive externality dimension* of social capital, raising the question of whether education is still a public good. Education can, as social capital, be partly a public good and partly a private good: “access to information and influence through social networks confers private benefits on individuals and in some cases can be used by individuals or groups to exclude others and reinforce dominance and privilege”.

On social capital and schools, the report refers to Coleman, who introduced social capital to education research: “[He] argues learning can be supported by social capital through the existence of many types of supportive relations among adults who are parents of the children in the same school. The types of support relate to homework, out-of-school activities, and direct parental involvement in school activities and support for families and children in difficulty. Empirical evidence at US state level for impact of social capital on students learning outcomes is shown by Putman.” The latter’s findings suggest that higher levels of social interaction appear to have a strong positive impact on learning, that levels of trust and informal socialising seemed to be more significant that level of organisational membership, and that compared to traditional policy levers such as reduction in average class size, the likely leverage of social capital seems to be greater in raising achievement scores. All such findings are relevant to Schooling for Tomorrow discussions about the role played by the parents and their expectations with regard what schooling is about in understanding the demand side; there is a clear relationship between the involvement of parents at school and in their children and the quality of the attainment through the school system.

Conclusions of Interest for Schooling for Tomorrow:

a) Education can be considered as a good investment, with an impact on economic growth and on non-economic benefits such as improved health, better parenting, and greater civic engagement. The positive relationship between educational attainment and social capital is also important, even if unsurprising for any sociologist, and informs the interpretation of international achievement studies such as PISA; policy-makers should know that these results are not “social capital free”.

b) The role of schools in the formation of social capital can be related to the different scenarios and here again school structures matter. Social capital is built in and outside schools so the degree of openness of the school system can hamper or accelerate this process. One example is the length of school holidays during the year - students profiting from their grandparents taking care of them will increase their social capital differently from those remaining inside school following a recreation programme.

New Challenges for Educational Research (*"Knowledge Management" series, 2003 pp. 146)*

This report reviews educational research and development in two countries of widely different scale - New Zealand and England – based on largely descriptive background country report and more normative OECD reviews.

For New Zealand, the examiners' report exploits the taxonomy data/information/knowledge/wisdom that had been used in the earlier *Knowledge Management in the Learning Society 2000*, and the triptych production, mediation, and use of knowledge also structures the argument. The nature of the interface between research and practice especially interests the examiners: linkages between practitioners and researchers, between policy makers and researchers. They note the value of the dissemination through a journal for teachers providing readable research results. They also note good communication between research and practice at the school level; for example, many teachers are undertaking professional upgrading which includes research components. And, they see the existence of structures linking parents, teachers, principals and researchers.

Clearly the experts push their recommendations through different ways and means: 1) mixing education research with other disciplines and setting up a critical mass, 2) favouring competition and collaboration, 3) promoting networking structure, 4) blurring boundaries between the formal education system and other providers of education.

England presents a different scale (volume of research, number of researchers, amount of funding), as well as a different history as regards the role of research in education policy-making. The examiners were impressed by the quality and the quantity of the government efforts to attend to research and development capacity in education. They support its benchmarking approach, and suggest that England is near or at the top ranking of the OECD countries even if the amount of education R&D is weak compared with other sectors such pharmaceuticals. For, R&D in education still represents only some 0.3% of the total expenditure in education in the OECD countries for which the data are available, which is given some perspective by comparison with the health sector where between 5 to 10% of expenditure is devoted to this.

Such cross-sector comparisons are, however, fraught with pitfalls: R&D in the added value chain for producing a drug, for instance, is very different from its place in the added value chain for producing a primary school student whose educational achievements are the expected outcome. The examiners use the Pasteur quadrant as proposed by Stokes, (Pasteur's Quadrant - basic research and technological innovation, Brookings 1997) as a grid for analysis, combining two dimensions: "the quest for fundamental understanding" and the "considerations of use". The call for evidence-based and use-inspired research underlies the report.

The national education R&D system is considered as a knowledge management system in terms of four dimensions: 1) the balance in the nature of the research: this addresses questions such as whether the system produces "blue sky" and applied research; it is about the management of the portfolio of national research and the balance that is achieved; 2) its quality and availability[1]; 3) capacity: this is about resources and competence issues, incentives, and attractiveness in order to recruit good researchers; 4) the relationship of the research to school improvement and reform: the examiners insist on local loops and focused on the *formative assessment strategy* [the "cornerstone of a process of continuous improvement of instructions across the nation" (p.48)].

[1] One approach to quality is through consideration of its richness and its availability to potential users - its "reach". The relation between the two is discussed in this author's paper prepared for OECD's Puma and published in *Budgeting and Control* Volume 3. It is a useful way of understanding dissemination processes and may contribute to the Schooling for Tomorrow toolbox.

The background country report was prepared by the UK Department for Education and Skills, and it embodies the principles which can be labelled under the umbrella of *new public management*: setting clear targets, devolution of responsibility at each layer of the hierarchical pyramid, accountability, transparency, external and self evaluation of performance, incentives and rewards for teachers who deliver and sanctions for those who do not. The political will for putting these principles into action is vigorously expressed. Two quotations illustrate the sense of urgency and political agenda: "time is running out for public education to prove its worth"; "public education must deliver in order to achieve social cohesion and prevent ever-growing inequality from one generation to another" (p.61).

The report focuses more on management principles than explicitly on knowledge management. Previous reviews of the state of educational research appear to provide the context and the agenda of shortcomings to be corrected, despite the controversy and mixed feelings they generated. The need for high quality is clearly identified (p.64), and specialised, dedicated research centres of excellence are part of the solution. There are four dedicated "centres of excellence" of education research, which are used as a tool for competition in the funding allocation processes: i) one on *wider benefits of learning;* this centre builds on the assumption of the education as a positive externality for the economy. This key assumption is buttressed by what is labelled as "the school of internal growth" in economics; ii) *the economics of education*, focusing on cost effectiveness measure of educational interventions; iii) one on *ICT* in association with a not-for-profit Learning Lab; iv) another is devoted to *adult literacy and numeracy*. The background report mentions other initiatives undertaken such as the National Educational Research Forum, which is responsible for developing a framework for research.

Conclusions of Interest for Schooling for Tomorrow

a) The report is enlightening in describing a variety of organisations and institutions which are clearly designed to foster conditions consistent with the "re-schooling" scenarios. Some tools are classic (teachers magazines, dissemination seminars, web sites), others are innovative such as teacher research grant programmes, best practice research scholarships, and networked learning communities (pp. 78-9). Within England at least, there appears to be a restless policy for improving the quality of the research in education mainly in endorsing new public management approaches; these are openly used even within teacher communities that are traditionally hostile to the managerial rationale.

b) The report endorses the knowledge management approach as a guideline with few insights on "how to make it run"; the class room level and teachers are not seriously examined as to how this will be implemented in practice.

PUMA/GOV and Knowledge Management

Different initiatives have been taken by Puma on knowledge management: a joint CERI and Puma analysis - *knowledge management in the public and private sectors: similarities and differences* - addressed three questions

i) Do the public and private sectors face the same challenges concerning the emergence of knowledge intensive economy?
ii) Is the public sector lagging behind the private sector in its knowledge management practices?
ii) What should the public sector copy from the new knowledge management of large private sector companies and where does it have to create its own strategy? With managing knowledge the art of creating value by leveraging intangible assets, the opportunities created for the public sector are of two kinds: a) improvement of organizational effectiveness; b) the acceleration of societal change by increasing knowledge about its policies.

These questions have been discussed at a forum in Copenhagen - *knowledge management learning by comparing experiences from private firms and public organizations* - attended by around a hundred private and public managers, policy makers and academics. It concluded that while large private organizations are still struggling to find new ways of managing knowledge, the public sector faces some additional challenges:

- Improving incentives and internal processes: flattening hierarchies, rewarding knowledge sharing, building up communities of practice will be important to building a learning culture. Some constitutional and legal rules put in place to promote equity within the civil service may well hamper the organizational flexibility required.
- Anticipating feed back from and communicating on outcomes of public policies will be at the core of the learning process. But it will require improved public debate with citizens and others (parliament, interest groups etc.).
- Learning organizations will also require new or improved governance arrangements for the manipulation of data, to protect citizen privacy, prevent the capture of knowledge by some groups avoid the danger of exclusion of those without voice and protect citizens' right to know, especially on the outcome of public policies.

PUMA/GOV also organized a learning government symposium (February 2003, Paris, see *« knowledge management in government: an idea whose time has come »).* It drew on a survey of knowledge management, which paralleled the CERI/Statistics Canada survey in the private sector, with responses from 132 central government organizations of 20 OECD countries. The survey uses the term « knowledge management » as a broad heading to refer to a range of organizational practices - generating, capturing, disseminating know-how and promoting knowledge-sharing within the organization and with the outside world.

Three proposals served to structure the symposium discussion:

1. Use NTIC's to eliminate paper and set cold data in terms of both quantity and quality;
2. Develop new competencies, such as learning how to interpret "cold data" - data taken as context-free raw material;
3. Changing the structures and methods of human resource management.

The broad conclusions of the OECD survey on knowledge management practices in central government organisations were that knowledge management ranks high on the management agenda of a good majority of central government organizations across OECD countries. This is supported by a cultural change whereby, for example, knowledge sharing is seen to a lesser degree as an impediment to career promotion, and staff more spontaneously share knowledge

Conclusions of Interest for Schooling for Tomorrow:

a) While the public sector delivers visible services and products such as utilities (electricity etc.) in many countries, it mainly delivers intangible services to citizens such as social equity, social order, quality of life, safety, a national scientific base, regulations, citizenship culture, security, well-being. To the extent that education is a service delivery among others, it is a very specific one which has to be redefined mainly through the demand-side approach

b) Action proposals discussed during the Puma symposium are relevant to the education sector. Focusing on the second proposal - develop new competencies: learning how to interpret cold data - the example *of recording absenteeism* in schools is a good case to look into. It illustrates well the definition of knowledge management as organizing the attention of players in data-saturated systems. Real-time collection of the information becomes a valuable tool for the school in dealing with the event symbolised by the student's absenteeism which is a breakdown or at least a signal that something is "going wrong" and it enables the teacher to have a better grasp of the situation.

Networks of Innovation - towards new models for managing schools and systems *(Schooling for Tomorrow series, 2003, pp.182)*

This report focuses on new public management even if this is not explicitly stated, and is valuable in deliberately bringing in concepts from the world of management. Approaches in which the main rationale for establishing individual incentives for managers are to improve their motivation and their performance, rather than grade and seniority, will often be uncomfortable for educators used to a different form of music. Two countries, England and Netherlands, are reported in detail as among those leading the way in realising the linkages between the knowledge society and new forms of governance in education. This report thus examines the scenarios in relation to approaches that tie closely with the focus of PUMA/GOV, and clearly relate to the question whether there are moves away from bureaucratic models. This focus is on new forms of management in the public sector - such as performance evaluations or merit review, individual incentive systems - and governance issues (such as the role to be played by agencies). Accountability is also a key concept in PUMA/GOV work; this report makes a clear distinction between *contractual accountability* and *responsive accountability* and applies them to the scenarios.

Education is firmly defined in the report as a public policy with explicit goals to be delivered through the provision of services. It identifies the network dimension as a *new form of governance* for the education sector**.** The tendency in the private sector is to push organisations increasingly towards collaboration and alliances despite the difficulties they encounter in making it happen. For, they come quickly up against basic questions when moving in this direction. Why should firms give up vertical bureaucratic structures? What is the strength or advantage of weak ties, as compared with more direct hierarchical relationships? How can organisations work together? These questions are highly relevant to education, which as a sector has been rather isolated from these strands of organisational evolution. The value of this report is to import the vocabulary of management, leadership, and governance, and consider how this is handled by policy makers from "Anglo Saxon" and Central European countries such as Hungary. In wondering about how this is being handled in Latin countries, a further step would be cross-cultural analysis comparing the implementation of new public management tools in the education sector.

Conclusions of Interest for Schooling for Tomorrow:

a) This report addresses a theory about organisations which can be related to the scenarios. This theory suggests that new mechanisms for co-ordinating and controlling different sectors of the economy are emerging. Large and centralised organisational structures which rely on control and communications channels are vanishing because they are ineffective (bureaucratic model). While these have been successful institutional arrangements, they are now like dinosaurs, unable to cope with a flexible environment and to respond to a growing variety of unstable demands in a knowledge-based economy. The new emerging form is *a cluster of organisations,* linked together for making new products or delivering services in shorter time periods, and facilitating competitive co-operation within a sector.

b) The growing literature on networks can permit the re-analysis of country cases and the effectiveness of networks. Co-operation can be measured, be it limited, moderate or broad. Adapting the grid from Hage's work (*Organizations Working Together,* Sage 1993) allows us to better characterise the networks of relevance to schooling. The grid provides eight environmentally determined dimensions, three of them external controls (degree of resource dependency, amount of network regulation, voluntary or involuntary work status) and five technological variables (task scope, task uncertainty, task intensity, task duration and task volume).

   The resource dependency approach points to the political and economic forces which affect the behaviour of members of the network. It is a key variable for understanding how *the de-schooling scenarios* might work and raises questions about the variety of sources (private and public funding) which secure network stability. Similarly with the extent of network regulation, this is about the degree to which a network is constrained in its ability to select its own methods of operation and outcomes. Who decides procedures? Training methods? These two variables are distinct: a network may be highly dependant on public funds (local or regional) and weakly regulated; on the contrary, a network may depend on a mix of different sources of financing which gives it substantial latitude but highly regulated as regards specific procedures. Work status is also an important aspect of external control; a network obliging compulsory participation is different from a voluntary network for sharing knowledge with peers. The technological variables are more difficult to handle but are also important to understand in relation to the schooling system.

DSTI[2] Work on Knowledge

Measuring knowledge in learning economies and societies [OECD/NSF conference, May 1999)

Can knowledge be measured? This basic question has for some time exercised DSTI and to which the answer can be summed up: "At best, imperfectly". While knowledge is now recognised as a key factor of economic production alongside land, labour and capital, it differs in a number of ways from these more tangible factors. The impossibility of obtaining an aggregate estimate of knowledge inputs is not just a technical matter of measurement, but also arises from the character of knowledge itself. It is extremely heterogeneous, and its value is not intrinsic but depends on its relationship to the user. This does not mean that indicators of the production, stock or application of knowledge in particular sectors are meaningless; they can produce useful insights, but only if there is clarity about why and how knowledge is important, rather than stockpiling knowledge on knowledge for its own sake.

Harder to measure, but no less important, are *mechanisms for access and attention*. Mediation processes are needed not just to allow users and decision-makers to access knowledge created by others, but also to bring to their attention those aspects of large knowledge bases that are most relevant for taking decisions. This applies particularly to the information available to public policy-makers, but also to busy practitioners who cannot keep pace with many aspects of knowledge evolving at an unprecedented pace. Indicators of accessibility depend on qualitative observations of, for example, the dispersion of the knowledge base.

A further universal set of problematic issues concerns the capacity for, and rate of, innovation. While these can be estimated in manufacturing by the number of new products brought to market, or the relative number of people not directly involved in production, such measures translate with difficulty in a public sector service industry. Another aspect where cross-sector comparisons are complex is competition: it might be assumed that a competitive environment is a spur to innovation and therefore to knowledge production, but in some cases it may run counter to a collaborative environment that allows ideas to be shared and developed. Networking and collaboration can sometimes flourish in a competitive environment, of course, as shown by the experience of Silicon Valley. But especially in the public sector, it is by no means clear that an optimum level of knowledge advancement will always be obtained by giving individual agents incentives to outperform their "rivals".

Social sciences for knowledge and decision-making *(2001)*

This report is based on outcomes from a conference held in Bruges in 2000. It was part of a programme on the future of the social sciences under the OECD Committee for Scientific and Technology Policy; and the focus on the “soft” social sciences was thus unusual. Two communities of social scientists and models of transfer are presented in the report. The first is termed the *limestone model of transfer* - this metaphor refers to the slowness of the knowledge transfer from social science research as it permeates into society. The second is the *engineering model*; in this model social scientists are “engineers” or experts working for decision makers. In fact, these correspond to Mode I

[2] OECD’s Directorate for Science, Technology and Industry.

linear and non-linear models of knowledge transfer in the Gibbons typology, and the report calls for the creation of a new function coined as *knowledge brokering*.

The report addresses the longstanding question of the relationship between the scientist and the decision maker - can the social scientist act as an agent of change in society? The report suggests that a ready consensus between scientists and policy-makers should be avoided, and calls for the re-establishment of distance between science and politics. Some suggestions for reinventing the social sciences are worth noting: nurture serendipity - as expressed by Nobel Prize-winning economist Kenneth Arrow *"invest in craziness"*; continue the transition from a cottage industry mode of research to more intense collective mode of structuring the research environment, alongside the development of collective research tools; encourage problem-focused, multidisciplinary research teams. A fourth suggestion is more controversial – "stop whining about being misinterpreted and instead go public or else perish": if social scientists spend public money, it is legitimate for the public to know what they are accomplishing with it and social scientists must deliver their results in understandable language.

Conclusions of Interest for Schooling for Tomorrow

a) In dealing with the contribution that social scientists make to their surrounding society, some conclusions are similar to those concerning the relationship between researchers in education and the users of results in policy or practice: in education there is not a specific discipline dedicated to mediation and teacher educators are viewed as an important intermediary channel.

b) The issue of bias in the social sciences is relevant to the scenario methodology and the question of whether the social sciences should restrict themselves to the analysis of society or be instrumental in changing it. A related issue concerns the governance challenge of knowledge management. The education sector needs to get the right information as raw material prior to it being interpreted. Because of weaker links in education between political action and outcomes and the less obvious political consequences of publishing data/indicators than in many policy sectors, it could well be more difficult to "get the facts right". Governments thus need to inform public debate on the interpretation of the facts.

Innovation in the Knowledge Economy: implications for education and learning systems (*CERI 2004)*

The report is divided into four parts and mainly deals on innovation in general terms. The theoretical framework is similar to those used by DSTI, and the report draws inspiration from the work of the economist and historian of innovation, Paul David. It introduces the notion of the "knowledge-intensive community", referring to groups in which a large proportion of members is involved in the production and reproduction of knowledge. Within such communities, there is an effort to co-produce new knowledge among members in a "public" or "semi-public space" which can be major sources of innovation. The open source software project exemplifies this notion.

Teachers at the elementary and secondary level, however, do not fit this model of knowledge-based communities, despite making intensive use of knowledge. There may be massive amounts of innovation going on as individuals strive for solutions to their teaching problems, but because those problems involve working with un-standardised materials – students - relatively few of those pedagogical innovations are passed on to and shared by the rest of the teaching community.

As regards the capacity of different sectors to codify and make explicit the embedded knowledge rooted within organizations, education is taken as an example of failure in its inability to produce rapid advance in human knowledge as is the case for information technology or certain areas of medical care (surgery or drug therapy): "In the field of education, science does not enlighten the art of teaching. It can hardly be said to play a very strong role as a factor enabling the direct production of systematic knowledge which translates into 'programmes that work' in the classroom and lecture theatre…

Education is not a field that lends itself well to experimentation: what works with a pilot school may prove hard to replicate elsewhere".

Further in the report, the reader is introduced to a powerful metaphor: *the innovation tank and its four pumps.* The tank represents the *innovative potential* within a specific sector; the pump a means of delivering the *innovative fuel* to the engine. Four pumps are described and detailed.

- The *first pump* is well known, i.e. innovation, but viewed in an historical perspective.

- The *second pump* is less usual and directly related to the CERI programme: the collaboration among users or practitioners. This is a new line of enquiry raising a key question: do users/doers have any interest to be innovative, for altruistic or other reasons, in substitution for commercial suppliers? Incentives make possible the sharing and circulation of innovation; it is worth asking whether and how "innovation generosity" can be replicated among knowledge communities in schools.

- *The third pump* is focused on the organizational side of innovation, the fuel is labelled *modularity*. There is an ample managerial literature on this topic: "module" means a quasi-autonomous sub-system related to the larger system which leads to the development of new knowledge that produces coherence to the whole. The term for this is "integrative knowledge", which means that it has to produce norms, assessments, certifications, and common infrastructure. The report also mentions the trade-off between integration and differentiation - a generic trade-off facing large organizations.

- The *fourth pump*– under the umbrella "information and communications technologies" - is more familiar. Several OECD reports have tackled this subject; the report builds on the specific case of emergency health care systems which can dramatically improve their productivity through ICT applications.

Conclusions of Interest for Schooling for Tomorrow

Concerning the first pump, a clear distinction is made between two approaches or "epistemic cultures" - the *scientific* and the *humanistic* - distinguished by the manner in which knowledge is created, accumulated and diffused. The accumulation of knowledge is faster in the scientific model, using "science-illuminating technology", than within the humanistic model. Education can be located within these two.

On the second, a parallel is made between teachers and doctors to highlight the importance of learning by doing: "a range of selective incentives need to be identified for prompting teachers to reveal and share their practical knowledge".

With the third (modularity), it needs to be observed that modular structures are in fact the rule in "one class, one teacher" education régimes; the question raised is the balance to be found between innovation at the local level and co-ordination at the central level.

Concerning the fourth pump, a challenging issue for discussion is the "easy assimilation" assumption: have ICT tools fundamentally changed the nature of education or have they made only a cosmetic impact because the main structures of teachers' activity are considered inviolable?

All these are outstanding questions that could usefully be addressed