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Expanding Public Space for the Development of the Knowledge Society

Report of the Ad Hoc Expert Group Meeting on Knowledge Systems for Development

4-5 September 2003

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Department of Economic and Social Affairs
Division for Public Administration and
Development Management

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FORWARD

At its inaugural 2002 meeting, the United Nations Committee of Experts on Public Administration – the governing body of the Division on Public Administration and Development Management (DPADM) – considered the topic of the capacity of the public sector to capture the benefits of the revolutions in knowledge, innovation and technology, as well as its ability to put in place policies and conditions that would create an enabling environment at the societal level. In its report, the Committee recognized that capturing and disseminating data and information - largely associated with e-government initiatives - was a first step toward this end but that in order to properly reap the rewards of the broader knowledge society, more had to be done. As such, it recommended that "further work be undertaken to better define the role of the state as enabler and as user of knowledge….in order to support and encourage innovation throughout the public administration and the society as a whole". (E/CN.16/2002/8)

This expanded mandate led to the creation of the Knowledge Management Branch in DPADM which, in addition to continuing our work on e-government, is tasked specifically with examining issues pertaining to the knowledge society and knowledge in the public sector. This deepens our work on good governance for the 21st century in that improved knowledge generation, exchange and utilization within the public sector constitutes an important factor not only in innovation but also in learning, and more relevant and effective policy making and public service delivery. Moreover, the implementation of sound knowledge governance structures at a societal level encourages greater responsiveness, inclusion, participation, and expression of human rights – all central aspects of the good governance framework.

The 2003 **Ad Hoc Expert Group Meeting on Knowledge Systems for Development** represents the first activity on this subject of our newly constituted branch and what will be the beginning of a broader programme dedicated to these important issues. The meeting addressed the issues raised by the Committee of Experts for Public Administration, as well as those of knowledge governance and the impact of knowledge on governance, which were reinforced as important areas for future work.

It is hoped that this Report of the meeting will also be useful to member states and partner organizations in their consideration of policies towards building an inclusive knowledge society.

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Under the guidance of the Chief of the Knowledge Management Branch, Mr. Jerzy Szermeta, the meeting was conceived and organized by Ms. Jennifer Sisk. Ms. Elvira Doyle was responsible for the day-to-day organizational arrangements and Ms. Patricia Penuen provided administrative services. The report was prepared for publication by Ms. Jennifer Sisk, both as editor and contributor. Ms. Neena Koshy was responsible for layout/typesetting.

All the participants and presenters in the Meeting contributed with information, knowledge and ideas that are incorporated in the report.

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INTRODUCTION

Background

This report presents the discussions and findings of the **Ad Hoc Expert Group Meeting on Knowledge Systems for Development** held by the Division for Public Administration and Development Management (DPADM) from 4-5 September 2003. The meeting gathered together 10 eminent experts – academics and practitioners – and over 30 representatives of UN member state delegations, other entities of the UN system and partner organizations to discuss various facets of the knowledge society. In addition, the meeting served to advise DPADM on its particular niche in advancing the knowledge society. This report attempts to capture the rich debate that took place, some of the challenges raised, and recommendations on where greater focus should be placed.

UNDESA, and specifically the Division for Public Administration and Development Management, sees the Knowledge Society as a critical subject to address. Through the division's work on e-government, the role of information and knowledge in public administration and public sector reform has been considered for some time. More recently, however, the division has begun to also explore the role of the public sector in developing and implementing "national knowledge policies". These are the dual facets of the public sector in the knowledge society.

The role of knowledge in development and governance is certainly not new. However, knowledge has taken on an even greater degree of relevance and a different shape with the advent and deepening of the knowledge economy and society. There are multiple drivers of this phenomenon, one of them being the way in which society is becoming more complex and unpredictable in both positive and challenging ways. One can point to globalization, the economic value of ideas, global production chains, demographics of youth, challenges to political systems and rapid development in science and technology, including ICTs, as examples of this change.

It can be argued that these new imperatives demand responses that are more creative, innovative, smarter, and more active in their use of knowledge. Yet, while we often have an abundance of information, there is equally often a pronounced deficit of knowledge, or at least a deficit in our ability to create, use and apply it *meaningfully*.

UNDESA is guided by the Millennium Declaration in its work. In addition to detailing a number of socio-economic and governance goals, the Millennium Declaration also takes note of the importance of innovation, science and technology and knowledge as tools for meeting the Declaration's objectives. Capacity building towards these ends is called for. Guided by this framework, DPADM seeks to determine those knowledge-related activities and policy decisions that add *public value* and result in the *meaningful utilization of knowledge* throughout the whole society. The philosophy of the Millennium Declaration and its specific benchmarks also compel us to examine questions such as "how can all benefit from the knowledge society" and "how can its impact be felt across multiple spheres"?

However, these general goals and recommendations must be translated into more concise – though flexible – conceptual frameworks, implementable policy, and concrete actions. How to do this still remains somewhat vague, and most certainly complex. As such, the meeting sought to identify what it is that DPADM, from the perspective of the public sector, can do to further clarify and make more tangible the concept and practicalities of the knowledge society, especially taking into consideration the lessons learned to date by those around the world seeking to realize its potential.

The meeting explored a fairly wide range of questions so as to get a more holistic picture of the issues at hand and determine where DPADM's primary focus fits within the broader considerations of the knowledge society.

This report is structured around the four main sessions of the meeting which focused on the following themes:

I. Theoretical and Historical Underpinnings of the Knowledge Society
II. National Knowledge Systems
III. Measuring Knowledge Assets
IV. Knowledge in the Public Sector

Theoretical, Ethical and Historical Underpinnings of the Knowledge Society

The meeting started by asking "what is the knowledge society"? In this regard, experts reviewed the ethical, historical and theoretical underpinnings of the knowledge society. Questions posed included:

- What is knowledge (as opposed to data and information)?
- What are the antecedents to the knowledge society?
- What is different about knowledge today?
- What are the contours of the knowledge society?
- What are the values of the knowledge society?
- What are the cultural shifts that must take place?
- What are the different types of knowledge (for example technical, institutional, social, and cultural)?
- To what degree are guiding ethics and past and dominant frameworks compatible with the Millennium Declaration framework?

National Knowledge Systems

Having outlined these more general considerations, the specific characteristics of the knowledge society and its manifestation at the national level, coined "national knowledge systems", were examined. One can begin to identify some of the key goals, actors, institutions, partnerships, processes and systems or dynamics that constitute elements of a national knowledge system. One can additionally point to a number of disciplines that arguably fall under the knowledge rubric - including education, science & technology, research & development, innovation, information policy and human rights, promotion of culture and others. Ultimately, we must also examine cultural and political issues and systems within which knowledge is embedded and which will ultimately support, hinder or prohibit the meaningful development of the knowledge society. Under these themes, questions posed to experts included:

- Are national approaches adequately addressing these realities?
- Are they also directing these efforts towards socio-economic goals in a way that will allow all to reap the rewards of the knowledge society?
- Given this emerging complexity, to what degree is a holistic approach to the development of a knowledge society possible?
- Is the existing overlap between sectors merely duplicative or are there positive redundancies?
- What is the role of the public sector in building national knowledge competencies?

- And finally, are objective models possible to develop when what constitutes valuable knowledge may differ from society to society?

Measuring Knowledge Assets

The meeting sought to examine whether existing national approaches yield any common understandings and practices. If we can identify a number of variables that might constitute elements of a national knowledge system are there then possibilities for measuring knowledge assets at the national level. Questions posed to experts included the following:

- Can we measure a country's knowledge assets as embodied in individuals, institutions, and processes (for example learning, or the continuum of producing-acquiring-managinging-adapting-disseminating-absorbing/appropriating-applying and converting knowledge into something productive)?
- To what degree can we truly quantify creativity, innovativeness, intellectual capital, tacit knowledge and the potential to create new knowledge?
- How do we measure cultural and political variables such as diversity, tolerance, openness, trust and integrity? Can indicators, direct or proxy, be identified?
- How realistic would it be to develop and implement a measurement diagnostic tool and in a manner that would lead to more sound information and knowledge policy?

Knowledge in the Public Sector

Finally, while the precise role of the public sector in developing national knowledge systems may be the subject of debate, there is a clear role for the public sector in enhancing its own generation, dissemination and use of knowledge and in gathering knowledge through public debate and citizen participation in policy making and implementation. This goes beyond mere e-government and seeks to place knowledge as an essential factor in improving quality, effectiveness, collaboration, multidisciplinary programmes, and meaningful government reform. As such, the meeting also sought to focus not only on the tools of knowledge management, namely ICT, but also on the content and practices of knowledge as it is found in various forms in the public sector. The following question was posed to experts:

- How are governments currently grappling with this issue and do their practices yield any lessons and suggest future directions of work?

Objectives

These issues represented a fairly comprehensive agenda for what was a meeting of limited duration. As the intention was not to reach a consensus nor chart a comprehensive path to the knowledge society, the following slightly more modest and outcome oriented objectives were proposed to guide the discussions:

- Achieve a better understanding of what the Knowledge Society means in both conceptual and practical terms.
- Identify the special conditions – both challenges and opportunities - facing developing countries in this area.
- Observe on the role of the public sector in the development of a national knowledge systems, or components thereof.
- Propose a set of realistic and focused recommendations on next steps for national policy makers.

- Propose a set of recommendations on how DPADM can assist country states in building their knowledge capacities, at a national level and within the public sector.
- Identify specific tools that might be developed.

This report includes background papers prepared by the four primary experts, a summary of all the expert presentations, and a synthesis of the discussions held around each theme. It concludes with a series of findings from the meeting and attempts to outline some of the issues which the international community – at the national, regional and global levels – will have to address as we forge deeper into the knowledge society, seek to realize its potential, and more equitably capture its benefits.

I. THEORETICAL, ETHICAL AND HISTORICAL UNDERPINNINGS OF THE KNOWLEDGE SOCIETY

I.1 Overview

Every society has always been a knowledge society in the sense that it has been using knowledge – formally and informally - in economic growth and in social development. However, the ICT revolution at the end of 20th century revamps the ways in which knowledge can be created, harvested, assembled, combined, manipulated, enhanced and channelled. This increases the efficiency and effectiveness of using knowledge in economic growth and development to the extent that it is becoming the leading factor for adding value and for wealth creation in the market economy. In this Knowledge Age, intellect and creative, innovative ideas become a primary source of advantage. These factors also carry a promise of dramatically advancing human development and increasing the quality of life.

At the same time, while the creation and use of knowledge has accelerated, ethics have experienced difficulty in catching up. Unless creation and use of knowledge is put in the framework of the desired societal context – that of human development – and supported by shared values, the increased impact of knowledge that serves its own agenda, or a particular market agenda, or particular political agenda, will shape the societal context on its own. This can prove counterproductive from the point of view of quality of life of all people everywhere. As the march toward the global knowledge society progresses, questions concerning the historical antecedents and theoretical basis of the knowledge society, its current characteristics and attributes, the ends to which knowledge is applied, the ability of a society to participate in shaping the knowledge agenda, warrant greater attention.

In addressing these concerns, the experts and discussions for the first session focused on the history of the knowledge revolution in the west, views of what constitutes knowledge, the ethical dimension of the knowledge society, and knowledge architectures, systems or features that seek to promote economic development, productivity and human centered development.

I.2 Expert Background Paper

The Knowledge Society: Theoretical and Historical Underpinnings

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Useful Social Knowledge: some definitions

What is useful social knowledge? The term includes two elements, "social" and "useful" and I will deal with them in succession. What does it mean for an entire society to know something? The only sensible way of defining knowledge at a social level is as the *union of all the sets of individual knowledge of the members of this society*. It requires some simplifying assumptions – for instance, that we agree about who belongs and who does not belong to society. It also means that individual "knowledge" can be defined abstracting from the degree of certainty that the individual has in the correctness of this knowledge (which I will discuss in more detail below). An immediate corollary of the definition is that the set of knowledge contains contradictory elements: it usually contains elements inconsistent with one another (some people still believe the earth is flat or that AIDS is not caused by the HIV virus). Another obvious characteristic is that the "truth" of knowledge is irrelevant (by "truth" was can only mean that it conforms to the consensus views of our own time). In other words, "knowledge" pertains to what an individual *believes* to be true

This definition is consistent with our intuitive notion of the concept of an invention or a discovery – at first only one person has it, but once that happens society as a whole feels it has acquired it. When Einstein discovered relativity in 1905 it was felt that all of humanity had, even though only the minutest fraction could understand it (or even knew what it was all about). Knowledge differs from information in that it exists only in the human mind. It can be stored in external storage devices such as books, drawings, and artifacts but such knowledge is meaningless unless it can be transferred to and acquired by an actual person. Such a definition immediately requires a further elaboration: if one person possesses certain knowledge, how costly is it for others to acquire it? I shall refer to these costs as *access costs* and they are central to any understanding of the process of knowledge accumulation.

This concept of access costs is at the heart of the idea of a "technological society." Knowledge is shared and distributed, and its transmission through learning is essential for such a society to make effective use of it. Between the two extremes of a society in which all knowledge acquired by one member is "episodic" and not communicated to any other member, and the other extreme in which all knowledge is shared through some monstrous super network as envisaged by Robert Wright (2000), there was a reality of partial and costly sharing and access. But these access costs were not historically invariant, and their development is one of the keys to technological change. Basically, these costs depended on two types of factors, technological and cultural. The technological factors determined the physical costs of disseminating information including communications, transportation, printing, and the technology of organizing information. The cultural factors determined to what extent the people who possessed the knowledge were willing to share it and place it in social domain.

What kind of knowledge do I have in mind? What makes knowledge "useful? The term "useful knowledge" was used by Simon Kuznets (1965, pp. 85–87) as the source of modern economic growth.

[i] This paper draws in part on my *The Gifts of Athena: Historical Origins of the Knowledge Economy* (Princeton: Princeton University Press, 2002) and a number of papers.

One could debate at great length what "useful" means. In what follows, I am motivated by the centrality of technology. Because technology in its widest sense is the manipulation of nature for human material gain, I confine myself to knowledge of natural phenomena and regularities that exclude the human mind and social institutions. To be sure, a great deal of important knowledge, including economic knowledge, involves people and social phenomena: knowledge about prices, laws, relationships, personalities, the arts, literature, and so on. I should add right away that some "technologies" are based on the regularities of human behaviour (e.g., management science and marketing using psychology) and therefore might be considered part of this definition. Moreover, some segments of useful knowledge thus defined are rather unlikely to be applied to any technical purpose (e.g., astronomical knowledge about remote galaxies). Despite some gray areas and ambiguities, I shall maintain this definition.

Propositional and Prescriptive Knowledge

The set of useful knowledge defined above can be partitioned into two subsets: one is the knowledge that catalogues natural phenomena and regularities ("knowledge of what"), which I will call *propositional knowledge*. The other is the knowledge that prescribes certain actions that constitute the manipulation of natural phenomena for human material needs ("production") and which I will call *prescriptive knowledge.*

A few notes on the characteristics of those two sets. Propositional knowledge contains what we call "science" (formal and consensual propositional knowledge) as a subset, but it contains a great deal more than science. Through most of human history, indeed, science was a negligible subset, and it is one of the hallmarks of technological modernity that the relative size of the scientific component of propositional knowledge has grown in relative importance. Propositional knowledge also contains practical informal knowledge about nature such as the properties of materials, heat, motion, plants, and animals; an intuitive grasp of basic mechanics (including the six "basic machines" of classical antiquity: the lever, pulley, screw, balance, wedge, and wheel); regularities of ocean currents and the weather; and folk wisdoms in the "an-apple-a-day-keeps-the-doctor-away" tradition. Geography is very much part of it: knowing where things are is logically prior to the set of instructions of how to go from here to there. It also includes what Edwin Layton (1974) has termed "technological science" or "engineering science" and Walter Vincenti (1990) has termed "engineering knowledge," which is more formal than folk wisdom and the mundane knowledge of the artisan, but less than science. Engineering knowledge concerns not so much the general "laws of nature" as the formulation of quantitative empirical relations between measurable properties and variables, and imagining abstract structures that make sense only in an engineering or a chemical context, such as the friction-reducing properties of lubricants or simple chemical reactions(Ferguson, 1992, p. 11).

Prescriptive knowledge has the form of techniques or instructions: the archetypical technique is the recipe, which instructs one how to prepare a certain dish. In principle, all techniques are such sets, although vastly more complex and often full with nested do-loops, if-then statements and so on. It is the technique, not the artifact, that is the fundamental unit of analysis in evolutionary accounts of technology. They are sets of executable instructions or recipes for how to manipulate nature, much like Richard Nelson and Sidney Winter's (1982) "routines." When these instructions are carried out in practice, we call it *production*, and then they are no longer knowledge but action. It is comparable to DNA instructions being "expressed."

The instructions in the set I call prescriptive knowledge, like all knowledge, reside either in people's brains or in storage devices. They consist of designs and directions for how to adapt means to a well-defined end, much like a piece of software. They can all be taught, imitated, communicated, and improved upon. A "how-to" manual is a codified set of techniques. An addition to the prescriptive knowledge set of a society would be regarded as an "invention" (although the vast majority of them were and are small incremental changes unrecorded by patent offices or history books).

One feature of any technique is that it cannot wholly be written down, and that there is always an irreducible "tacit" component that cannot be eliminated, requiring the persons executing it to possess some knowledge. Not all techniques are explicit, codified, or even verbalized. But even those that are rarely complete, and much is left to be interpreted by the user. Thus riding a bicycle or playing a musical instrument consists of neuromuscular movements that cannot be made entirely explicit. It should be obvious that in order to read such a set of instructions, readers need a "codebook" that explains the terms used in the technique (Cowan and Foray, 1997). Even when the techniques are wholly explicit, the codebook may not be, and thus another codebook is needed to decipher the first and so on. Eventually some knowledge must be tacit. Sometimes instructions are "tacit" even when they could be made explicit but it is not cost-effective to do so.

Each society has access to some metaset of feasible techniques, a monstrous compilation of blueprints and instruction manuals that describe what society can do. What these techniques looked like in the more remote past is often hard to pin down. All the same, they existed. From that set, economic decision-makers, be they households, peasants, small-scale craftsmen, or large corporations, selected the techniques actually used. This choice is the technological analogue of natural selection, and since Nelson and Winter first enunciated it in 1982 it has remained the best way to describe and analyze technology and technological change.

Naturally, only a small subset of feasible techniques are in use at any point in time. How society "selects" some techniques and rejects others is an important question that needs to be discussed (Mokyr, 2003a). In addition, techniques need to be passed on from generation to generation because of wear and tear on their carriers. Much learning happens within families or in a master-apprentice relationship. Despite the codifiability of many techniques, direct contact between teacher and pupil seemed, at least until recently, indispensable. We need to distinguish between the knowledge needed to write down a set of instructions for the first time ("invent") and carry them out ("produce"). In order to write this paragraph, I have learned to use Word Perfect, but I need not know much about the programming language and technique used by the people who created the software. The amount and kind of knowledge necessary to play the *Hammerklavier* sonata is very different from the knowledge needed to write it.

The role of technology in economic growth

An increase in the set of prescriptive knowledge, allowing society to produce cheaper and better products is at the heart of the economic growth process. Economists have become accustomed to associate long-term economic growth with technological progress; it is deeply embedded in the main message of the Solow-inspired growth models, which treated technological change as exogenous, and even more so in the endogenous growth models. Whether technology is an exogenous deus ex machina that somehow descends like manna from heaven and makes productivity grow a little each year, or produced within the system by the rational and purposeful application of research and development — technology is central to the dynamic of the economy in the past two centuries. The growth of human and physical capital is complementary with growth in useful knowledge, and even the simple TFP computations that often equate the residual with technological progress demonstrate its importance beyond doubt. Many scholars believe that people are inherently innovative and that if only the circumstances are right (the exact nature of these conditions differs from scholar to scholar), technological change is almost guaranteed.

All the same, economic historians studying earlier periods have come to realize that technology was less important than institutional change in explaining pre-modern (say, before 1750) episodes of economic growth. It is an easy exercise to point to the many virtues of "Smithian Growth," the increase in economic output due to commercial progress (as opposed to technological progress). Better markets, in which

agents could specialize according to their comparative advantage and take full advantage of economies of scale, and in which enhanced competition would stimulate efficiency and the adoption of best-practice technology could generate growth sustainable for decades and even centuries. Even with no changes in technology, economies could and did grow in the presence of peace, law and order, improved communications and trust, the introduction of money and credit, enforceable and secure property rights, and similar institutional improvements (Greif, 2003). Better institutions could lead to improved allocation of labour and land, encouraged productive investment, reduced the waste of talent on rent-seeking and the manipulation of power for the purposes of redistribution (North, 1990; Shleifer and Vishny, 1998; Baumol, 2002). Pre-1750 growth was primarily based on Smithian and Northian effects: gains from trade and more efficient allocations due to institutional changes. The Industrial Revolution, then, can be regarded not as the beginnings of growth altogether but as the time at which technology assumed an ever-increasing weight and eventually dominant role in the generation of growth.

The main reason why technological progress was at best an also-ran in the explanation of economic growth before 1750 is that even the best and brightest mechanics, farmers, and chemists — to pick three examples — knew relatively little of what could be known about the fields of knowledge they sought to apply. The pre-1750 world produced, and sometimes produced well. It made many path breaking inventions. But it was a world of engineering without mechanics, iron-making without metallurgy, farming without soil science, mining without geology, water-power without hydraulics, dye-making without organic chemistry, and medical practice without microbiology and immunology. Not enough was known to generate sustained economic growth based on technological change.

Around 1750, all this began to change. Economic historians refer to the phenomenon as the Industrial Revolution and locate it in certain regions in Britain in a few key industries such as cotton and iron, but as I have argued elsewhere (Mokyr, 2003b), it relates to deeper changes occurring in much of the western world. In any event, the Industrial Revolution marks the beginning of modern economic growth, the kind of continuing expansion that can be sustained decade after decade, and did not run into the blockages and ceilings that previous societies had encountered. The literature on the Industrial Revolution is huge and still growing, and scholars have placed different emphases on economic and social components. The consensus is, however, that it is unimaginable without its technological component. From then on, technological change plays a growing and increasingly pivotal role in economic change, and whereas there can be no dispute that it started in the West, the underlying changes soon were to affect the entire world. What, really, changed?

To understand this profound historical question, we need to make some use of the concepts introduced earlier. The main idea is that in order to manipulate nature, something has to be known about its phenomena and regularities. Each technique in the set of prescriptive knowledge has a support or base in the set of propositional knowledge. I shall call that concept the *epistemic base* of the technique. For purposes of succinctness I shall summarize the logical and historical relationships between the different kinds of knowledge in ten propositions.

1. Every technique has a *minimum* epistemic base contained in the set of propositional knowledge, which contains the least knowledge that society needs to possess for this technique to be invented. The epistemic base contains at the very least the trivial statement that the technique works. There are and have been some techniques, invented accidentally or through trial and error, about whose modus operandi next to nothing was known except that they worked. We can call these techniques singleton techniques (since their domain is a singleton).
2. Some techniques require a minimum epistemic base larger than a singleton for a working technique to emerge. It is hard to imagine such techniques as nuclear resonance imaging or

computer assisted design software as emerging in any society as the result of serendipitous finds or trial-and-error methods, without the designers having a clue of why and how they worked.

3. The *actual* epistemic base is equal to or larger than the minimum epistemic base. It is never bound from above in the sense that the amount that can be known about the natural phenomena that govern a technique is infinite. In a certain sense, we can view the epistemic base at any given time much like a fixed factor in a production function. As long as it does not change, it imposes concavity and possibly even an upper bound on innovation and improvement. On the other hand, beyond a certain point, the incremental effect of widening the actual epistemic base on the productivity growth of a given technique will run into diminishing returns and eventually be limited.

4. There is no requirement that the epistemic base be "true" or "correct" in any sense. In any event, the only significance of such a statement would be that it conforms to contemporary beliefs about nature (which may well be refuted by future generations). Thus the humoral theory of disease, now generally rejected, formed the epistemic base of medical techniques for many centuries.

5. The wider the actual epistemic base supporting a technique relative to the minimum one, the more likely an invention is to occur, ceteris paribus. A wider epistemic base means that it is less likely for a researcher to enter a blind alley and to spend resources in trying to create something that cannot work. Thus, a wider epistemic base reduces the costs of research and development and increases the likelihood of success.

6. The wider the epistemic base and the lower the access costs to it, the more likely an existing technique is to be improved, adapted, and refined. The more is known about the principles of a technique, the lower will be costs of development and improvement. This is above all because the more is known why something works, the better the inventor can tweak its parameters to optimize it for different applications and debug the technique. Furthermore, because invention so often consists of analogy with or the recombination of existing techniques, a larger catalogue of existing techniques (which is part of propositional knowledge) and lower access costs to it stimulates successful invention.

7. The epistemic bases in existence during the early stages of an invention are historically usually quite narrow at first, but are often enlarged following the appearance of the invention, and sometimes directly on account of the invention. A new invention which is not properly understood stimulates the curiosity of researchers to try to see why it works and focuses their minds on a specific problem. In this sense, there is positive feedback from prescriptive to propositional knowledge, and it is this positive feedback that turbo-powers economic expansion in a technologically progressive economy.

8. Both propositional and prescriptive knowledge can be "tight" or "untight." Tightness measures the degree of confidence and consensualness of a piece of knowledge: how sure are people that the knowledge is "true" or that the technique "works?" The tighter a piece of propositional knowledge, the more likely the technique is to be adopted, and vice versa. Of course, tightness is normally closely correlated with observables: a laser printer can be easily seen to work better than a dot matrix, and there can be little dispute about the characteristics here. But for many medical and farming techniques it is often difficult to observe what works and what does not work as well without careful statistical analysis or experimentation.

9. It is not essential that the inventor, that is, the person writing the instructions, actually knows him or herself everything that is in the epistemic base. It is enough for the inventor to consult someone that knows – hence the importance of access costs. Even if very few individuals in a society know quantum mechanics, the practical fruits of the insights of this knowledge to technology may still be available just as if everyone had been taught advanced physics. What counts is collective knowledge and the cost of access as discussed above. It is even less necessary for the people actually carrying out the technique to possess the knowledge on which it is based, and normally this is not the case. Instead, each person executing a technique needs to possess a certain *competence*, which consists of the knowledge of how to read and execute the instructions in the technique and the supplemental tacit knowledge that cannot be fully written down in the technique's codified instructions.

10. The existence of a minimum epistemic base is a necessary but insufficient condition for a technique to emerge. A society may well accumulate a great deal of propositional knowledge that is never translated into new and improved techniques. Knowledge opens doors, but it does not force society to walk through them. It is here where the centrality of institutions and their interaction with useful knowledge is paramount.

Given these propositions, we can sharpen our understanding of modern economic growth. The technological breakthroughs we associate with the early stages of the Industrial Revolution (1760-90) could have crystallized into a new more or less static world as had happened repeatedly in the past. The Industrial Revolution would still have taken place in some sense, but it would have fizzled out by 1800 and a new stationary state would have emerged, as most observers at the time expected. This did not happen largely because the epistemic bases of the new techniques were wider, and more importantly, because they were growing. The growth of propositional knowledge after 1750 was of course no accident: technology and science influenced one another in many ways and coevolved, reinforcing and strengthening one another. The traditional linear model in which advances in science led to technological progress has long been abandoned. Technology affected science as much as the other way around. Moreover, as noted propositional knowledge contains a lot more than science and while the hallmark of technological modernity is that the scientific component is large and growing, in the period of the Industrial Revolution it was still quite small. The artisanal and descriptive forms of propositional knowledge were, however, rapidly as well. Dexterous and clever men learned to design better machines, based on principles that were slowly becoming better understood even if the science behind them was still quite murky.

Had the set of propositional knowledge remained more or less static, and had access costs remained the same, the expansion of techniques in the early Industrial Revolution would have run into diminishing returns. We might well imagine a counterfactual technological steady state of throstles, wrought iron, canals, and stationary steam engines, in which there was a one-off shift from wool to cotton, from animate power to stationary engines, and of cheap wrought iron, with no further progress. However, the "first wave" of innovations was followed after 1820 by a secondary ripple of inventions that may have been less spectacular, but these were the microinventions that provided the muscle to the downward trend in production costs. The second stage of the Industrial Revolution adapted novel ideas and tricks to be applied in new and more industries and sectors, improved and refined the earlier and eventually showed up in the productivity statistics. The techniques applied first in cotton were adapted to wool and linen. Iron became progressively better and cheaper. Railroads reduced transport costs and allowed more local specialization and eventually more labour mobility. Iron ships equipped with modified high-pressure boilers began shipping ever-cheaper food and raw materials from other continents. Chemists learned why the old processes worked and then varied them to make the old ones cheaper and create entirely new ones. By 1870 we can speak of a second Industrial Revolution. While income growth in Britain during the

"classical" Industrial Revolution had been modest, per capita growth after 1830 accelerates to around 1.1 percent, modest perhaps by modern standards but unprecedented in the nineteenth century.

In the ensuing years, the role of technology in economic growth has been steadily expanding. The second Industrial Revolution added many new ingredients to the ever expanding horizons of production in the west: cheap steel, electrical power, synthetic chemicals, pharmaceutics, food processing, and interchangeable parts manufacturing to mention a few. By 1914, the technological gap between the West and the Rest had reached unimaginable proportions, resulting not just in a large difference in income per capita as far as we can measure it, but also in the ease with which Europe controlled much of the under-developed world.

The economic history of the twentieth century is perhaps the best testimony to the enormous force that growing useful knowledge had acquired as an agent of historical change by 1914. After all, whereas during the nineteenth century (actually between 1815 and 1914) Europe had been relatively at peace and subject to only minor and short-lived fluctuations, the twentieth century was an age of two devastating world-wars, a collapse of the international economy after 1914, violent inflations and a great depression vastly more serious than anything previous experienced, the rise of totalitarian and/or collectivist governments that imposed policies almost always detrimental to economic growth. To top things off, Europe lost its colonies after 1945 and population growth slowed down to a trickle with the decline of fertility in the closing decades of the century. Had an informed observer in 1914 been told of these pending events, a prediction of unavoidable sharp economic decline would have been in place.

Yet despite those obstacles the West experienced much faster growth in the twentieth century than before. We can only guess at how much faster this growth would have been had the fateful events in July 1914 taken a different turn and the world had been spared the horrors of the wars and of Leninism and Hitlerism. What is even more remarkable is that there were few dramatic technological breakthroughs in the decades immediately following 1914: many of the technological advances of the twentieth century were in place in 1914, and just needed continued development and improvement to make their mark on daily life. Internal combustion engines, aviation, telephony, electricity, synthetics, even electronics had their starts in the years before World War I. The following three decades witnessed continuing expansion of these techniques, with dramatic consequences for the standard of living of those lucky enough to survive.

After 1945, dramatic new developments did occur again, especially the advances in microprocessors, unorthodox energy sources and uses, antibiotics, satellites, and a plethora of new materials, to name just a few. Yet here too, what strikes one is the importance of development rather than invention alone. The invention of the laser, to pick just one example, is a dramatic application of quantum physics and would have been probably impossible in the nineteenth century. But its rapid application to areas as diverse as music playing, barcodes, eye surgery, and smart bombs testifies to the wide epistemic base of the knowledge underlying it and the much lower access costs that twentieth century engineers and inventors faced. Not all new techniques were equally successful, and some of them have been abused. Yet the overall picture is undeniable: the growth of useful knowledge and the concomitant technological progress has turned from a relatively small contributor to economic change to the engine that moves economies to ever-higher plateaux.

Institutions, politics and the conditions for knowledge

Technology may have been the engine of economic growth in modern times, but as any driver knows, cars do not move by engines alone. Many scholars feel that *institutions*—formal and informal—matter more: the trustworthiness of government, the functionality of the family as the basic unit, security and the

rule of law, a reliable system of contract enforcement, and the attitudes of the elite in power toward individual initiative and innovation. Some societies are simply better organized and their incentive systems work better. In this view, best expressed by North (1990) and Eric Jones (2002), hard work, initiative, and frugality will bring about growth only if they are properly rewarded, and such rewards are determined by the institutional structure. The main institution that accounted for economic success was the market, but I submit to you that markets on their own could not have generated the level of growth we have experienced since 1914.

The juxtaposition of "institutions" and "useful knowledge" as alternative explanations of economic growth is, to a large extent, artificial. Differences in institutions are better at explaining differences in income levels in cross section at a given moment. Knowledge can and does flow across national boundaries, if not always with the frictionless ease that some economists imagine. If the only reason why Germany is richer than Zimbabwe today were that Germany possesses more useful knowledge, the difference might be eliminated in a relatively short time. If we were to ask, however, why Germany is richer today than it was in 1815, the importance of technology becomes unassailable—though better institutions might still be of importance as well.

However, such decompositions of the sources of growth are of limited use. Institutions and knowledge interact, and the interaction term may be larger than the individual components on their own. Institutions play a central role in the rate and direction of the growth of useful knowledge itself. Science and technology, as the constructivist school insists, are social processes. This approach is not as remote from the thinking of economists as they believe: everyone agrees that incentives matter. It is also understood that the supply of talent in the economy is finite, and that it should be regarded as another scarce resource Murphy, Shleifer, and Vishny, 1991). Institutions help determine on which margins the efforts and time of the most resourceful and ambitious men and women will be applied. Potential entrepreneurs, innovators, and inventors will try to make their fortune and fame wherever they perceive the rewards to be most promising. There are many possible avenues where this can be done: industry, commerce, innovation, the arts, and finance—or plunder, extortion, and corruption. From the point of view of the economic agent a dollar made in any activity is the same. From the point of view of the economy, however, entrepreneurial activity is enriching, rent-seeking is impoverishing (Baumol, 1993). The institutions of society determine where these efforts will be most rewarding and remunerative.

Institutional factors mattered first and foremost because they determined the efficiency of the economy by affecting the exchange relations among people, resource allocation, and savings and investment behaviour. Useful knowledge is different. The fundamental nature of production is an attempt to tease out of the environment something that is desirable by humans but that nature is not willing to give up voluntarily. By abandoning hunting and gathering and by exploiting the regularities they detected in nature, people invented farming and created what we might call a production society. By formalizing these regularities into something that eventually became "science" and allowing them to interact with the techniques they implied, the Baconian program reached a critical mass in late eighteenth-century western Europe. There was nothing inevitable about this, and it is far from obvious that, had Western Europe never existed, or had it been wiped out by Ghenghis Khan or taken over in its entirety by the Spanish inquisition, that some other society would have eventually developed X rays, solar-powered desk calculators, and freeze-dried coffee.

The search for new knowledge can take many different avenues, some of which are more useful than others. Knowledge that may have seemed initially as rather abstract, such as pure mathematical knowledge, can find eventually unexpected uses. And yet, the accumulation of useful knowledge is not like other entrepreneurial activities. The drive for the understanding of nature and the recognition of one's peers for having done so successfully transcends purely material motives. In all human societies, curiosity

and the thirst for knowledge for its own sake have been a driving motive in the accumulation of propositional knowledge. People do not expect to be paid for solving crossword puzzles; they enjoy the challenge. Scientific and technological puzzles are no different. One way of describing the modern age is that the relative importance of knowledge for its own sake has declined relative to useful knowledge that may be mapped fruitfully into better techniques. Whereas some part of the growth of propositional knowledge in a society of market-driven capitalist institutions is still motivated by pure epistemic motives, economic interests, no matter how remote, have become increasingly important in driving and directing the growth of useful knowledge in the past century and a half. The Baconian dream is increasingly becoming a reality.

Moreover, much of the transformation of useful propositional knowledge into techniques comes from discoveries whose significance as an epistemic base was realized only much later. What may seem knowledge acquired for purely epistemic reasons, ends up finding unexpected applications never dreamed of by the discoverers. It would be absurd to think that Niels Bohr and Erwin Schrödinger were thinking of MRIs and lasers when they helped develop quantum physics. Yet such detachment cannot be said to describe "pure" science fully today. Somewhere in the back of the minds of most "pure" scientists are funding considerations. Funding agencies, somewhere in the back of their minds, think of legislators. And legislators, one hopes, in a remote corner of the back of their minds, have society's needs at heart. Much research into prescriptive knowledge, of course, is directly inspired and motivated by the perceived needs of society. No inventor sets his mind in making something that nobody would want. Curiosity, the love of challenge, and other "internal" mechanisms have not disappeared, but they have to share the dominant motivation for research into propositional knowledge with financial considerations as determined by the market.

The existence of organizations in which such knowledge is preserved, diffused, and augmented (such as academies, universities, and research institutes) and the rules by which they play (such as open science, credit by priority, reproducibility of experiment, and rhetorical rules of acceptance) helped determine its historical path. The rate of technological development has been deeply affected by the fact that the people who studied nature and those who were active in economic production have been, through most of history, by and large disjoint social groups. The flows of knowledge between them and the ease of access to social stores of knowledge were of central importance in explaining progress over past centuries.

Access was important because useful knowledge could only become economically significant if it was shared, and access was shaped by institutions, attitudes, and communications technology. Today, far more than in the past, those who create new techniques and products have the training and the wherewithal to give them easy access to the propositional knowledge that serves as the epistemic base for the new prescriptive knowledge. The miracle of modern economic growth cannot be understood without a clear understanding that the modern age is different in this respect.

How this transformation occurred is a complex tale, to which no justice can be done here. In the middle of the seventeenth century most of what was to become the industrialized West was still in the grips of mercantilism, which regarded economic activity as a zero sum game in which whatever one nation or one group within that nation could wrestle away from others was their net gain. The notion that such redistributive or "rent-seeking" activities were bad for society still had not ripened. It is only during the Enlightenment that it slowly dawned upon Europeans that the search for useful knowledge was one of the keys to the continued economic and social progress they sought. This movement within the Enlightenment traced it origins back to Francis Bacon and insisted that the social agenda of research take into account the potential of natural philosophy to improve the "useful arts" – that is, technology.
For such progress to take place, a number of things had to happen. One was that society would ensure that whatever gains resourceful innovators and manufacturers made of their technological advances would not

be expropriated by criminals, foreign invaders, tax collectors, or personal-injury litigators. Rent seeking had to be constrained, and this point became a major item of concern among Enlightenment thinkers, above all Adam Smith. Secondly, social institutions had to restrain political forces that opposed technological innovation and the expansion of useful knowledge. Such resistance might originate from vested interests trying to protect their turf, from conservative ideologues, or from concerned citizens who fear that unknown techniques might incur unforeseen and unsuspected costs that dwarf their benefits. In any event, without institutions favourable to innovation, technological progress might be seriously impeded and even completely stopped in some areas. Furthermore, it is frequently maintained, society needs a certain degree of individual freedom to achieve technological progress. Historically, this is less obvious than it might sound. Technological progress occurred in many places that do not seem free, at least by our standards. What may be more important than "freedom" is a certain tolerance for rebels and deviants, who are dissatisfied with current states of knowledge and think they can do better. It bears keeping in mind that most of such rebels never discover or invent anything useful and become little more than a nuisance to others. It is a small proportion of them who become the Galileo's, Lavoisiers, and Faradays. But *ex ante* it is impossible to know who among them will make important discoveries, so the unavoidable price society pays for technological progress is to put up with troublemakers and crackpots.

Finally, society has to set up positive incentives for creative individuals. Some of the best recent work in the economic history of technological change focuses on the working of the patent system as a way of preserving property rights for inventors. In a series of ingenious papers, Kenneth Sokoloff and Zorina Khan have shown how the American patent system exhibited many of the characteristics of a market system: inventors responded to demand conditions, did all they could to secure the gains from their invention and bought and sold licenses in what appears to be a rational fashion. It was accessible, open, and cheap to use and attracted ordinary artisans and farmer as much as it did professional inventors and eccentrics (Khan and Sokoloff, 1993, 1998, 2001; Khan, 2002).

Whether this difference demonstrates that a well-functioning system of intellectual property rights is truly essential to the growth of useful knowledge remains an open question. For one thing, the American system was far more user-friendly than the British patent system prior to its reform in 1852. Yet despite the obvious superiority of the U.S. system and the consequent higher propensity of Americans to patent, there can be little doubt that the period between 1791 and 1850 coincides roughly with the apex of British superiority in invention. The period of growing American technological leadership, after 1900, witnessed a stagnation and then a decline in the American per capita patenting rate. Other means of appropriating the returns on R&D — above all first-mover advantage — became relatively more attractive. In Britain, Mac Leod (1988) has shown that the patent system provided only weak and erratic protection to inventors and that large areas of innovation were not patentable. Patenting and intellectual property rights were associated with commercialization and the rise of a profit-oriented spirit, but their exact impact on the rate of technological progress is still obscure.

What is sometimes overlooked is that patents placed technical information in the public realm and thus reduced access costs. Inventors, by observing what had been done, saw what was possible and were inspired to apply the knowledge thus acquired to other areas not covered by the patent. In the United States, *Scientific American* published lists of new patents from 1845, and these lists were widely consulted. Despite the limitations that patents imposed on applications, they reduced access costs to the knowledge embodied in them. This function of the patent system apparently was fully realized in the 1770s. The full specification of patents was meant to inform the public. In Britain this was laid out in a decision by chief justice Lord Mansfield, who decreed in 1778 that the specifications should be sufficiently precise and detailed so as to fully explain it to a technically educated person.

Patenting is not the only mechanism that has historically been used to reward inventors for their efforts and make sure they reap the fruits of their work and investment. In propositional knowledge, indeed, IPR's are not used and explicitly eschewed. Inventions can be patented, discoveries cannot. The norms of "open science," established in Europe during the Scientific Revolution, meant that contributions to propositional knowledge were placed in the public realm as soon as they were made. The recognition of a property right in an idea meant a citation, but no more. Academics get very obsessive about citations to their work, and this is precisely the cause. Those who made discoveries that were regarded as particularly useful were rewarded in a variety of ways: medals, pensions, life-long tenured jobs, honorary doctorates, aristocratic titles, and prizes (including the Nobel prize in our time). There is no suggestion that there is any proportionality between the magnitude of these rewards and the economic value of the addition to propositional knowledge. Perhaps there should not be: it is society at large that appropriates most of the surplus of new knowledge. All the same, the rate of growth of useful knowledge is sensitive to the incentives to which creative individuals are subject, because on the margin individuals make decisions on how to spend their lives and what careers to pick.

Useful knowledge and changes in daily life

Knowledge matters not only to production. What people know — or, more accurately, what they *think* to be true — matters a great deal to daily life. Households allocate resources to purchase goods not just on the basis of preferences, income and relative prices. They also have certain beliefs about their environment and physical world which helps make decisions as to how to consume. A medieval farmer might have paid a priest whose prayers, he believed, would increase his crop. Rhinoceros horn is eagerly purchased by some people who believe it to be an aphrodisiac. On the whole, however, until recently, consumption was not affected much by knowledge of the human body because the understanding that what people eat and how they look after themselves and others determines their health required knowledge that was simply not there. Most people were fatalistic about sickness and death and believed it beyond their power to prevent it from happening. Though *some* ideas that dirt was unhealthy and that spoiled foods could make one violently sick had been around since antiquity, these ideas were developed and became far more accepted in the last third of the nineteenth century. It became, perhaps, the greatest revolution that more and better knowledge ever produced.

The basic idea I want to propose is that consumers choose consumer goods in part on the basis of their beliefs as to how consumer goods affect their health. This has had major consequences in human history. What counts, above all, is what people believe to be true about the material world around them and how their actions and the way they run their lives affect their physical state. Nobody can fully understand the complete impact of consumption on their health, because the human body is an unbelievably complex entity, which interacts at many level with its environment. People can, however, be closer to or further from the truth (or what appears to us to be the truth) in measurable amounts. The household choices regarding matters that affect their health depend in part on what they know, of course, but there must be more to it than that. As biologist Richard Lewontin has observed, "the reason that people do not have a correct view of nature is not because they are ignorant of this or that fact about the material world but that they look to the wrong sources in their attempt to understand it" (1997). The point, however, is that one can follow better recipes even on a narrow epistemic base, that is, without having a "correct view of nature," as long as one is willing to accept techniques and rules of thumb designed by authorities and trusted experts, if these actually improve health. In that sense the notion proposed above regarding the social character of the epistemic base of techniques applies. Homemakers do not have to know in any detail *why* certain kinds of prescriptive knowledge work, they just have to be persuaded to follow the instructions.

How do households pick and choose from the vast menu of commodities and recipes those that they believe enhance their health? Best-practice medicine, bacteriology, physiology, and nutrition science (to pick just a few) of course play a major role. But households are not like firms: no competitive pressures "force" them to adopt best-practice techniques. Someone had to persuade them. Rhetoric, marketing skills, political influence, and prejudice, as well as emulation and social learning, came into play. Persuasion requires shared standards of evidence, chains of authority, networks of trust, and accepted rules of logic and evidence. Changes in the rules of discourse and communication, the nature of authority and expertise, no less than the knowledge itself unearthed by science, were the background to the changes in health and longevity that are the mark of the "modern" age.

The sources of the growth in this knowledge can be readily identified. One was the growing use of statistics (in the sense of large databases) to identify patterns and regularities. The roots of this movement went back to the eighteenth century, especially to the debates around the efficacy of the smallpox inoculation procedure, the beneficial effects of breast-feeding, and the bad effects of miasmas (putative disease-causing elements in the atmosphere). But only in the second third of the nineteenth century did this movement truly take off. The founding of the Statistical Society of London in 1834 led to an enormous upsurge in statistical work on public health. In Britain, William Farr, William Guy, and Edwin Chadwick were the leaders of this sanitarian movement, but it encompassed many others (Flinn, 1965). On the continent, the leaders of the statistical movement included such notables as Adolphe Quetelet, René Villermé, and Charles-Alexandre Louis clustered around the *Annales d'hygiène publique* in the 1830s. The connection between the sanitarian movement and the statistical revolution was fundamental to the changes in the perceived health effects of consumption and behaviour. Between 1853 and 1862 no less than a quarter of the papers read before the Statistical Society of London dealt directly with public health and vital statistics.

Among the other great triumphs of this methodology were the discoveries of John Snow and William Budd in the 1850s that water was the transmission mechanism of cholera and typhoid, and in 1878 that milk was a carrier of diphtheria by correlating the incidence of the disease with milk-walks (Hardy, 1993, p. 90). In clinical medicine, the use of statistical tools was critical to the insight of C. A. Louis, who developed a "numerical method" for evaluating therapy and around 1840 provided statistical "proof" that bloodletting was useless, leading to the gradual demise of this technique (Hudson, 1983, p. 206). Louis's work and the decline of bloodletting was an excellent example of how statistical methodology could make propositional knowledge tighter and subsequently persuade others to change their techniques. Similar work on breast-feeding led to a campaign to persuade women to nurse longer. Statistical analysis — using more sophisticated techniques and huge databases — still underlies much work on the impact of consumption on health in our own time, from the effects of smoking to those of breastfeeding and fat consumption. Such quantitative studies are a substitute for a true epistemic base: it is exactly because we do not understand precisely how broccoli or garlic prevent colon cancer that we need to rely on large scale statistical studies to persuade us to change our diets.

The second breakthrough of the nineteenth century, was the germ theory of disease. Bacteriology was more than just a way of attributing certain symptoms to certain microorganisms. The germ theory provided an entirely new concept of disease: how it was caused, how to differentiate between symptom and cause, and how infection occurred. As is well known, the germ theory was not quite "invented" in the decades after Pasteur's famous work on silkworm disease. It had been proposed repeatedly since the sixteenth century, and in 1840 Jacob Henle revived the theory in Germany. It remained, however, on the fringes of medical science, and in the following decades Henle was regarded by the medical profession as fighting a "rearguard action in defense of an obsolete idea" (Rosen, 1993, p. 277). We might say that the germ theory prior to Pasteur and Koch was *untight*. It might be true or it might not, but for contemporaries there was no way of knowing for sure. The triumph of the germ theory after 1865 should be

regarded above all as a victory of scientific persuasion in which brilliant scientists were able to combine scientific insights with considerable academic prestige and a good understanding of how power and influence work in the scientific community (Latour, 1988). It relied on an experimental method widely touted to be a failsafe way of unearthing "truth" and was thus accepted by increasing numbers of people with the same blind faith previously reserved for religion. Rhetorically, then, it was useful knowledge that was powerful and persuasive enough to change the recipes used by households in the West even if many of the details of the new theory of disease remained highly controversial for decades.

The third revolution consisted of the knowledge that small traces of certain substances are crucial to human health. The realization that some crucial substances cannot be manufactured by the body from other nutrients and need to be supplied by the diet is of special interest here, because normally these techniques involved relatively minor and inexpensive reallocations of household resources with disproportionate favourable effects. It may seem that once this knowledge was discovered, the mapping of this knowledge to household techniques would have been obvious and immediate, and changes in behaviour would be forthcoming rapidly. But historically this was not quite the case. Physicians in the West had discovered in the nineteenth century that cod liver oil was an effective treatment for rickets, but this was a purely empirical procedure, a typical singleton technique not based on any notion of why it worked (Rosen, 1993, p. 383). Hence mistakes were made and further development was blocked, as was often the case with techniques that rested on a narrow epistemic base. Another example is the history of scurvy. The importance of fresh fruit in the prevention of scurvy had been realized even before James Lind published his *Treatise on Scurvy* in 1746. The Dutch East India Company kept citrus trees on the Cape of Good Hope in the middle of the seventeenth century, yet despite the obvious effectiveness of the remedy, the idea did not catch on and "kept on being rediscovered and lost" (Porter, 1995, p. 228). Only after the seminal paper by Axel Holst and T. Fröhlich in 1907, which reported the inducement of scurvy in dietarily deprived guinea pigs, did it become clear that certain diseases were not caused by infectious agents but by deficiencies of trace elements, and only in 1928–32 was ascorbic acid isolated as the crucial ingredient (Carpenter, 1986; French, 1993). Before the epistemic base of nutritional deficiency diseases was recognized and became tight, the techniques dealing with these diseases were simply pathetic.

In this fashion, new knowledge affected daily life. People learned to make sure to drink safe water, to take better care of their babies, to avoid lice and mosquitoes, to eat fresh vegetables and fruits, to wash themselves and their utensils, and so on. Humanity had discovered that microbes around them threatened their lives and while they could still not cure these diseases when they occurred, they learned how to avoid them by "tweaking" their consumption, buying more soap and grapefruits. For this to occur, of course, they had to be persuaded that this was in their interest.

The prestige and authority of learned men and women in white coats increased steadily in the late nineteenth and twentieth centuries, and an entire discipline arose ("domestic science" or home economics) whose purpose it was to instruct people in the healthy and responsible ways of running a household. A main function of medical professionals – who still made house calls in those days – was to instruct and inform the population of the "correct" procedures. They were assisted by such organizations as the British Ladies' National Association for the Diffusion of Sanitary Knowledge (founded in 1857). Between 1857 and 1881 this association distributed a million and a half tracts loaded with advice on pre- and postnatal care, made millions of house visits, and spread the gospel of soap and clean water. In the late Victorian period, the poorer classes were apparently receptive to these volunteers (Wohl, 1983, pp. 36–37). The association also published tracts on diet and either taught cooking classes or campaigned to have it taught in elementary schools (Williams, 1991, p. 70).

The effects of this revolution were massive and can be summarized under the following headings.

1. **Longer lives** Life expectancy increased enormously in the seventy years before the invention of antibiotics, mostly due to the decline in infectious disease. Between 1900 and 1950 most Western societies experienced a gain of about 25 years, a historically unprecedented event. Since clinical treatments for most of these diseases were still largely unavailable, it must be chalked up primarily to preventive treatment and public health.

2. **Better lives** Data on morbidity are more difficult to find but not altogether absent. By avoiding diseases – especially childhood diseases – people lived healthier and better quality lives. One corollary of this is the increase in the physical stature of Western people, for centuries stunted by childhood diseases and malnutrition.

3. **Changing Role of Government** It became clear that certain forms of disease prevention could only be carried out effectively by the public sector, especially in the areas of sanitation and insect control. This led to a considerable increase in government intervention, widely regarded as benign by most economists. At times the government felt it knew better than its own citizens what was good for them, adding chlorine and later fluoride to drinking water, and Vitamin D to margarine (a policy that eliminated rickets).

4. **Changing roles of women** Much preventive medicine depended on cleaning and other forms of household labour. Traditionally, these tasks had been carried out by women, and the sanitary and nutritional revolutions made women the foot soldiers of the movement. This redefined the role of women as the sanitary guardspersons of the household and created a serious impediment to their employment outside the household until the second half of the twentieth century.

5. **Changing role for Science** There can be little doubt that the improvement in health and life expectancy have contributed enormously to the prestige and authority of science in the modern world. Far more than the discoveries of quantum physics, relativity, genetics, and other major scientific achievements of our century, this revolution has been responsible for the crowning of scientists as the new oracles of our modern society. Experts and trained professionals are now expected to solve our problems whatever they are, much as priests were in earlier times. The successes of social science, economics, psychiatry, and psychology in affecting our daily lives, such as they are, cannot really compare with the dramatic increase in the physical characteristics of life.

6. **Social Security** The increase in life expectancy has created, for the first time in history, a new leisure class of pensioners. Leisure classes in previous ages were always the rich and powerful; the poor normally worked until they dropped, and few workers lived much beyond their productive years. The twentieth century has made it possible to create a wide-spread phenomenon in which the majority of people can live beyond the age at which they can usefully work. Thus new knowledge has created, indirectly, a new economic and social phenomenon whose full implications are apparently not yet fully understood.

The diffusion and migration of knowledge

As noted above, the impact of knowledge is proportional not only to its content but also to its diffusion. Knowledge dissemination takes place at both the international and the local levels. The fundamental fact that dominates the literature on this topic is that knowledge is almost always costly to acquire, but it is a public good in that someone who possesses it and shares it with another — unlike pizza or land — does

not have less of it him or herself, a property known as non-rivalrousness. Moreover, in many cases it is difficult to exclude others from access to knowledge. To be sure, secrecy and intellectual property rights can to some extent exclude from knowledge, but once the knowledge has been imparted to another, it is hard for the original owner to prevent it from flowing to third parties.

A very naive question would be this: if useful knowledge is the central factor in economic growth and if it is a public good that can flow at low cost from developed countries to the third world, why isn't the whole world developed (Easterlin, 1981)? As I noted above, economic performance depends on institutions that will actually allow an economy to take advantage of whatever knowledge it has. It is therefore perfectly imaginable that if Iraq and Denmark have access to the same knowledge, they would still have very different economies.

Yet knowledge is not equally shared amongst different economies in the world, and understanding why may enhance our understanding of how knowledge affects the economy.

1. **Human Capital** A great deal of useful knowledge – both propositional and prescriptive – requires substantial training to acquire. It is often written in technological jargon and demands heavy investment in prior education. In countries in which these skills are scarce, knowledge can only be imported together with foreigners who possess it. Yet upon closer examination this issue seems to be less important than is often believed: many poor countries have good institutions of learning (e.g. the Indian Institute of Technology) and yet the graduates of these schools seem to have a low social marginal product and often emigrate to Western countries. If they were truly indispensable, their countries would make more of an effort to keep them. Moreover, many residents of these countries have opportunities to study in the West. Had this been the sole bottleneck, a massive education effort would be able to solve much of the problem in a fairly short time.

2. **Physical Capital** Technology is knowledge, but often it requires implements or artefacts to be actually executed. No knowledge of playing a piano will be of much use in the absence of the instrument. Advanced equipment and knowledge are typically highly complementary, and if such equipment is too costly in a particular society, there seems to be little point in acquiring the knowledge. Poor nations that cannot afford, say, sophisticated MRI machines would be ill-advised to send their doctors to study how to use these machines.

3. **Bad Policies** Institutions affect economic performance directly, but they also feed through useful knowledge. Governments play, as I already noted, an important role because knowledge as a commodity cannot rely on market mechanisms alone. Governments must invest in infrastructure for knowledge to be diffused: libraries, communications networks, and the like. Moreover, governments must create the conditions for knowledge transfer. These can be quite different than knowledge *creation.* Knowledge diffusion requires a willingness to learn, to follow, and to imitate. After the Meiji revolution in Japan, this is precisely what the Japanese authorities did and the Chinese did not. It involves an implicit admission of the technological superiority of foreigners (in some dimension at least), which can be hard on the national pride. It also may conflict with local ideology or religion: it is often asserted, for instance, that some Islamic societies tend to be hostile to Western science. Moreover, it may well be that the correlation of this knowledge with the West may create a hostility toward it for political reasons that have little to do with the content.

4. **Competence and Knowledge** The fundamental reason, however, why not all useful knowledge is spread equally among nations is that it may actually matter less to economic development and performance than is commonly believed. The reason I believe so goes back to the very definition of production: production is the execution of a technique. It is, as I noted, not important for the person who carries out the technique to possess the epistemic base of the underlying instructions. He/she does not have to understand how and why a technique works the way it does. All he/she has to know is how to carry them out. This knowledge is what I call competence and its relationship with useful knowledge is actually quite complicated. It is quite possible for techniques to become increasingly sophisticated, relying on increasingly wide and diverse epistemic bases, and yet to require less and less competence because they are more standardized and user friendly. This implies, in fact, that much of the knowledge in this world that drives continuous economic growth is normally concentrated in the minds of a relatively small number of better and better trained people, but that for the vast bulk of workers this knowledge is not necessary. African nations can use cell phones and airplanes well without having the sophistication of the engineers of Nokia and Airbus and anti-AIDS medications without having to develop them from scratch. At first glance, there is no real down-side to this: an international specialization in knowledge is inevitable in any case. Nobody expects Luxembourg to develop their own knowledge of airplane construction, for them that of Boeing is quite sufficient.

A corollary of these propositions is that the uneven diffusion of knowledge among different societies is not the main cause of the huge and growing differences in income and living standards between developed and underdeveloped countries. There is not much in Western science and technology that Liberian or Haitian engineers could not learn in a relatively short time, if perhaps assisted by spending a few years at MIT or CalTech. But on its own, such knowledge would not help these countries bridge the gap; all that would happen is that such highly trained people would search for jobs in richer countries and not go back to their home countries. Instead, the economic conditions for production using sophisticated and interdependent techniques have to be met: stable and honest government, law-and-order, competent, reliable, and compliant workers, and similar normal requirements for a prosperous society. If these are met, all that counts is access costs to the knowledge that is already there. Given the recent sharp fall in the marginal access costs to much of this knowledge, this does not seem to be too high a hurdle.

Intellectual Property Rights

The one obstacle to the use of prescriptive knowledge in countries that may be behind in their propositional knowledge is IPR's. Corporations that spend large sums on R&D that yield successful prescriptive knowledge are understandably unlikely to make it freely available to possible users and while they hold patents tend to charge high prices for the knowledge. The economic quandary is well-known: once the knowledge exists, it is costless for the owner to share it, but of course this will erode a monopoly position that may have been the incentive to create the knowledge in the first place. Most economists seem to regard some profits to those who create prescriptive knowledge as the inevitable cost of progress. It surely is possible to regulate and modify such profits by economic policy. The drug companies that created antiviral drugs, at possibly very high cost, should sell at prices very different from those charged for good with lower net social utility. Simple policy measures in the knowledge-creating countries could resolve this issue fairly easily, but relying on free markets alone may not do the trick.

Is Knowledge "good?" Some ethical considerations

Economists today are usually bad philosophers. The age of giants trained in philosophy such as Adam Smith, Karl Marx, and John Stuart Mill, is long passed. For most people trained in economics, the simple idea that "more is better" derived from Benthamite utilitarian calculus seems to be enough. It is better to

have more than less, and welfare comparisons are based on that axiom. Distributional issues are of course discussed, but often in terms that look at the effect of redistribution on the total size of the pie. With the issue of useful knowledge as defined here, the matter does get more complicated and it is important to at least place the issues on the table.

Is more knowledge always better? In general, the answer must be no: everyone can think of a possible set-up in which an individual can be made worse off by revealing some damaging fact. But in this paper I have defined useful knowledge in a far more limited way namely as that subset of all knowledge that deals with the understanding of nature for the purpose of controlling and manipulating her for our material benefit. Can such knowledge ever be bad? It is obvious that in the past people have clearly believed so. Prometheus, who revealed to mankind the Gods' secret of fire was punished for his deed, and humanity itself was punished by unleashing Pandora's box. The famous myth of the Sorcerer's Apprentice symbolizes the dangers of mankind acquiring knowledge not meant for it. Frankenstein-type of stories are all over the literature and reveal a genuine and sincerely felt concern. The current world, despite its seeming sophistication, is not really very different: the resistance to cloning and stem-cell research in the US and to genetically modified foods in Europe reflects these attitudes.

The history of the twentieth century bears out some of those fears. The new useful knowledge acquired in the West during the second Industrial Revolution was used in terrible ways during the two World Wars, culminating in the use of weapons of mass destruction. Many new techniques have had mixed track records in terms of their overall social benefit: internal combustion engines, nuclear power, insecticides and other techniques of environmental control, chlorofluorocarbons, and many other techniques have ex post have involved costs far higher than anyone suspected. The difficulty is not just that some of these techniques have had a negative effect on economic welfare. The problem is the irreversibility of new knowledge. Once it exists, it can almost never be "undone." It may well be that we might be better off in 2003 if nuclear power had never been discovered at all, but that option no longer exists. Much of the political world we live in today is shaped by concerns about the proliferation of knowledge that can be abused by irresponsible governments. It has become obvious that preventing the flow of knowledge to such governments is in the long run a hopeless task, so other measures have to be taken.

In the end, we return to Adam and Eve: what are the ethical implications of useful knowledge? Thanks to useful knowledge, homo sapiens is the most successful species on this planet, dominating and to a large extent controlling the environment. Most other species — not counting insects and rats — exist because humans want them to and countless others will go extinct if homo sapiens wills it. The past two centuries have created material conditions never experienced in history. Middle class people in industrialized countries experience levels of material comfort not even dreamed of by the Pharaohs and Popes of the past. Access to knowledge and art is unprecedented and is getting better at an exponential rate (what, really, did we do before Google?). Infant and child mortality have declined to levels that are as close to zero as they could be. At the same time, mankind is capable of actually wiping out all life on this planet through nuclear weapons and is affecting long-term atmospheric parameters through normal economic activity. Would we better off if we knew less, or at least if we acquired knowledge less rapidly?

The hard fact is that some types of new knowledge will advance whether we like it or not, and that repressive policies that try to prevent its emergence will in all likelihood produce societies that are even worse. Governments that believe that they can stop stem-cell research or cloning by legislating or by denying them funds will be disappointed; off-shore research will eventually produce the new knowledge if there is money to be made. Short of introducing a totalitarian state and suppressing the market economy altogether, the capitalist system cannot be prevented from producing new knowledge if it is feasible and if most of the economic gains can be captured in some fashion by the developers.

Where governments have an opportunity to affect outcomes through policy is in those parts of useful knowledge where the market mechanism does not work well and the outcome is ambiguous. It seems unlikely that private enterprise would ever have produced hydrogen bombs or nuclear reactors without government policies. Yet it did produce lead-based paints, asbestos, thalidomide, and may well be able to produce VX-chemical agents or anthrax and sell it to an affluent terrorist. Neither the private nor the public sector have spotless track records here. Market economies on the whole are rarely destructive per se, but they are capable of making dreadful errors in the blind pursuit of profit and disregard for the interests of others. Lenin was not too far off the mark when he remarked that capitalism would sell the hangman the rope used to hang it. Yet it is governments that have created weapons of mass destruction, that have created the worst environmental disasters, and that have abused useful knowledge in the worst ways. As always, mankind has to stumble and fumble its way through second-best options, hoping to avoid a Chernobyl on a planetary scale or a manmade pandemic on the scale of the Black Death.

Yet if knowledge is full of dangers and pitfalls, so is ignorance. As I have already noted, the twentieth century has been an astonishingly successful century in terms of the improvements in the human lot. We are not individually better people, certainly not smarter, wiser, more judicious, or more moral. But as a collective, mankind in 2003 knows more than ever before and is still learning rapidly. Such knowledge has enormous potential to make life better on this planet, or it has the potential to extinguish it. It seems to me that by knowing more rather than less, the likelihood of a disaster can be limited and any costs incurred by knowledge that misfires can be reduced. Modern technology produced not only the CFC's that threaten the ozone layer of the atmosphere, it also provided Molina and Rowland with the tools to detect the danger and the know-how to come up with substitutes. It is only thanks to the insights of modern microbiology that we have been able to identify the cause of the AIDS epidemic and produce medications. Had the disease occurred, say, in the middle of the eighteenth century, mankind would have had no clue as to how to combat it (in fact, it might never have discovered that it was a STD). Global warming, similarly, has been identified through careful measurement, modelling, and statistical analysis, and its causes are by now increasingly well-understood despite the complexities involved. Useful knowledge based on wide epistemic bases has the miraculous ability to continuously adjust, improve, and self-correct. A wise historian of technology once formulated what has become known as Krantzberg's Law: Technology is neither good nor bad. Nor is it neutral. The same might be said about useful knowledge in general.

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I.3 Summary of Presentations and Discussion

1.3.1 "The Knowledge Society: Theoretical and Historical Underpinnings"

Joel Mokyr, Northwestern University

The historical roots for the knowledge revolution in the West can largely be found in the Enlightenment. The industrial revolution increased the technological component of economic growth and created a new phenomenom, that of sustainable and persistent economic growth. This was combined with an effort to also obtain what was desirable from the point of view of society. In the Industrial Enlightenment of the 18th century, Europe experienced a knowledge revolution which affected the way useful knowledge accumulated and was utilized. It led to a change in attitudes and institutions which were instrumental in influencing the development of knowledge upon which material progress was largely based.

Knowledge was defined as what an individual believes to be true and is different from information in that it exists in the human mind. It is meaningless unless it can be transferred to and acquired by an actual person. In this regard, access costs are central to knowledge accumulation, as is learning. In order to focus the discussion, the concept of "useful" knowledge was employed throughout the presentation. Though its importance was recognized, social knowledge was not dealt with. Useful knowledge is defined as knowledge pertaining to the natural environment and is linked with technology. It is also the basis for productivity and economic development.

Useful knowledge comes in two forms. The first is propositional knowledge which describes and catalogues natural phenomena and is inclusive of science and the epistemic base of techniques. Knowing the principles behind something - the why - is critical to adaptation and debugging. The second is prescriptive knowledge which describes knowing how to do something, a cookbook of techniques, instructions on how to produce goods and services, and can reside in storage devices as well as peoples' brains. When prescriptive knowledge is carried out, it is termed production and when an addition is made to the base of prescriptive knowledge, it is typically called invention. In prescriptive knowledge, there is always a tacit component. A goal of a knowledge society should be to achieve positive feedback between propositional and prescriptive knowledge.

In examining the attributes of a successful knowledge society and how a society distributes and uses knowledge for economic growth, as well as how and why knowledge grows over time there are several factors that have, historically and in the West, proven determinative of success.

Policies: The government has an important role to play in setting knowledge policies because knowledge as a commodity cannot rely on market mechanisms alone. Among other actions, governments must invest in the infrastructure for knowledge to be diffused and create the conditions for knowledge creation and transfer.

Institutions: Discrepancies between the developed and developing world in turning knowledge into economic productivity can be largely explained by lack of adequate institutions, in addition to access to knowledge and training. Historically institutions have played a central role in encouraging the creation of new propositional and prescriptive knowledge; enhancing communications between prescriptive and propositional knowledge holders; in determining the rate and direction of the growth of useful knowledge; and in helping to determine on which margins the efforts and time of the most resourceful and ambitious men and women will be applied and where entrepreneurial effort will be most rewarding and

remunerative. Moreover, the existence of organizations in which knowledge is preserved, diffused, and augmented (such as academies, universities, and research institutes) and the rules by which they play (e.g. open science) also helped determine the historical path of knowledge development.

Competence: In addition to human capital (specifically education), competence - or the "know how" to carry out a technique - is critical to the knowledge society and is essential to technology transfer. Competence also allows for international specialization in knowledge, in that one needs to know only how to work a technology rather than knowing how it is developed.

Physical Capital: Possessing the appropriate physical implements and artifacts of a knowledge society (e.g. technology) are necessary.

Access Costs: Access costs refers to the cost to an individual of acquiring knowledge from another. The economic significance of useful knowledge depends on low access costs. When considering access costs one must examine intellectual property rights, the width and accessibility of the epistemic base, technological infrastructures, institutions, as well as cultural factors such as the willingness to put knowledge in the social domain.

Culture: Cultural factors also come into play. Non-conformist societies that tend to embrace deviants and rebels - often the source of genius - and where there is less support for "conservative lobbies" and vested interests tend to fare better. Also, knowledge diffusion depends on changes in household behavior and attitudes.

Other Factors: Other success factors include the rule of law and order and the existence of a certain amount of individual freedom. Finally, governments are encouraged to consider the ethical implications of knowledge and remember that while knowledge is neither good nor bad, nor is it neutral.

I.3.2 "Rethinking Ethics of Development: A Human Centred Knowledge Agenda"

Karamjit Gill, Brighton University

There exist diverse and overlapping local-global contexts within which producers, users and reproducers of knowledge interact, participate and collaborate. In examining knowledge systems, there are a number of dominant models to look toward. These range from those with a technocentric view to those with a human centered view of knowledge. A human centered view with its unique set of values was proposed as preferable.

The technocentric and more linear model emphasizes the shaping role of technology, technological fixes, and convergence into best practices and one size fits all models. This approach tends to value cause and effect, sameness, calculation, fact, data and efficiency.

The human centered model instead concentrates on human centered notions of purpose, judgment, belief, knowledge, and effectiveness. It views the human as the shaper of technology and knowledge and places great value on tacit knowledge. Tacit knowledge can also be explained as what we experience. Much rich tacit knowledge can be found in the social and cultural traditions of people and grass roots innovations. The failure to recognize this source of knowledge limits the design of creative, imaginative applications, leads to "one best way" models and impoverishes the ability of a society to participate in shaping the knowledge agenda. The human centered model of development also embraces the valorization of diversity, as well as inter-dependence and even a certain amount of uncertainty and ambiguity.

The human centered vision of the knowledge society sees the individual as a social citizen, playing various roles such as that of actor, participant, interlocutor, mediator, and decision maker. Knowledge systems should support this multifaceted role and optimize human capacity along with machine capacity. This requires a changed policy design culture. It also requires that civil society is engaged, pursues need based and purposeful goals, makes committed choices, and uses knowledge as a valuable resource.

The question was asked as to how knowledge architectures can be developed which take into account and realize human centered values and goals and build systems and tools that bring together objective knowledge and technical capacity with creative and innovative capabilities of the human dimension. The answer comes partly in the form of knowledge networks.

The development of a knowledge society through knowledge networking potentially serves several functions, some of which follow:

- It is seen as a process and a tool for building and promoting coalitions of knowledge systems, creating new alliances of creators, users, mediators and facilitators of knowledge, connecting the local (grassroots), national and global (different cultures) and thus encouraging diversity.
- It is a means of transferring personal knowledge to experiential knowledge and then, where possible, into objective knowledge and vice versa.
- It supports the principle of subsidiarity by bringing knowledge and science and technology closer to the people, improving quality and appropriateness of knowledge resources and building local capacity for acquiring and interpreting new knowledge and then absorbing the transferred knowledge for practical use within new application contexts.
- It can encourage democratic dialogue, coalition building and action, thus representing a source of power.

Examples of networking in the form of a cross-cultural project between EU and Indian institutions and a grassroots knowledge network, the Honey Bee Network, were provided.

I.3.3 Discussion

The discussion centered largely around a debate on the concept of human development and the notion of the individual versus the community in the knowledge society.

There was concern that some views of the knowledge society may simply be repackaging the Washington consensus for the 21st century and that the fundamental differences between knowledge and industrial economies be better addressed. Careful and compelling arguments must be put forth for pursuing a knowledge based society. The concept of human development was introduced as a possible guiding framework for the direction of knowledge society development but to date there seem to be very few, if any, countries that have adopted this approach. However, this proposal was met with questions concerning whose values were being represented, how the desires of the public are defined (e.g. what if people just want entertainment), and the criteria for persuading people what is right and what is wrong. Human development was explained as expanding human opportunities across many sectors, of which the economy – though important - is only one. The knowledge base of a society is much broader than the knowledge economy. In this same vein, tacit knowledge is valued to some extent around economic growth but seemingly is not valued elsewhere. It was argued that validating different types of knowledge and integrating tacit and informal knowledge with evidenced based knowledge will be important.

Secondly, the question of emphasis on society (emancipated state or society) or the individual (emancipated individual) - an I/We paradigm - was raised. There are different models one can look to including the Weberian model which preserves hierarchy and a pyramid structure where people are not encouraged to think. On the other side is the networking model which is very difficult to manage and requires individual responsibility. More experience is needed on how networks work in reality. Some proposed that one cannot separate the individual from society and that individuals make up society. They should be seen as interlocking and seek inclusion. Yet, the individual has to flourish within society. This can be achieved by enlargement of human rights, respect for ideas and expression (including challenging, questioning and discarding others' ideas), an environment where individuals can think and take risks in presenting ideas, respect for the grassroots level where incubation occurs, encouragement of entrepreneurs, and outside of box thinking. However, it was proposed that with individual rights come individual obligations and responsibility to the community.

II. NATIONAL KNOWLEDGE SYSTEMS

II.1 Overview

Strategies can be adopted and systems can be established for enhancing the creation and purpose-driven use of knowledge. A lot of thought has been given recently to doing this in the market environment and in the context of a business firm. However, examination of the national context is also needed. The knowledge assets of a nation must be put in a creative and growth environment that brings added value: in business, in politics, in social life in general. Moreover, the full spectrum of a society's ability to generate, access, disseminate, appropriate, adopt, adapt, and manipulate knowledge must be taken into consideration and appropriate actions taken towards these ends. One such step is the creation of strategies and systems for capturing the benefits of knowledge for development. Strategies comprise common understandings of the concept of knowledge for development, goals, policies, modalities and eventually strategic allocation of resources. Policies must be rooted in social and cultural environment and must be aligned with and make sense from the point of view of the goals. Systems, processes and institutions fall under the category of modalities and must assure effective and efficient pursuit of the adopted goals in a given policy or regulatory framework.

In this context, a host of issues is worth considering when one speaks about knowledge, growth and development. To wit, if we believe that the world is increasingly complex, unpredictable and politicized, sheltered national space for creation and sharing of explicit and tacit knowledge in a society must be established. If we believe that knowledge economy undermines the market foundations of excludability, rivalry and transparency – the architecture of the intellectual property rights that has fitted the "pre-knowledge" era must be reviewed and adjusted. If networks are pivotal, technical and regulatory environments for them must be considered.

Ultimately, governments will have an instrumental role in creating an environment that adequately addresses these issues, therefore enabling society as a whole to benefit from and contribute to knowledge development. The public sector's formulation and implementation of strategy, policy, programmes and partnerships will very much determine the success of a nation in the knowledge society.

Several nations have been adopting knowledge development strategies and systems for some time now. They encompass a broad range of approaches including the development of knowledge strategies per se, to the consideration of knowledge as a component in broader science and technology, innovation, ICT or education and even cultural strategies, or sometimes a combination of these.

The second session experts and discussions highlighted some of the approaches taken thus far throughout the world, lessons learned and actions for improvement, as well as proposed policies and strategies that reflect a holistic and human development based knowledge society.

II.2 Expert Background Paper

Futures of Knowledge for Development Strategies: Moving from Rhetoric to Reality

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"What matters clearly is culture and institutions. Culture determines preferences and priorities. All societies have to eat, but cultural factors determine whether the best and the brightest in each society will tinker with machines or chemicals, or whether they will perfect their swordplay or study the Talmud. Institutions set the incentive and penalty structure for people who suggest new techniques."
(Joel Moykr, The Gifts of Athena: Historical Origins of the Knowledge Economy, 2003)

Introduction

There is much to be said for "la sagesse" or wisdom. Rooted in experience and culture, and, above all, people (the Japanese refer to their true craftspeople as "greatest living treasures"), it is one of those givens of a fully functioning society: though often rarely properly factored in the policies, programmes and statements that have become so common in studying societies or economies. Words like creativity, inventiveness, connectedness, networking, innovation, and entrepreneurship seem to carry more weight as if these too are easily compared and measured. They are not. [1].

Knowledge is another such moniker. It usually conveys a non-threatening political message of increasing conformity (repeat after me....) that makes it difficult for anyone to disagree with. How can you be against knowledge per se?..[2]. Progress?.. maybe...development?... perhaps... competitiveness?... at times... but knowledge? And so, the lexicon has happily adopted "knowledge"` as the 21st century harbinger of new things that may be good for you, or that, in the very least, you should think about in a positive sort of way.

Within this bin called knowledge comes a variety of choices that you can make to qualify the term:

Box 1: Some Knowledge-based economy (KBE)- Knowledge-based society (KBS) definitions

APEC: a KBE is an economy in which the production, distribution and use of knowledge are the main drivers of growth, wealth and employment across all industries.

OECD: where investment in knowledge is defined as public and private spending on higher education, expenditure in R&D and investment in software.

UNESCO: economy in which knowledge is substituted for labour as the main factor of production.

World Bank: a KBE relies primarily on the use of ideas rather than physical abilities and on the application of technology rather than the transformation of raw materials or exploitation of cheap labour; economy that makes effective use of knowledge for its economic and social development including tapping global knowledge.

[i] The author would like to acknowledge the constructive comments and inputs by Pam Golah, Jean Woo and Sonia ter Kuile of IDRC; views expressed herein are the author's and do not necessarily represent those of IDRC

tacit, formal, science and technology, imbedded in learning; indigenous or traditional, structured or unstructured, and so on. These too have many connotations that we will not dwell upon in great detail, suffice to say that there is enormous literature on such definitions (*See Box 1: Some KBE-KBS definitions*).

For the purposes of this paper, we will focus on aspects of knowledge that are more structured, formal, networked and conventional, that is, the formulation of knowledge through science and technology for sustainable development.[3] Knowledge in this form has taken on a rather urgent tone, usually accompanied with some sense of objective. In short, knowledge for what and for whom becomes a major consideration. Knowledge for development (or in its sustainable form), therefore, is at the nexus of global questions that surround health, water, environmental, natural resource management, climate change, poverty reduction, economic growth, trade, investment, and so on[4] *(see Box 2: Emerging Global Issues Requiring Effective Use of Knowledge*).

Box 2: Emerging Global Issues Requiring Effective Use of Knowledge

Global Warming
Biodiversity and ecosystem losses
Fisheries Depletion
Deforestation
Water deficits
Maritime Safety and pollution
Fight against poverty
Peacekeeping, conflict prevention, combating terrorism
Education
Infectious diseases
Digital and knowledge divides
natural disaster preventions
Biotechnology rules and food security
Illegal drugs
Trade, investment and competition rules
Intellectual Property Rights (IPRs)
E-commerce
International labour and migration
Risk management

(*Adapted from Rischard, J.F. High Noon, 2003*)

Policies associated with these challenges have led to some interesting variety of experiments (policy is by definition experimental), as well as attempts to shoe-horn them into some standard bench-marking matrix. Hence, the rise of development reports, leagues tables, indicators for development, etc... Such approaches engender a bit of a herd mentality often bordering on a lemming-like approach leading countries and their geopolitical and economic clubs to which they adhere and other international institutions to adopt frameworks that will allow for better use of knowledge on knowledge.

Nowhere is this more apparent than in the UNDP Human Development Reports. For years (seven to be precise) Canadian politicians made hay with the fact that Canada was ranked 1st on the Human Development Index (HDI). Today, having been chastened by the vagaries of such indices, they are more subdued as Canada has slipped to 8th. Or take the OECD rankings of gross expenditures on R&D to GDP ratios that has become the leitmotif of advanced knowledge economies. Such rankings show up in most global league tables of one sort or other, and they are religiously used to make the political case for moral suasion[5] (see Chart 1 on innovation systems in Appendix).

Knowledge on knowledge begets complexity, which in turn begets confusion and, its consequence, information overload (the new form of an emerging infectious disease in this technologically wired world is something labelled CPA or Continuous Partial Attention). Be that as it may, policy-makers of all stripes are embracing the new word, and using it to justify and launch new programmes, initiatives, ventures and the like. Consultation, coordination and collaboration have quickly become the hand-maidens of knowledge. "Best practice" (if there is such a thing) becomes mantra. Excellence, equity, and

sustainability follow quickly from this, and soon, the unsuspecting are pummelled with a blitzkrieg of rhetoric. Some examples are in Box 3.

How to move the rhetoric to some form of comprehensible reality is the subject of this paper, but first, we need to look more closely at the cultural phenomenon of knowledge for development.

Box 3: Some recent statements on use of knowledge and science

Progressive Governance Summit:
Both globally and domestically we have discussed a new progressive agenda that is based on preparing our societies and economies fo the challenges of the future, ranging from climate change to science. (London, 13-14 July 2003)

NEPAD: explicitly recognizes that the region's economic recovery and transition to sustainable development will be achieved if science and technology are harnessed and applied to pressing food production, diseases, energy insecurity, communication and environmental problems. (draft, 2003)

G-8: Cooperative scientific research on transformational technologies offers potential to improve public health by cutting pollution and reducing greenhouse emissions to address the challenge of global climate change (Evian, 3 June 2003)

UN: The idea of two worlds of science is anathema to the scientific spirit. It will require the commitment of scientists and scientific institutions throughout the world to change that portrait to bring the benefits of science to all. (Kofi Annan, Science, 2003)

The Notion of National Systems

"Knowledge networks between producers and users cannot be assumed, neither can they be ordained by funders. They need to be carefully constructed.``

(Louk Box,`` Crossing the Divide: the Precious Art of Science and Technology Policy Dialogue", 2003)

The above quotation hints at the need for engineering public policy for sustainable knowledge production. It also argues that a knowledge-based society (or one that is knowledge-thirsty to borrow from a 1990s Canadian report) is linked to the emergence of a more networked economy through the generation, diffusion and use of information. Governments and other decision-making organizations are struggling with how to manage this networked society; both from the point of view of putting in place structures and institutions that will help adjustments to change, but also to increase the flow of this knowledge. Thus, knowledge flows and knowledge regions become important.[6] Chart 2 highlights one such model of these knowledge flows as it represents a global map of science. The illustration here merely points to the growing inter-connectivity of knowledge systems.

The use of Information and Communication Technologies (ICTs) becomes a critical investment as witnessed by the enormous sums of funding now going into this transformational technology. But the investment in e-things is a necessary though not sufficient condition for ensuring effective use of knowledge for development.

How states organize themselves to strengthen or improve their knowledge-producing, transfer and research capacities is often a bit of hit-and-miss exercise, and there are different methodologies one can engage. The OECD for example, has made an industry of adopting national innovation systems as a technique for assessing the complementarities among research and innovation actors in any given country or region.[7] Fine and good for the developed world. But what of the developing countries? How can they learn? How can they innovate and shape skills? How can they develop effective mechanisms, policies

and tools to encourage S&T-conventional and indigenous- and manage the impact of their respective societies? How can they ensure that they are participating in the global pool of knowledge production and taking advantage of knowledge to improve their standard of living, eradicate poverty, and strengthen their capacities for decision-making?

A joint workshop organized by IDRC and UNESCO in April 2003 addressed many of these issues. Both UNESCO and IDRC have had a track record in these national assessments with IDRC having produced reports in partnership with Chile, China, Vietnam, South Africa and Jordan. UNESCO had its history with country reviews dating back to the early 60s, involving over 70 reports, including more recently, Albania, Bahrain and Lebanon. Other institutions such as the World Bank, with its S&T Vision statement,[8] and work on China and Korea; USAID with its report on S&T and capacity development examining cases such as India; SIDA with its programming on universities and research in developing economies; UNCTAD with previous assessments of Jamaica, Colombia, and Ethiopia; and the OECD with reviews of China, Korea and Mexico, have all tackled this trend setting tool.

And the impacts? Clearly, results vary. Timing for some of these reviews is critical. IDRC's presence and ability to respond to a clearly defined demand in South Africa when the transition to the ANC government took place was a key factor in success of its reviews on S&T. Politics almost always plays a role. How Vietnam has implemented the results of the reviews of its knowledge systems is in part tied to the changing nature of the political regime in that country. Champions are required. It makes no sense to drive recommendations for change by outside experts unless the directions are those that mirror those in charge. So too is funding. Unless states are willing and committed to change by investing in new support for knowledge production or changes to institutions, little will happen. And luck can be important.

But, ultimately, an institutional capacity to absorb the recommendations for change is a must. As many in the Paris workshop recognized, unless there are sound frameworks for decision-making, data collecting, regulatory regimes, communications and governance of innovation and knowledge infrastructure, little will come of recommendations designed to improve research and knowledge capacity. For example, this was spelled out in the Jamaican case study which flagged the need for regulatory and other requirements to put in place sound ICT infrastructure. Training is critical. Not just an educational system that is well developed, but also some need to institutionalize critical thinking on future directions for knowledge and its production. Such is the South African model that has put in place a variety of new training and development organizations for innovation since 1994. Ongoing assessment, benchmarking and evaluation are also crucial, as has been the case of Vietnam where the government has attempted to respond and update its activities related to the 1999 review conducted with IDRC.[9]

Responsibility for such implementation is not a one-sided issue, however. It requires commitment and engagement from all levels of society. Stakeholder activities designed to involve these elements are critical to a successful course of action or policy direction. And donor agencies have a role to play. As the Paris workshop pointed out, learning from good practice is a healthy thing. Enhanced coordination and-or communication among donor groups on their respective approaches to partnerships for knowledge production needs to be re-assessed. As a recent report has argued, the new network age has permitted alternative tools for capacity development and there is an understanding that local knowledge combined with knowledge acquired from other countries and institutions in both the South and North, can contribute to a successful paradigm for growth and social development. "The notion that the only ideas for development that are worth trying are those that derive from the North looks less and less plausible."[10] For this reason, one must be careful in applying any form of model such as a national systems approach to innovation, without regard to the history, culture or institutional capacity of a country. Indeed, there may be times when such models simply do not apply and other approaches are necessary.

The same premise holds true for knowledge production. As developing states engage in advancement of knowledge and research systems, a learning process is taking place. Soon, such processes lead to a better appreciation of the requirements for a stronger knowledge base and programme initiatives. But one should be wary of what models one examines. It is important to try to look at other models that are similar, rather than vastly different from your own in order to affect change. The fact that India is now looking carefully at the emergence of the Chinese economy and is assessing areas on need to catch up is an indication of this. Collaboration is often another good tactical strategy is the case with certain Latin American countries in support of designing common networks for R&D and S&T data collection. Let us examine the case of four different states that are experimenting with a knowledge transformation: India, Vietnam, South Africa and the Maldives.

Four States in Search of Knowledge

***"Sustainable development will not be achieved unless there is a redirection of our efforts to develop the full potential of people through education: an education that must include the mastery of modern technologies"* (Ben Ngubane, 2002)**

In a forthcoming book, the Peruvian scholar Francisco Sagasti makes the argument that the difference in economic disparities and the knowledge divides between the developed and developing world is even more striking when one looks at scientific, technological and production outputs.(See Chart 3). In short, there are huge differences in the capacity to generate and utilize knowledge between rich and poor countries.[11] In fact, there are huge differences of this sort within countries and among regions, which is why one has to be careful when using comparative data to make sweeping generalizations. But the examples of four very different economies will show that there are clear attempts to try to manage and engineer knowledge.

In their recent (August 2002) statement on research and development, the South African Government has made a point of noting that investments in this area will be designed to improving the quality of life with a focus on national poverty reduction and improving national competitiveness in the international environment. Three pillars of the strategy include science, engineering and technology human resources development and transformation focussing on the need to develop human resources on key sectors of S&T: Astronomy[12], human palaeontology, and indigenous knowledge ; innovation centred around various technology sectors; and third, creating an effective government S&T system. Among the areas of technology that the government will develop are those related to S&T for poverty reduction (emphasis on health-diseases, energy and indigenous knowledge), new technology platforms in biotechnology and IT (South Africa has a well developed programme dealing with Public Understanding of Biotechnology or PUB); technology for manufacturing and technology and knowledge for and from the resource-based industries.

In the case of India, its 2003 S&T Policy has a goal of "raising the quality of life of all Indians, particularly of the disadvantaged, in creating wealth for all, in making India globally competitive, in utilising natural resources in a sustainable manner, in protecting the environment, and in ensuring national security." The Indian Department of Science and Technology hopes to ensure greater integration of R&D activities into the socio-economic sectors; emphasize the basic research strengths and build on them; adapt indigenous resources and knowledge, specifically traditional systems of medicine; collaborate and cooperate with the international community; popularize science and disseminate it to society; and monitor and evaluate the impacts of S&T. And of course, one should remember that with the current effort by India to move away from a donor-assisted country to a donor contributor, the knowledge base through its science, technology and engineering cadre (an enormous one) will be an important contributor to the global knowledge pool.

In Vietnam's case, the transformation of the economy from a socialist to a more open economy has gradually been taking place. As a result, the need to assess how knowledge and research will contribute to this process is a critical one. In 1997, the IDRC was asked to undertake a review of its 1996 science and technology strategy which led to several recommendations for the Vietnamese Government to consider. Vietnam has placed a high priority on accessing technology from overseas and then applying and adapting it to the needs of the nation. While there was a focus towards a demand-driven S&T framework with the private sector playing a stronger role, there is still a tendency on behalf of individuals and institutions towards supply-side S&T activities. Vietnam has recently undertaken to assess a key element of its knowledge strategy; that of international S&T cooperation. This review, to take place in the coming year, will examine such issues as human resources; mobilizing and using financial resources; linkages between various actors of the national system of innovation; promoting enterprises to improve their linkages via foreign direct investment and international trade, and examining the question of make or buy.[13]

Finally, in contrast to these emerging players is a small island state, the Maldives. An archipelago of 200 islands, the Maldives economy had grown considerably over the past few years with heavy reliance on tourism and fishery industries. Concern for the long-term sustainability of these industries that are reliant on the natural environment has pushed its Government to consider how S&T can be deployed to address new opportunities. Its Science and Technology Master Plan (drafted in 2001) emphasizes the need to use and adapt external technologies to national needs, rather than on specific areas of national innovation and research. The plan is also designed to put in place a new institution –a National Research Foundation– that can coordinate research funding in selected areas. There is a general emphasis in the Plan to recognize the importance of ICTs (indeed, the responsible Ministry is called Communication, Science and Technology), with a recognition that such technology is useless without information to be conveyed. Other areas of emphasis include energy strategies, health, and research on fisheries and tourism (See Chart 4 for a comparative look at these countries).

One could go on to map the knowledge strategies of the other 204 nations on this planet, but the point is this: good governance, strong economic development and well developed social and environmental practices are all to some extent dependent on a sound knowledge strategy. And a strong, integrated approach to link the objectives of the various functions of governance is critical; otherwise, the right hand will not know what the left hand is doing; or worse, well-intentioned policies will counteract each other.[14] And of course, for it to be effective, knowledge must be connected to the cultural and historical context of the locale of the problems involved. Given this, it should come as no surprise that India's objectives are tied, for example, to national security; that South Africa's and the Maldives emphasize indigenous knowledge; and that Vietnam 's approach seeks to link to the global trade system. It should also come as no surprise given the nature of knowledge transfer that these countries pay particular attention to learning from other places. In South Africa's case, for example, their R&D strategy is premised with a look at the R&D strategies of Australia, South Korea and Malaysia. As an observer to the OECD Committee for Scientific and Technological Policy, and a member of the Commonwealth Science Council, (along with India), South Africa takes advantage of these strategic linkages. For the Maldives, its small size requires international linkages and connections, and for Vietnam, its membership in such clubs as APEC and ASEAN provides it with an entrée into an important club that is examining the use of knowledge through the APEC Industrial S&T Working Group. In short, memberships have their privileges; a subject to which we will return.

Towards a Global Knowledge Contract: Does Advice Really Matter?

"We are calling on society as a whole, and in particular on the State, scientists and the productive sector, to use science and technology in a responsible way, orienting their efforts so that they fulfill the needs of present and future generations, with responsibility and all forms of life."

The above quote could have been drafted by virtually any international body. It could easily have come from the World Conference on Science in Budapest in 1999 or the WSSD in Johannesburg, or could have been the result of a European conference on the science-society interface. Actually, it was written on 21 May 2003 at the University of Antioquia, in Medellin during an international symposium to celebrate that university's 200th birthday and the tenth anniversary of the initiation of the Colombian Presidential Science, Education and Development Mission. The Medellin manifesto aimed at a new social contract in science and technology for fair development and called for a decade of science (2003-2013) within Colombian society. It is the shape of things to come.

The use of knowledge for advancing society will need to be imbedded in decision-making structures that are both independent of states, but also linked to some form of accountability. Society will expect nothing else. And with good reason. Turning knowledge into policy and then into outcomes requires a fair measure of integrity and trust, not to mention commitment. Look at any public opinion polls for example that measure civic society's assessment of trust in professional groups, and you will invariably find that politicians are in the bottom rung and health professionals and scientists near the top. (see Chart 5 which looks at how the science community is viewed as a public institution). Dig a little deeper and you will see that public sector scientists rate higher than private sector employed researchers. That is why where a government places its knowledge assets is just as important as with whom.

For example, the Zambian government has just unveiled a $40M National Biosafety and Biotechnology Strategy Plan that will be used to support human resource and infrastructure resource development. This comes after Zambia had spent some considerable political capital rejecting modified foods. The Nigerian Government, in a flashy insert in the NY Times on July 14 labelled its new approach "Towards a Knowledge-Based Society,"` as being dependent in large part on plans to make Nigeria a key player in IT by 2005. Mozambique has been working to introduce a new plan for innovation, and science as a key element of its economic development. Argentina has just announced the notion of a ``debt for knowledge`` scheme whereby one percent of the interest that it pays to foreign creditors should be reinvested in the country's S&T. These examples imply a new, and creative engagement with society, and of course, with global partners.

Public demand has dramatically altered the knowledge landscape. Specialized institutions and elites no longer have a monopoly on wisdom. The spread of knowledge (not just Western science) has led to an opening of a more global and national debates on issues surrounding risk, choice, culture, environment and quality of life. This demand, manifested through new groups, advocacy organizations and NGOs (all of whom have ironically mastered the new technology) is a driver for change—sometimes for positive effect, but not always for the better or to the good of the society.[15] There are signs that research or knowledge producers are also changing their ways. No longer as insular , protective or arrogant about the implications of the implementation of new knowledge, they have gradually come to adopt new strategies to work with the public at large, and eventually have become more adept civic players in communicating and consulting on the results of research and the implications for the future human condition.

ETC and Greenpeace have both engaged in the latest debate surrounding the introduction of nanotechnology, and have argued that lessons need to be learned from the public controversies that affected biotechnology and its social and environmental impacts.[16] South Africa's public understanding of

biotechnology approach argues for the public to inform itself with the best knowledge available and then decide for itself (``Biotechnology and you: read about it, talk about it, think about it... and decide for yourself``).[17] Taking a page from this, the IDRC has begun an exercise in assessing the landscape for changing receptivity to GMOs and biotechnology issues in the South and it is looking carefully at how to engage a multistakeholder dialogue in this controversial field. The World Bank has been the leader in issuing a Budapest Declaration urging a global assessment of agricultural science, knowledge and technology that can improve rural livelihoods and address poverty reduction in low income countries. Similarly, the UK Government has prepared an elaborate public engagement process for the future development of both the research and the policy associated with biotechnology and nanotechnology [18]

But it will take more than a change of strategy from knowledge producers to have an impact on policy outcomes. After all, as Yankelovich has argued, "Most public policy decisions must rely on ways of knowing–including judgement, insight, experience, history, scholarship, and analogies-– that do not meet the gold standard of scientific verification."[19]

Decision-makers will have to be more creative at integrating and learning from various sources of advice. Multiple networks of knowledge are growing in complexity (not just those associated with government, and not just traditional science), making it difficult to isolate the cause and effect of policy outcomes. Governance and risk management here take on a much more meaningful public policy function. One of the key forms that this advice takes place is through science advice. Increasingly, attention is being paid to this dimension of knowledge production within most states. The reason: decision-making operates in a social and public value milieu, rather than a strictly economic investment framework. Indeed, the debate in most societies today has shifted from the hey-day of competitiveness and prosperity to its more complex, yet socially inclusive assessments of innovation and knowledge trends.[20]

Hence, as a result of the growing nexus between science, citizen and state, many countries and organizations are re-shaping their formal (and informal) science advisory mechanisms while keeping an eye on how others do it. This latter point is critical since much of what is being discussed as involving changes in knowledge and its impact on society is not limited to domestic sources, but has become globalized.[21] SARS epidemics, mad cow disease, HIV/AIDS, disaster mitigation, food safety are but some examples of issues requiring transboundary advisory structures and channels. But science advice must go hand in hand with other forms of governance. It needs to be imbedded into the full machinery of government. As Tony Blair has bluntly put it: "Bad science didn't cause the spread of BSE; it was bad agriculture and poor government.[22] " The attempt by the UN to re-examine its own structures of science advice is a good case of recent recognition of the importance of this issue, In the National Academy of Sciences (NAS) report, Knowledge and Diplomacy released last year, the report argues for a series of changes. Among them:

- That governing bodies of the UN that have substantial responsibilities for implementing sustainable development programs should each create an Office of the Science Adviser or equivalent facility[23];
- That each such facility should adopt an appropriate set of general procedures based on best practice procedures of science advice;
- That the UN should help member states to strengthen their own scientific advisory capabilities[24]; and
- That assemblies and other deliberative bodies should make greater use of scientific assessment mechanisms that have transparency and credibility.

One should be circumspect about science advice of course... it is after all, only advice. It can be acted on or ignored. And it is only one part of the policy equation. And if science advisers are not used (or studies requested), the relevance of such bodies quickly becomes an issue. In Canada, for example, the Advisory Council on Science and Technology which (on paper only) advises the Prime Minister on issues of national importance affecting S&T, was largely ignored by the former Minister responsible for its work. Today, it is undergoing a transformation and has developed a new remit to better address urgent questions related to priority-setting. In a similar vein, the Council for Science and Technology in the UK has just undergone a quinquennial review with the Government responding that it will ask the CST to organise its work on five broad themes: sustaining and developing science, engineering and technology (SET) in the UK and promoting international cooperation; SET and society; SET education: SET in Government, and SET and innovation. The Government will even advertise publicly to get new members, a significant departure from traditional methods of recruiting advisers you can control.

Given its very nature, science advice needs to address global as well as domestic issues. For this reason, science advice is increasingly seen as an integral part of foreign policy, international finance, trade, global ethics and sustainable development issues. A more global science advisory capacity is required. While there are clubs that meet periodically to discuss such questions in the European context and the G-8[25], quite often the developing world has little say in such structures nor does it have a major presence. Groups like the InterAcademy Panel established by the NAS on international issues have established a creative structure—the InterAcademy Council (IAC)-- to help provide these links. The IAC brings together the collective advisory expertise and experience of a worldwide group of national academies, including those in Brazil, China, Mexico, South Africa, and the Third World Academy of Sciences (TWAS). The IAC is just completing a major report on promoting worldwide science and technology capacities for the 21st Century. And the UN Commission on Science and Technology for Development has concluded an e-chat group on measures for strengthening support institutions and science advisory mechanisms.

Thus, science advice has taken on a much needed renaissance, one that will look to using the knowledge assets and expertise of many states to resolve issues affecting sustainable development. But such advice is only part of the picture.

What we have here is a failure to communicate

"Science is just knowledge. And knowledge can be used by evil people for evil ends. Science doesn't replace moral judgement. It just extends the context of knowledge within which moral judgements are made. It allows us to do more, but it doesn't tell us whether doing more is right or wrong." **(Tony Blair, Science Matters, 10 April 2002)**

Knowledge networks of the future–especially those affecting the South-- will be challenged by at least three key issues. The first is the question raised by the Blair quote above. For the advisory apparatus to be effective and politically attuned, it will need to pay attention to issues at the margins (not marginal to) of knowledge development. A key concern surrounds ethical and legal issues affecting the introduction of new and emerging technologies to both developed and developing state alike. Unless you are a card-carrying member of the Raelian Movement[26], most organizations are taking this challenge up from the UN system through to Greenpeace. The biggest debate facing the Bush Administration before September 11 was in fact the ethical issues surrounding use of stem cells for reproductive purposes. Other countries have followed suit and are now debating the questions of human cloning, xenotransplantation and other medical issues associated with the spread of revolutionary health sciences. A similar debate will emerge on nanotechnologies as countries like India, China, Korea, Philippines, South Africa and Vietnam adopt strategies for these newer technologies.. These are issues not just ripe for ethicists, religious leaders,

philosophers and lawyers, but concerned citizens as well. The mere mention of the need for biotechnology and genetically-modified crops is enough today to generate a raft of spins on the good, the bad and the ugly of this issue.

The media will need to be engaged in such future debates. They play a strong role in shaping the debates, and can influence public policy in significant ways. (See Chart 6 for an understanding of how the public attitudes differ from country to country re GMFs) The adage that politicians are scientifically illiterate and scientists politically clueless is not far off the mark. Add to this the oft made observation that scientific communities tend to be insular or even arrogant, and combine this with the notion that governments are prone to spinning information to suit respective needs and you have a deadly fuel that can ignite quickly. Linking science journalists, communicators and practitioners of research and knowledge is a key element of a successful knowledge strategy. In the UK and Canada, efforts have been developed to strengthen the communication of science to the general public and guidelines have been produced to assist this process. In Canada, for example, these guidelines help shape communications as an integral part of the government's S&T policy. A recent report argues that federal science departments should embrace the concept of participatory communications, whereby audiences engage in dialogue, deliberation and decision-making; adopt communications by integrating this element in the early planning phases of S&T programming; develop comprehensive communications strategies to complement and support the conduct of S&T; and invest in S&T communications planning; training and delivery.[27] Governments everywhere are realizing that in order for the public to both understand, become active in, and be informed of decisions that will affect public policy, they need to be part of the process, not separate from it, or worse, separated from it.

At the global level, similar challenges are being addressed. A new web-site on science and technology for development (SciDev.Net) has been established whose objective is to provide reliable information on issues related to science and science-based technology that impact on social and economic development. The service, funded in part by donor agencies and supported by the prestigious journals, Science and Nature, is a valuable tool in assisting decision-makers from the developing world and other professionals interested in the interaction between science and development. The site offers news and various briefs called dossiers on such issues as the brain drain, GMOs, biodiversity, climate change and ethics in science and technology. It has also improved its geographic spread from its HQ in London to include regional networks in Sub-Saharan Africa, Latin America and has initiated capacity-building workshops to train science journalists on emerging issues in those regions. One, on the use of ICTs to report on the science of AIDS, took place in Kampala last year, and this may likely be repeated in India later this year. A public meeting on science and technology communication is being organized for Nairobi in 2004. At last count, just under half of all registrants to the web-site (which is free) came from developing countries, with the top five coming from India, Brazil, Mexico, South Africa and Argentina. SciDev is looking to its next five year plan (2004-2008) with a view to increasing its presence in the South and increasing coverage of various dossiers and regional nodes.

If the research and knowledge communities are to build more powerful alliances with states and other sectors they will need to consider building on the changing dynamics of the science-society interface and develop newer tools (such as SciDev) that are more representative of the issues involving global civic society itself. Hubris and humility, not the new 21st century post modern affliction of Acquired Situational Narcissism (as the NY Times puts it) will be required. Educating people is not the answer as this implies a one-way view of knowledge (or the information deficit approach): from the expert to the layperson. Rather, the issue is about involving the key stakeholders in all societies in the decision-making process, not just meting out information (which almost always has some spin to it). [28]

As a second consideration, the new technologies that are shaping innovation and change will require not just attention to new knowledge, but to social and institutional innovation as well. Anticipating change will be one of the most important dimensions of this. As Willis and Wilsdon aptly point out, "New technologies will never achieve their full potential unless they are accompanied by social and political innovation that alters the framework within which economic choices are made."

So how to anticipate change and scan the horizon? How to put into place new mechanisms to do this? This will be a major challenge for societies bent on using reliable knowledge to make choices. Here, the issue is how to engage in a dialogue that will potentially alter visions of the future. Private sector firms engage in this type of exercise, Shell International being probably the most well- known. But increasingly, governments are now experimenting with different forms of foresight exercises. UNIDO has recently produced a summary of some of these national exercises to highlight some of the common themes that are emerging with respect to economic and social change.[29] Among them:

- That technological development will be the key agent of change and change will be faster;
- The life cycles of products will be shorter and shorter and new knowledge networks will emerge;
- The demands on education will increase especially with respect to technology and natural sciences;
- In developing countries, information technology is expected to dramatically influence the possibilities of growth, as will biotechnology;
- Globalization will get even more accentuated than it is today and there will be a free flow of information investment capital, ideas, products and services between countries; and
- The proportion of women in the work force will increase and a series of new systems and models for childcare and housing services will emerge.

Of course, this all sounds well and good, but as the adage goes, if you can't forecast well, forecast often...The UK, Germany and Japan have years of experience in this type of methodology, producing biennial versions, but gradually, the list has expanded. ICSU , for example, has recently published an examination of these reports and suggested areas that have an international or global scope for further assessment.[30] (See Chart 7 for some examples of national approaches) The APEC Centre for Technology Foresight launched in 1998 is one of the more unique since it covers multi-country assessments. Consultations on megacities, urban and water issues, genomics and nanotechnology had been produced with the expert inputs of many countries from that region. Foresight activities also require sound data collection and analysis. The data issue is problematic in many respects as several counties do not have the institutional capacity to collect necessary data and analyze in a way that can be helpful for decision-makers. The need to train people in this area will be important. The UNESCO Institute for Statistics has been working on a strategy that will elaborate such requirements for S&T data and indicators in developing countries. Creating demand for such information and linking data needs will be a challenge in this area. But this is one of a complex of questions that needs to be addressed if communication of knowledge processes is to be adequately addressed. There are some bigger issues though, and this is the third area that will need to be addressed.

The 500 pound Gorilla

"I feel myself fully competent to render this dear cheek as faultless as its fellow, and then, most beloved, what will be my triumph when I shall have corrected what Nature left imperfect in her fairest work." **(Nathaniel Hawthorne, The Birthmark, 1846)**

Are there brakes to local innovation and global knowledge production? Yes is the short answer. As the public debate becomes more heated and engaged in the coming years over the development of knowledge, there will be more calls for ensuring a sound social function to this knowledge. To borrow from Auguste Comte's dictum: "Savoir pour prévoir, prévoir pour agir." Those societies that have invested heavily in knowledge over the past forty years are beginning to understand the hidden costs of such investments. True, knowledge has given us many gifts, but there are limits : limits in terms of costs, limits regarding choices and priorities, limits with respect to technical tolerance and risk, limits to capacity, limits to ethical standards, etc... Above all, there are society's transactions costs. The bar has been raised. More will be expected of investments in this knowledge. More accounting, more transparency, more translation of the benefits AND costs of this. Some of this will fall on the shoulders of the research communities; some on the public; and much on the commitment from decision-making systems.

Ironically, at the very time the West has called on a greater need for investment in knowledge (10 countries are responsible for over 80% of the world's total expenditures on S&T) in the developing world, and at the very moment that technologies have increasingly become more "open-sourced" and freely available, geo-political and security issues threaten to stall the potential for a new knowledge renaissance. Continued and fair access to knowledge will be a strong playing card. Trade issues are blocking the ability of the South to develop intellectual property regimes that are relevant to their respective economies; including concerns over bioprospecting and the need to respect traditional knowledge, and access to generic drugs for health care. Subsidy regimes for agriculture in the West are hampering the development of export markets for the South, not to mention strengthening of their research infrastructure for agriculture. The development of global research organizations to address social and economic gaps have been short-circuited as funds are slow in coming. National policies designed to address a strengthened innovation and research effort are poorly integrated into national policies designed to assist developing countries; quite often, these are conflicting policies. And the knowledge community will be challenged to address its responsibilities as the landscape shifts with many more players than before. As noted earlier, media will play an increasing role in this; the public will become a more diverse stakeholder in these debates. Calls for moratoria on certain technologies will likely become de rigueur, however misplaced such arguments may be.

The geo-politics of security, and the moral compunction of aid will have counteracting roles on the potential for a truly open knowledge system. The debate over the research community restraining from certain publications because of national security or international spread of "dangerous" technology, will grow (though there are now calls for a global Public Library of Science to allow for free, on-line access to scientific and medical information). The restrictions on movement of skilled personnel in certain fields and from certain states, will clearly impact on creativity and entrepreneurship. Paradoxically, the knowledge community will be drawn into the security and defence fields as demand for these areas grow, and the higher education community will feel the impact of this on enrolments and faculty. Visas will limit movement. Foreign students are being watched. Wraps will be put around certain key technologies in IT, biotechnology and nanotechnology because of security concerns. At the very time that the university community is becoming internationalized– with more and more players having a role in knowledge production – there is a public pressure for them to be more responsive to a risk environment. New structures for knowledge production will emerge that respond to such limits[31]

So what is to be done?

Constructing knowledge societies around such impediments will be delicate and complex challenges. But a key will be continuous learning and investment in training and education. Paying attention to grey matter, (not just grey goo) will be a major issue for developing societies. Not for nothing that a key

Millennium Development Goal is universal primary education or that the World Bank has focussed on tertiary education systems. or that the G-8 Research Councils have developed a strategy for math and science education as key inputs for development. The talent pool is rich in all countries. Entrepreneurs, skilled craftspersons and knowledge producers exist in all societies. Providing the right incentives and institutional capacity to attract such development is what often distinguishes the richer societies from the poorer ones. In developing countries. A healthy mix of investing in national educational policies for growth, and a strong linkage with the diaspora abroad will be critical investments to consider.[32] Development of national or regional centres of excellence will help keep talent at home, along of course with strong professional recognition of the knowledge producers and adequate support through wages and infrastructure.[33]. Investing in teachers and rewarding them is also essential. Some countries have tried to develop Teachers' Awards to provide incentives in this direction. Development of diplomatic corps to use their networks for increased linkages to the diaspora and to new opportunities for investment in ideas and innovation from their respective host countries is another strategy in the knowledge toolkit. Countries like China, Eritrea, South Africa, Colombia and Argentina have introduced strong incentives and mechanisms to tap into their talent pool living abroad.

In the end, specific attention must be devoted to a suite of measures that will maintain a healthy national knowledge system linked to the global environment. The rhetoric of investing in knowledge has to be followed by the reality of long-term (not on and off again) support for skills and people. Institutions and integrated policies that complement, not contradict, each other need to be viewed as assets, along with an attention to the specific cultural, economic and social fabric of the society one is trying to improve. Capacity to learn has to be introduced: not just in copying other models blindly, but in studying and analysing carefully the good practice that can be gleaned from such exercises (including examining the right countries for comparison). And, an advisory and communications capability that is able to interact with various stakeholders in the society to ensure adequate and effective decision-making on futures for knowledge strategies. Finally, the careful monitoring and analysis of global developments will be a sine qua non for positioning the society and economy in a well-rounded approach to development.

In this last context, more attention needs to be paid to the strategic use of and learning from the activities of regional and global clubs. All countries belong to clubs of one form or another (some belong to too many making it difficult to provide proper funding or substantial inputs)[34]. The use of such fora , be it through the UN system, or APEC, the Commonwealth, the African Union, or OAS, or la Francophonie, or NATO, etc..., offers countries rare opportunities to leverage funding, talent, and political cachet. Unfortunately, it is rare that states pay much attention to evaluating the benefits or impacts of memberships in these clubs.

Box 4: Selected international S&T clubs that have Canada as a member:

OAS Common Market for Scientific and Technological Knowledge
APEC Industrial S&T Working Group
OECD CSTP
NATO Science Committee
World Health Organization
International Arctic Science Committee
International Space Station
International Panel on Climate Change
Convention

In fact, most states often join clubs because they see a political advantage to such adherence, not necessarily because the membership offers substantial intellectual rewards. Canada, for example, as a member of the G-8, takes it as a given that it will have to continue to belong to many clubs simply because of the geo-political cachet such a membership brings. (See Box 4) Nevertheless, because of limited resources, developing countries in particular should be paying more attention to how they can benefit from selected knowledge fora.

An assessment of existing and potentially new memberships should be developed in such instances. In addition, regular, careful examinations of bilateral and multilateral S&T, education and related agreements should be introduced in the decision-making systems in order to ensure that national and international objectives can be met.

But there is more to this equation. International organizations must themselves become more attuned to their clientele. It is axiomatic that international organizations are experimental and learning institutions. Nevertheless, they must be attuned to changes in the landscape. The NGO ETC (based in Winnipeg) has transformed itself radically over the past several years to focus its efforts on emerging technologies that may have significant impacts on society. As part of its new long-range plan, the International Foundation for Science (based in Stockholm) has substantially increased its work in support of young scholars from low income and lower middle income countries by 2004. USAID is exploring a new approach to supporting science and technology in specific regions of the world. A new Global Research Alliance of technology organizations for the South has been established to create a network designed to build on opportunities for technology exchange and joint ventures: in short to fill a perceived gap. NEPAD has a newly minted African Forum on Science and Technology for Development. And the UNDP Human Development Report of this year has argued for a series of international fora to help establish research priorities required to meet the technological needs of the developing world. The list goes on.

It is not rocket surgery to say that knowledge will continue to expand. Institutions designed to advance and diffuse this knowledge will also increase. The developing countries have an opportunity to position themselves well in this new arena if they pay attention to the lessons of the past, and help shape and dictate the direction of this new and complex frontier of knowledge.

Appendix: Charts

Chart 1: Innovation Systems [35]

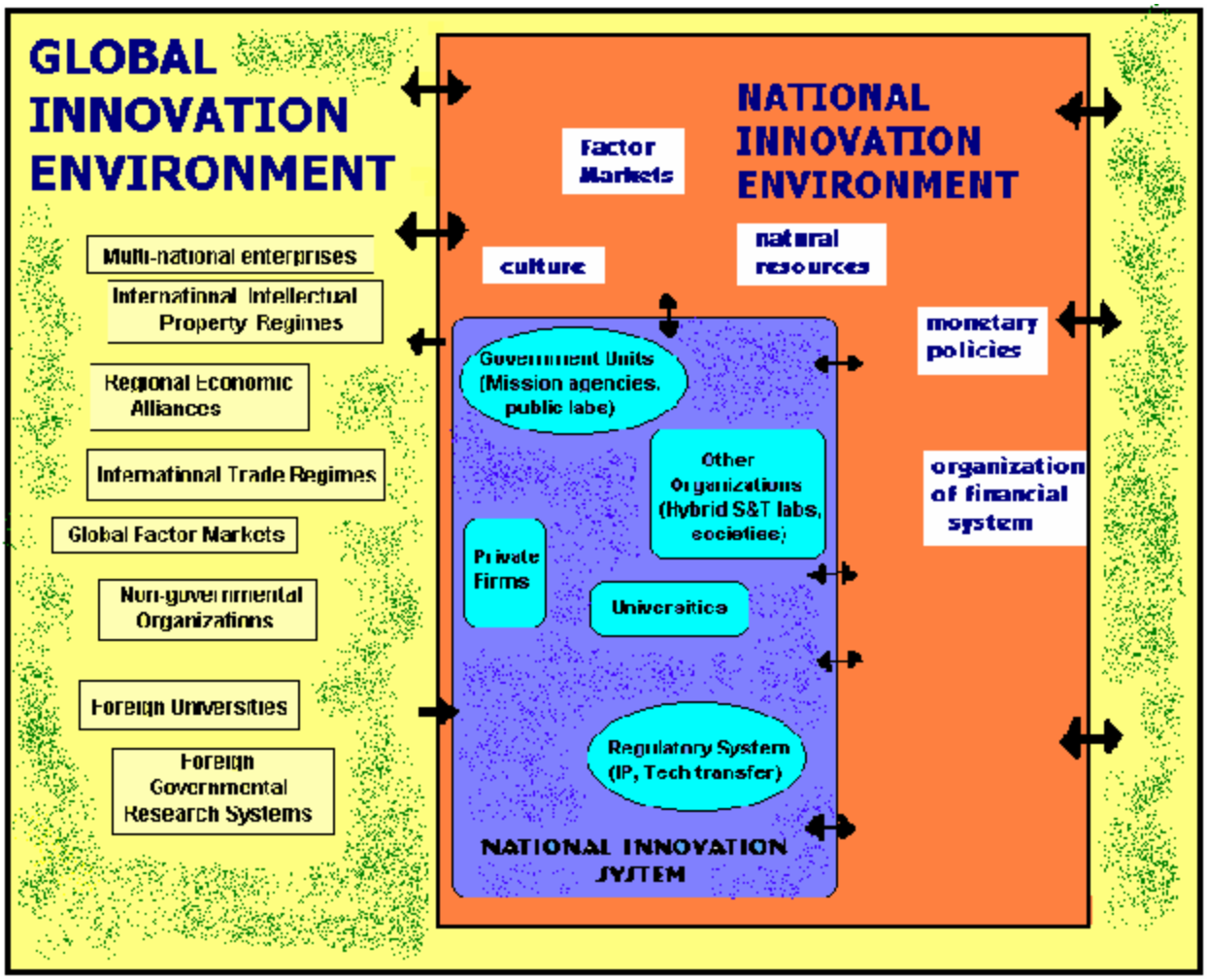

Chart 2: Models of Knowledge Flows: The Global Map of Science[36]

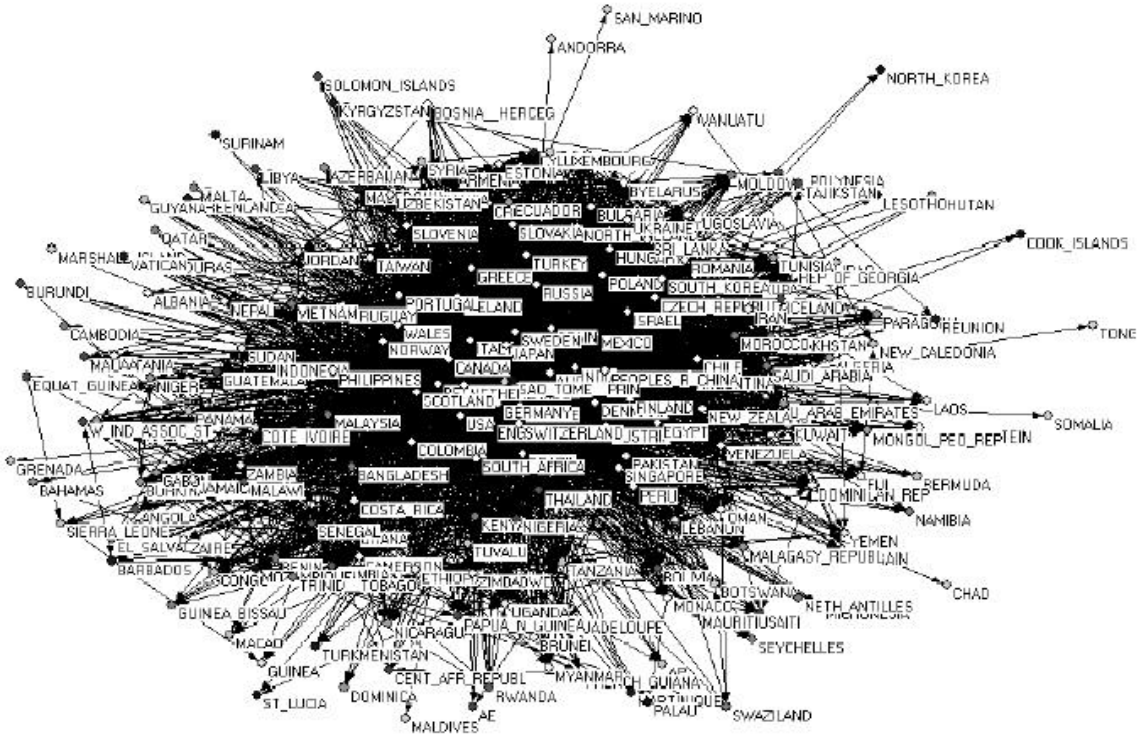

Chart 3: Economic Disparities and the Knowledge Divide[37]

	Values and Ratios				
Indicator	**OECD countries (A)**	**Low income countries (B)**	***Ratio* (A)/(B)**	**Low income countries (excluding India) (C)**	**Ratio (A)/(C)**
Gross capital product per capita (constant 1995 US$)	29,578.0	461.0	64.2	465.8	63.5
Gross capital formation per capita (constant 1995 US$)	6,730.3	101.7	66.2	95.2	70.7
Trade per capita (imports + exports of goods and services) (constant 1995 US$)	13,030.9	190.6	68.4	246.4	52.9
Scientific Output : Scientific publications per 100,000 inhabitants (1995)	72.9	0.8	88.8	0.2	331.4
Technological Output: Patent applications by resident per 100,000 inhabitants	75.4	0.4	197.2	0.3	260.0
Production Output: High-technology exports per capita	831.6	1.3	645.5	1.1	729.5

Chart 4: Comparative Charts on S&T Policy and Directions: South Africa, India, Vietnam, and Maldives.

Table 4.1: S&T Policy and Performance Indicators[38]

	UNDP 2001 Technology Achievement Index Ranking[39]	**Total R&D Expenditure (% of GDP, 1996-00)**	Planned Increases in R&D Expenditure (Policy date), (% GNP)	**Education Indicators**			**Science and Technology Indicators**				
				Public expenditure on Education (% GDP, 1998-00)	Youth literacy rate (% age 15-24, 2001)		Tertiary Students in science, math and engineering (as % of all tertiary students, 1994-97)	Tech. Diffusion: Telephone mainland and cellular users (per 100 people, 2001)	Tech. Creation: Receipts of royalties, licence fees (US$ per person, 2001)	High-tech exports (as % of manufactured exports, 2001)	Scientists and engineers in R&D (per million people, 1996-00)
Finland	1	3.4	N.A.	6.1	100		37	135.1	112.5	23	5059
South Africa	39	0.7	1(2002)	5.5	91.5		18	35.3	1.2	5	992
India	63	1.2	2 (2003)	4.1	73.3		25	4.4	0.1	6	157
Viet Nam	-	1	2 (1981)	N.A.	95.4		N.A.	5.3	N.A.	N.A.	274
Maldives	-	N.A	N.A	3.9	99.1		N.A	16.8	12.8	0	N.A

Table 4.2 : S&T Policy and Directions [40]

	S&T Policy Objectives	Salient Research Areas	Key Strategy Focal Points	Current Areas of Difficulty
South Africa (History of Apartheid)	Improving the quality of life of all Poverty reduction National competitiveness	S&T Innovation Missions: Poverty reduction New technology (Biotech and IT) Manufacturing Resource-based Industries Defining IPRs	Basic research and innovation Developing key sectors of strength (niches) Equity in human resources (women, black community)	Lack of clear strategy Human resources- aging white/male researchers Declining R&D in private sector Fragmentation of government S&T leadership
India	Raising quality of life of all National competitiveness Sustainable use of resources National security	Popularization of science Protection of traditional knowledge systems S&T for National security programs Defining IPRs	Basic research and innovation Developing key sectors of strength (niches) Bridging R&D and industry Empowerment of women Emphasis on monitoring and evaluation	Not available.
Viet Nam (History of socialist/ communist system)	S&T "as a means for development"	Social S&T (AIDS, water, poverty reduction) Economic/technical S&T (IT, Biotech, New Materials, Automation)	Application and adaptation of technology from overseas to national needs Shift towards privatization and liberalized trade Diversification and decentralization of S&T Strong political commitment to integration of S&T with national socio-economic objectives	Weak horizontal links between institutions Tendency towards supply-driven S&T activities Immense number of regulations and unclear overall strategy Aging researchers
Maldives (small island state, economically	S&T towards country's goals "to raise the standards of	Overall focus on IT and communications devt Other research areas:	Application and adaptation of technology from overseas to national needs	Economic and human resources insufficient to foster S&T Weak IT awareness and usage

dependent on tourism and fisheries)	living, improve social equity, modernize the economy, and participate effectively in an increasingly integrated world"	energy (alternative sources) health research fisheries/tourism	Gov't coordination and encouragement of private sector R&D Fostering research in regional/atoll centres outside capital Explicit criteria for selection and monitoring	Older telecommunications infrastructure Weak education system, particularly in S&T/research

Chart 5: Public Opinion of Professionals and Technologies[41]

Table 5.1: Public confidence in Professional Institutions

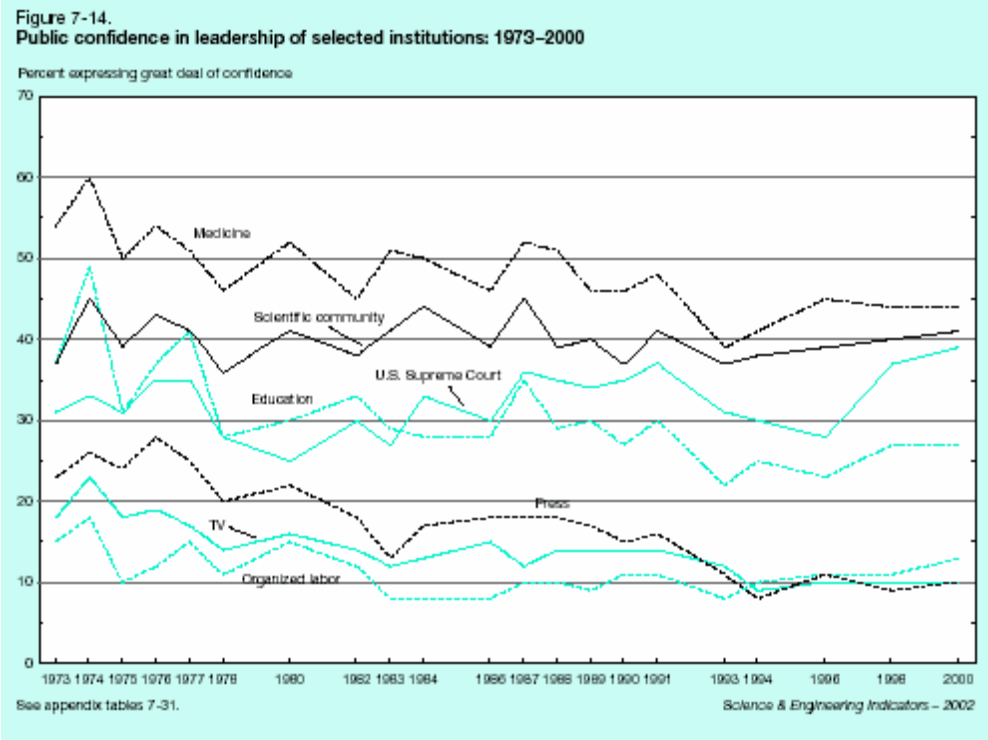

Table 5.2 : Public Attitudes towards Selected Technologies

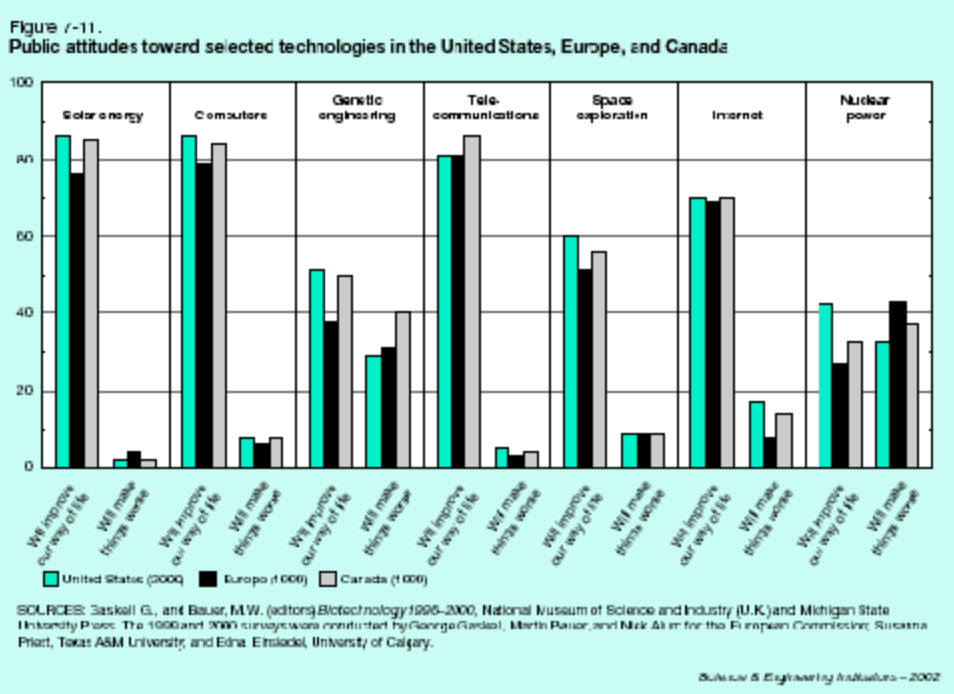

Chart 6: Public Attitudes of GM Foods[42]

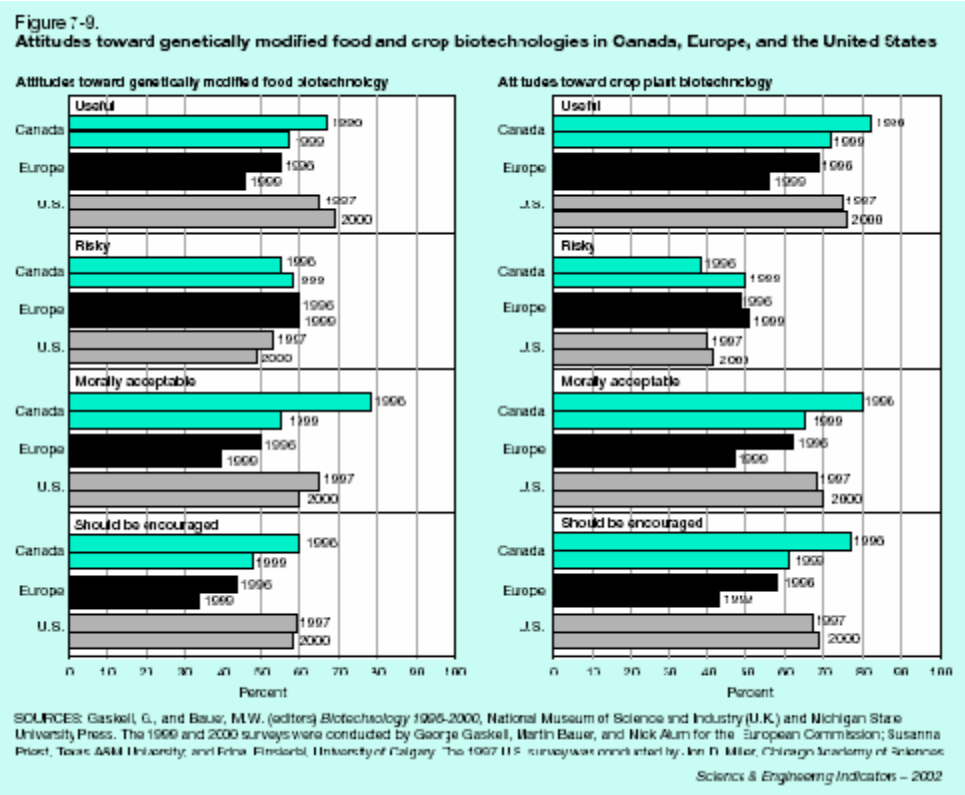

Chart 7: Priorities Identifies in Foresight Exercises and Relevance to Selection Criteria [43]

		Criteria					
Country	**Scientific Development**	**Scientific Potential**		**Collaboration Potential**		**Potential Impact**	
		Major scientific advances in 5-10 years	Impact on other sciences	International collaboration opportunities	Multi/ inter-disciplinary opportunities	Major societal benefit	Ethical issues
LIFE SCIENCES & BIOTECHNOLOGY							
Australia, Brazil, Canada, France, Hungary, Ireland, Japan, S Africa, Spain, UK, US, APEC	**Human Genetics, functional genomics -** identify disease-related genes/proteins, bio-informatics, gene therapy	YES	YES	YES	YES	YES (for some people/ countries)	YES
Australia, Brazil, Canada, Finland, France, India, Ireland, Japan, Peru, S Africa, UK, US, Uruguay, APEC	**Genetic modification of food/ crops -** eg using crops using less water, saline/disease/ pest resistant, etc.	YES	YES ?	YES	SOME	YES	YES
Australia, Hungary, APEC	**Intellectual property** and knowledge regulation, control	YES	YES	YES	YES	YES	YES
HUMAN HEALTH							
Austria, Brazil, France, Japan, UK, US	**Medical and supportive technologies** for the elderly and disabled	YES	MAYBE	YES	YES	YES	SOME?

ENVIRONMENT, SUSTAINABLE USE OF NATURAL RESOURCES							
Brazil, France, NZ, Peru, S Africa, Spain, US	**Biodiversity-** bio-mapping, inventory/ databases, conservation/ maintenance of biodiversity	YES	SOME	V LARGE	YES	YES	YES
Brazil, France, India, Japan, Peru, S Africa, UK, APEC	**Water recycling-** treatment and re-use of waste water from sewage	MAYBE	NO	YES	SOME	YES	NO
ENERGY							
Brazil, Germany, Ireland, India, Japan, Peru, S Africa, UK, US, Uruguay	**New/ renewable clean energy** sources (biomass, wind, hybrid systems)	YES	MAYBE	YES?	YES	YES	NO
INFORMATION AND COMMUNICATION TECHNOLOGIES							
Australia, Canada, India, Ireland, Hungary, Spain, UK, US	**Sensors -** biosensors, artificial senses + sensors directly stimulating nerves, integrated intelligence sensors, environmental sensors	YES	YES	YES	YES	YES	SOME?
MATERIALS SCIENCE							
Brazil, Canada, France, Hungary, S Africa, UK, US, APEC	**Nanotechnology-** including nanofabrication	YES	YES?	YES	YES	YES	NO

****

Endnotes

[1] On this see the work of the New Kind project in Europe which has attempted to provide a better set of measures of intangible capital like knowledge. www.researchineurope.org/newkind/index.htm

[2] Luddism might be an exception here, though history is replete with attempts to resist the introduction of new ideas and technology. As the Duke of Wellington once said regarding his resistance to the development of railways: "They would enable the lower orders to go uselessly wandering about the country."

[3] I am conscious of the issues associated with traditional or indigenous knowledge and consider this endemic to the question of knowledge that will be treated in this paper

[4] See for example, the paper in the Proceedings of the National Academies of Science on Knowledge Systems for Sustainable Development by David Cash et al, which outlines several case studies in knowledge systems for sustainability., PNAS, 8 July 2003, Vol. 100, no 14, pp 8086-8091.

[5] For instance, Canada's federal government has suggested that as a target, the country's expenditures for research and development (R&D) should gradually move from its current 14th place showing among league tables to 5th place by 2010. The dynamic nature of knowledge and the fact that other countries are also investing heavily in R&D is at times forgotten in such statements.

[6] The EU has launched a pilot programme to support regional measures to establish`` Regions of Knowledge`` in the field of technological development. Such regions already exist in the form of the so-called Four Motors of Europe, a loose coalition of sub-national regions designed to enhance competitive advantages through knowledge sharing.

[7] See James Mullin,`` Reflections on the Review Process of national S&T and innovation policies, paper prepared for IDRC-UNESCO workshop on Future Directions for National S&T and Innovation Policies in Developing Countries``, Paris, March 2003.

[8] See David Dickson, "Does the World Bank Really Care about Science?", SciDev.Net, 4 July 2003.

[9] See Ca, T.N,`` Donor Funded reviews on science, technology and innovation in Vietnam: the impact, the change and some thoughts for the future``, prepared for the IDRC/UNESCO workshop, Paris, April 23-24 2003.

[10] Sakiko Fukuda-Parr et al, Institutional Innovations for Capacity Development, in Capacity for Development: New Solutions to Old Problems, UNDP, 2002.

[11] Francisco Sagasti, The Sisphysus Challenge: Knowledge, Innovation and the Human Condition in the 21st Century, forthcoming.

[12] The reader may be wondering about the inclusion of astronomy here, but in fact, South Africa is well positioned to be one of the leading global players in this field due to its geography. For an articulate rationale to this, see Khotso Mokhele, ``South African Large Telescope, Model for International Scientific Collaboration between Developed and Developing Countries``, paper presented at MEXT/OECD Global Science Forum Workshop on Best Practices in International Scientific Cooperation, Tokyo, Feb 13-14 2003.

[13] Few countries have actually tried to link their domestic S&T agenda with the international knowledge and trade policies in any systematic way. Some recent examples of going ``intermestic`` include the Swiss attempts at establishing a scientific foreign policy (using foreign policy to link with science issues), and Finland which has recently issued a report on Knowledge, Innovation and Internationalisation (see Science and Technology Policy

Council of Finland, 2003) For more on this problematique, see the special issue of Science and Public Policy, Vol. 29, no 6, December 2002 on Globalization, Science, Technology and Policy (Josephine Anne Stein, guest editor).

[14] A good example common to many countries here is the use of immigration policy to attract skilled foreign nationals from developing countries, while the international development or aid policy argues for building capacity and skills in those same developing countries. The UK has recently tried to address this by issuing guidelines to prevent such internal policy clashes.

[15] See for example, some warning by Jesse Ausubel, in ``Reasons to Worry about the Human Environment, `Technology in Society, 21 (1999) 217-231 where he argues that the greatest threat to future well-being is the rejection of science. There's an interesting story in this paper about Galileo who contrived to have his two daughters placed in a convent. One of them was not able to pursue her own scientific interests as a result.

[16] See ETC Group: The Big Down: Atomtech: Technologies Converging at the Nano-scale, 2003. And Future Technologies, Today's Choices: Nanotechnology, Artificial Intelligence and Robotics: A Technical , political and institutional map of emerging technologies, A report for the Greenpeace Environmental Trust by Alexander Huw Arnall.

[17] There are signs that these knowledge producers are learning hard lessons from the GMO public scientific debacle in the next new emerging technology arena, nanotechnology. See Rebecca Willis and James Wilsdon, ``Technology, Risk and Environment``, working paper seven for the Progressive Governance Summit, London, July 13-14 2003.

[18] See www.ost.gov.uk.

[19] Daniel Yankelovich, "Winning Greater Influence for Science", Issues in Science and Technology, Summer 2003.

[20] See Barry Bozeman and Dan Sarewitz, "Public Failures in U.S. Science Policy, Centre for Science Policy and Outcomes," Washington , D.C., 18 October 2002.

[21] See Francis Fukuyama and Caroline Wagner,`` Governance Challenges of Technological Revolutions``, in Science, Technology and Governance, (John de la Mothe, editor), London, Continuum, 188-209.

[22] Tony Blair,`` Science Matters``, speech to the Royal Society of London, 10 April 2002.

[23] As a similar example, the UK Government through its Office of Science and Technology, has recently argued that each ministry or science-based department of Government should have its own chief scientific adviser, The Forward Look 2003, UK Department of Trade and Industry, 2003.

[24] On a related note, the National Academies have been working separately with both the African Academy of Sciences and the Arab states to introduce effective science academies that could in part serve as advisors on significant science-based issues of public policy for those regions.

[25] The Carnegie Group of Science Ministers for the G-8 meets twice a year in different locales to discuss (off the record and informally) issues of mutual concern amongst the G-8 memberships. See : D. Allan Bromley, Science Advisers to Presidents and Prime Ministers: A Brief History of the Carnegie Group's First Three Years, 1990-1992, April 1996, NY: Carnegie Commission on Science, Technology and Government.

[26] The Raelians showed up to demonstrate the G-8 Carnegie meeting of science ministers in Quebec in June 2001 to protest the discussions by Ministers of the ethics of new cloning technologies. Friends of the Earth and other activists were also in the crowd arguing against cloning; the Raelians were for it, making for a nice symmetrical debate.

[27] Council of Science and Technology Advisers; Science Communications and Opportunities for Public Engagement, Ottawa, 2003.

[28] For an interesting comparison of how the private sector and NGOs address communications of complex S&T issues, see the analysis of Edna Einsiedel,``A Snapshot of Private Sector and Non-Government Organizations' Science and Technology Communications Tactics and Related Best Practices``, A report commissioned by the Science and Technology Communications Sub-Committee of the Council of Science and Technology Advisers, Ottawa, 2003.

[29] UNIDO: "Technology Foresight Initiative for Latin America: An Overview of the Programme", 2003.

[30] ICSU, Identification of Key Issues in Science and Society: an International Perspective on National Foresight Studies, 2002.

[31] The Department of Homeland Defence has an entire budget and sub-structure devoted to technology that subsumes the research activities of several existing agencies. As a consequence, along with the bioterrorism and health budgets, it has become the one of the biggest single recipients of funding for research in the US Government. In Canada, a new programme for research and technology production in counter-terrorism and defence related areas is now the biggest single recipient of new funding for a government laboratory.

[32] See the arguments of Jacques Gaillard, "Overcoming the scientific generation gap in Africa: An urgent priority", Interdisciplinary Science Reviews, Vol. 28, No.1 15-25.

[33] Of course, such investments do not limit themselves to the South. In Canada, one of the principal reasons for the creation of 2000 well-paid Canada Research Chairs in research centres and universities, was the need to address a brain drain of talent to the US.

[34] It stands to reason that as more countries are created, more clubs will emerge. It also stands to reason that as knowledge becomes more specialized, the fora that discuss these issues will equally increase.

[35] Adapted from *Knowledge Flows, Innovation, and Learning in Developing Countries.* CSPO, 2003. www.cspo.org.

[36] Caroline Wagner and Loet Leydesdorff, "Mapping Global Science Using International Co-authorships: A Comparison of 1990 and 2000". University of Amsterdam. January 2003.

[37] Francisco Sagasti, The Sisphysus Challenge: Knowledge, Innovation and the Human Condition in the 21st Century. Forthcoming.

[38] Statistics originate from UNDP. 2003. *Human Development Report 2003.* New York: Oxford University Press; Government of the Republic of South Africa. 2002.; Ngoc Ca, Tran and Bo Goransson. 1999; Department of Science and Technology of the Government of India. 2003.

[39] UNDP. 2001. *Human Development Report 2001.* New York: Oxford University Press. UNDP Technology Achievement Index ranks countries based on various indicators of technological achievement, including technology creation (patents, royalties), diffusion of innovations, and human skills. Viet Nam and Maldives are not ranked because not enough information was available at the time of publication

[40] Information on **South Africa** comes from Government of the Republic of South Africa. 2002. *South Africa's National Research and Development Strategy.* Pretoria: August 2002; **India**: Department of Science and Technology of the Government of India. 2003. *Science and Technology Policy 2003*. New Delhi: January 2003. http://dst.gov.in/doc/STP2003.doc ; **Vietnam:** Ngoc Ca, Tran and Bo Goransson. "Reforming the Science, Technology, Education and Training System in a Transitional Economy: The Case of Vietnam" *Reconstruction or*

Deconstruction? Science and Technology at Stake in Transition Economies. Ed. Claes Brundenius et al. Hyderabad : Univerities Press, 1999.; **Maldives**: Ministry of Communication, Science and Technology, *Republic of Maldives, Science and Technology Master Plan*. Government of Maldives, 21 April 2001. http://www.mcst.gov.mv/Documents/mplan.htm

[41] *Science and Engineering Indicators 2002*.National Science Foundation, Division of Science Resources Statistics. Arlington VA: January 2002.

[42] *Science and Engineering Indicators 2002*.National Science Foundation, Division of Science Resources Statistics. Arlington VA: January 2002.

[43] Adapted from International Council for Science. 2002. *Identification of Key Emerging Issues in Science and Society: an International Perspective on National Foresight Studies*. pp. 18-19.

II. 3 Summary of Presentations and Discussion

II.3.1 "Futures of Knowledge for Development Strategies: Moving from Rhetoric to Reality"

Paul Dufour, IDRC

There has been much rhetoric surrounding the development of the knowledge society from multiple actors in the international community. However, we have reached the point where it is now necessary to translate this rhetoric into action. Despite the great disparities between developed and developing countries and within developing countries and regions, all countries have the capacity for knowledge production. However, how states organize themselves to strengthen or improve their knowledge-producing, transfer, and research capacities can be a bit of a hit and miss exercise. In moving from rhetoric to reality, many methodologies are available to governments but some general factors to consider include:

Knowledge for what and for whom: Knowledge for development is at the nexus of global questions that surround health, water, environment, poverty reduction, trade, and so on. Yet, knowledge is not an end in itself. Governments must identify their own niche and comparative advantage in knowledge production while also paying greater attention to the social function of knowledge development. It is also important that governments look at issues at the margins of knowledge development and the limits of knowledge in terms of societies' transaction costs - choices, priorities, risk, costs, capacity, and ethics. Moreover, it is recommended that governments pay attention to new knowledge, social innovation and anticipate future divides - nano divide or genome divide - and engage in foresight exercises which will also allow societies to look forward and determine what in the future will have knowledge elements.

Policy, decision-making and institutional environment: Governments should be careful in applying any form of a model such as a national systems approach to innovation without regard to the history, culture or institutional capacity of a country. Policy development is a particular challenge as in the increasing complex knowledge arena, it can be difficult to identify cause and effect of policy outcomes. Yet integrated policies and frameworks covering law, regulation, funding, ethics, infrastructure, and monitoring and evaluation must be developed.

Given this complexity, knowledge governance and risk management take on much more meaningful public policy function. As such, there needs to be in place sound and accountable decision-making structures, decision-makers that are more creative at integrating and learning from various sources of advice, including improved science advice which is embedded in the full machinery of government. The capacity to absorb recommendations for change, and training, critical thinking and learning skills are central, as are responsive and flexible government structures.

These national efforts must also be better integrated with regional and international bodies where much of the knowledge policy agenda is defined. Moreover, through practical collaboration in regional and international activities, national capacity can be built. A more coherent strategy at the national level also requires that donors act in a more coordinated fashion and learn from each other. A U.S. National Academy of Science report also called upon the UN System to build its own science advisory capacity in relevant agencies.

Partners: A successful approach to national knowledge systems also engages the public and the media. Public demand has dramatically altered the knowledge landscape. Governments are realizing that in order for the public to both understand, become active in, and be informed of decisions that will affect public policy, they need to be part of the process, not separate from it, or worse, separated from it. Commitment and engagement from all levels of society and participatory communications where stakeholders are involved in dialogue, deliberation and decision-making is required. The media must also play a role in

diffusing and debating knowledge and therefore linking science, journalists, communicators and practioners of research and knowledge is a key element of a successful knowledge strategy.

II. 3.2 "Beyond National Knowledge Systems: Designing a Framework for Knowledge Societies of the Future"

Shalini Venturelli, American University

In designing a knowledge society for the future, we are compelled to consider what is substantively different between traditional and knowledge societies, as well as alter our ways of thinking about conventional issues. Knowledge is more than just sharing ideas and technology; this misses the dynamic fluctuations and manipulation of ideas. Instead, knowledge should be seen as the rate of the development of new ideas, and innovation as the collision of ideas. This is not explained by a technically oriented view. So we must ask ourselves in what kind of environment can we encourage the collision of ideas where one mind plus one mind results in an exponential combination of ideas? What are the cultural conditions for creativity? How can civil society and individuals gather together to exchange, produce and exploit new ideas?

The present theories are not adequate. Knowledge is neglected in political, international relations, economic, sociological, cultural, development theory and eclipsed in communication theory. A new knowledge theory should be developed, where knowledge, culture, civil society and economics within the knowledge sphere are redefined.

Along with a new theory, there is a need for new frameworks and policies that prioritize the public sphere and participation in the knowledge infrastructure. This requires a focus on information rights, creative and innovative structures, broad social inclusion in expression, knowledge systems applied to consensus formation and associative action, civil society involvement in knowledge systems and networks, a new approach to knowledge and education, an enriched public domain, expanded culture industries, social networks for utilization of knowledge, consideration of information economics, and international policy and regulatory issues. It must also be kept in mind that these are dynamic components.

With regard to knowledge policy effectiveness the key standard is whether public policy promotes conditions for most people in a community to participate in the production and distribution of knowledge and creative expression. There are three necessary conditions for this to be realized: 1) a balanced IPR regime where the rate of ideas into the public sphere is expanding and there is a balance between the exploiter, creator and the public; 2) a functioning public sphere the boundaries of which expand so as to increase knowledge production and growth through various enlargement forces such as increased participation and civil society action, creative and scientific expression, research and libraries, infrastructure, consensus and lack of information monopoly, and freedom of expression, diversity of content and new ideas; and 3) the application of economics of ideas where a separate model is created for ideas, expression and knowledge which differ from conventional economic assumptions and do not obey traditional economic laws.

The knowledge society model of development has several characteristics: knowledge functions for public space centers, balance of non-commercial and commercial development, creative expression and emphasis of ideas production, redesign of educational goals, access to content and infrastructure, prevention of knowledge monopoly, broadened access to capital, accelerated public domain, R&D, and knowledge investment.

In line with the above, the following recommendations for action were specifically highlighted:

- Develop public space centers (not just telecentres)
- Revise education goals to include creative participation and knowledge innovation
- Design pilot projects to demonstrate dynamic knowledge sites at community level
- Promote civil society exploitation of information networks
- Develop balanced IPR regime
- Support local development of standards for knowledge

II.3.3 "Knowledge Based Estonia"

Kristi Hakkaja, Secretariat of the Estonian R&D Council

A national perspective on the knowledge society was provided by the Estonia experience. Estonia sees its participation in the knowledge society as key to its development, especially with regard to regional competitiveness. Moreover, it sees the development of the knowledge society as a means to increase the welfare and well being of its people and is intended to serve society's interests. To these ends, Estonia seeks to produce its own ideas, not depend on others.

In the effort to develop a coherent R&D policy, the "Estonian Research and Development Strategy 2002-2006: Knowledge Based Estonia" was developed. Its aim is to move from an investment based economy to an innovation based economy with the state acting as investor, catalyst and regulator. Its primary objectives are to update the pool of knowledge and increase the competitiveness of enterprises. Three focus areas were established including: user-friendly information technologies, bio-medicine and materials technologies. The Estonian R&D system is managed through the Research and Development Council, which advises government on R&D issues, and the Ministry of Economic Affairs and Communication (industrial research and innovation policies) and the Ministry of Education (research and education policies).

Two years after the launch of "Knowledge-based Estonia" several lessons have emerged in terms of what was done successfully and where further work and improvement needs to be undertaken. On the strengths of the programme, Estonia has been very active in acquiring knowledge and learning from others while not copying them; it has established a clear strategy that all stakeholders bought into, as well as a management system; and specific objectives, priorities and implementation mechanisms were identified.

However, on the implementation side, challenges have been identified on three levels. On the strategic level, the investment levels were not realized as the strategy was not decisively bound within the state budget and expected investment from the private sector did not materialize. Secondly, the priorities established in the strategy were not sufficiently narrow and were too far looking without immediate enough returns. Estonia is also facing social and ethical problems which necessitate greater focus of the strategy on the social and cultural impact of the knowledge society.

At the structural level, the important role of the implementation agency in effective application of various policy instruments has become evident. Weak coordination and linkages between the policies and initiatives of various agencies diminished the actual effectiveness of policies designed to support economic development. Stronger linkages also need to be made between strategic goals and actual planning in the use of the state budget and other funds.

Finally, several other technical and practical realities hamper progress. Competence of the staff within ministries has fallen short of what is needed to achieve goals within a specific timeframe. Also missing is

an efficient feedback loop and flexible management system. Consequently, when policy instruments and measures have sometime not proven effective enough they cannot be changed.

In the end, the following general recommendations were made on the development of national research, development and innovation (RD&I) systems:

- It is necessary to go deep into the context and conditions of particular countries.
- Formulate a clear strategy with specific goals and priorities, with enough political will and resources to bring about change, and remember what is desirable and what is possible.
- Build a management system that is effective and flexible.
- Pay attention to involving industry and SMEs in the RD&I system and addressing RD&I policies towards existing economic structures.
- Foresight can help in identifying prospective future needs of socio-economic development and act as a tool in bringing together various stakeholders to plan for the future.

II.3.4 Discussion

The discussion for Session II reiterated several of the points in the presentations concerning the purpose and elements of the knowledge society, as well as strategies for its development at the national level. Moreover, new issues were raised for further consideration.

Extension of the dimensions of the knowledge society beyond ICT and science and technology, to include social knowledge and innovation was proposed. It was also suggested that this broader understanding of the knowledge society be an issue for consideration by the General Assembly. It was felt that knowledge should not be regarded merely as a commodity and the need for its deliberate direction towards meeting the needs of the poor was emphasized. However, the knowledge economy should not be marginalized as a result, as issues such as trade, growth and employment are also central to governments' sustainable development efforts. Participants acknowledged that governments must be clear on the purpose of the knowledge society - from their unique perspective - and that the national goals established and modus operandi of the government and its policies were consistent. This is especially important for the sake of accountability. The problem of exclusion also was noted and the danger that the "e" so often attached to various aspects of the knowledge society did not come to stand for elite or expert.

The parameters of the knowledge society and whether they should be considered at the national or global levels was also discussed. The fixation on the nation state when considering the knowledge society, which often transverses national boundaries, was questioned. Indeed, many acknowledged that regional and global linkages matter and that policy, collaboration and connectivity at these levels are crucial. Yet, many felt that national issues were extremely relevant and that knowledge goals, policies, and implementation would have to be nationally defined. In addition, it was pointed out that the national level matters because much knowledge resides in the public sphere, which is nationally based, and that knowledge traditions and ways of valuing knowledge are also often locally specific.

Participants also further discussed the role of the media and civil society in the development of the knowledge society. With regard to the media, it was expressed that if they are to play an important role in knowledge production and dissemination, their independence is key. Moreover, it was felt that in knowledge communication, traditional media, not just ICT, should be given greater attention. Finally, it was reiterated that society, not just the private or public sector, produces ideas and that there is a need to create a third sphere where citizens can have input into the development of the knowledge society, raise their capacities and increase deliberation. It is important that neither the private sector nor government officials, who tend to come and go, dominate knowledge processes.

Participants generally agreed that there is no "science" to creating knowledge fields or systems. Moreover, it was suggested that knowledge production is resistant to functional analysis as it does not obey inputs, outputs and management. Rather, societies have to determine what matters (purpose) and how to organize around this (structures). The issues of creating competence, and introducing competition policy were reiterated and it was proposed that the distinction between knowledge access, use and effective use be more closely examined.

The issue of management and governance of knowledge was also debated. As knowledge is highly decentralized and given that innovation is proposed all the time, there indeed needs to be a selection and prioritization process but the question was posed as to whether knowledge can actually be managed, and if so, is this wise. Concerns over the underlying assumption that government is a benevolent entity doing good for society was also expressed. What happens when governments get control and management of knowledge to the detriment of society? In response it was suggested that, like all resources, knowledge can be an asset or dangerous, especially where governance processes are not in place. Moreover, as knowledge is power, people will manage to mange it. Therefore, what is needed is an examination of the governance of knowledge and the knowledge society, including a system of checks and balances of the public sphere and safeguards to respect the individual and basic freedoms.

Finally, the issue of culture was raised in the context of the readiness of the citizen for the introduction of new technologies, trust in government, and how to overcome resistance to technology and the means by which people can be encouraged to use knowledge. Popularization of science was suggested as ones means of doing so.

III. MEASURING KNOWLEDGE ASSETS

III.1 Overview

In the knowledge era, competitive advantage and human development will depend not only on access to knowledge at the local, national, regional and global levels but also on the strength of a nation's own knowledge assets – both the ability to generate and locate existing "raw" knowledge, as well as the ability to convert this raw material into something productive in innovate and creative ways. Every society owns or controls a number of knowledge assets. The measurement of the level of this stored knowledge as embodied in individuals, institutions, and systems, as well as the potential to enhance existing knowledge assets and generate new knowledge, may prove useful and serve as a valuable diagnostic, awareness raising and advocacy tool, pinpoint shortfalls, and mobilize political support for remedial action. Several methods have been developed which measure aspects of a nation's knowledge assets. However, to date it seems difficult, if not short of impossible, to compare nations in this respect and to declare a nation rich or poor in knowledge assets. It all depends on the goals a society pursues and the demand for specific kinds of knowledge that these goals create (e.g. a traditional rural society based on extensive agricultural methods versus a rural society that pursues mechanized agriculture focused on a particular cash crop; or, a peaceful society versus a bellicose society; or, a society espousing the value of human solidarity versus a society that is sharply elitist). On the other hand, it leads nowhere to declare that knowledge assets cannot be universally measured and compared. Experience shows that countries differ in levels of growth and development and this is combined to a large extent with an intuitive impression that those that fare better are rich in knowledge assets, most notably intellectual capital.

The third session reviewed existing knowledge assets methodologies being employed throughout the world, highlighted challenges and successes, proposed new approaches to measurement and debated the feasibility of accurately determining a nation's knowledge stocks and potential.

III.2 Expert Background Paper

Measuring Knowledge Assets of a Nation: Knowledge Systems for Development

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ABSTRACT: Ongoing transition of the United Nations Member States to knowledge-based economies is a watershed event in the evolution of the global knowledge economies. This transition marks a paradigmatic shift from energy-based economies with traditional factors of production to information-based economies based upon knowledge assets and intellectual capital. As envisioned in the UN Millennium Declaration, development of national knowledge societies should encompass social, cultural, and human development besides economic growth. Accordingly, one objective of this study is to develop the theoretical and pragmatic foundations for management and measurement of knowledge assets to facilitate this vision of holistic growth and development. Based upon a review of theory, research, practices, and national policies, we critically analyze and contrast the most popular models available for measurement of national knowledge assets. Our review includes knowledge modeling and measurement frameworks and their applications by reputed developmental organizations and national governments. There are two other key outcomes of the above review and analysis. First, to build the capacity of the public sector for measuring and managing knowledge assets, we propose, develop, and define specific frameworks, methodologies, models and indicators with illustrative real world applications. Second, we make specific recommendations for necessary improvements needed in knowledge assets management and measurement models and indicators. Prudent and effective policy directives depend upon pragmatic but theoretically and psychometrically valid measurement models for their success. We recommend that the future development of such models be based upon better understanding of human capital and social capital as well as their synthesis with existing intellectual capital frameworks and models. The findings and recommendations of this study will provide the cornerstone for measuring and managing national knowledge assets for United Nations Member States toward holistic socio-economic development.

Introduction

"For countries in the vanguard of the world economy, the balance between knowledge and resources has shifted so far towards the former that knowledge has become perhaps the most important factor determining the standard of living - more than land, than tools, than labor."

- *World Development Report, 1998*

The World Bank's prospectus document for national knowledge assessment notes that: "Knowledge assessment is a tool for assisting countries to analyze their capabilities for participating in the knowledge revolution. It focuses on those areas of the economy and society that directly benefit from knowledge and learning." A key motive for the current study is to develop better conceptualization, measurement, and evaluation of national knowledge assets to inform national and institutional policy making. It is generally understood that countries that are rich in knowledge assets and intellectual capital fare better in terms of higher levels of growth and development. Existing policy development directives and empirical studies of national knowledge assets, however, are still at a nascent stage given their recently started evolution beyond the assumptions and premises of the agrarian and industrial economies. It is therefore anticipated

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that the process of devising valid measurement frameworks and models will also generate insights for developing better theoretical, conceptual, and pragmatic understanding about the knowledge economy. This study starts with a review of existing empirical research studies, national policy frameworks, and measurement models used by developmental organizations. Specific measurement models, frameworks, and methodologies are then developed to facilitate building of public sector capacities for knowledge assets management and measurement. Future directions of research and development for improving extant measurement models of knowledge assets are outlined. Suggestions are offered for future theory development and research that can result in superior knowledge management and measurement models.

Knowledge assets represent the fount of a nation's competences and capabilities that are deemed essential for economic growth, competitive advantage, human development, and quality of life. United Nations Member States are undergoing fundamental changes with important implications for how knowledge assets are acquired, sourced, created, and utilized. The current study is concerned with understanding the relationship between national knowledge assets and economic growth as well as related human, social, cultural, and political development at the national level. Informed by recent theory, research, and developmental applications related to intellectual capital, social capital, and human capital, this study also attempts to define the future trajectory of knowledge assets measurement and management.

Many recent international comparisons of economic growth and performance are built upon accounting or information and communication technologies (ICT) based perspectives. Many such measures have also focused on structural inputs such as ICT investments with lesser consideration for the social and human capital that determines quality of performance outcomes. Fortunately, there is growing awareness about the role of social and human capital as the critical links between structural inputs and policy outcomes. Simultaneously, developmental organizations are adopting a more holistic perspective of national growth that goes beyond just economic performance and includes human, social, cultural and political development and general well being. Theoretical dimensions of social and behavioural behaviours and actions relevant to value-added performance however need to be better understood and applied.

Concerns about efficiency and effectiveness of knowledge assets are evident in questions about the return on investments in such assets. However, a more important and immediate issue that precedes such concerns is about how we conceptualize, understand, assess and measure knowledge assets. A critical and comparative analysis of existing measurement models is expected to reveal their strengths and limitations for public administration and development. Such analysis will also help in determining if, and how, any of the existing models may be adapted to meet the developmental needs of the public sector. A review of the models for national knowledge assets measurement and benchmarking used by major developmental organizations can provide additional insights about improving current measurement frameworks.

In Section 1, we define the constructs of knowledge assets and intellectual capital and outline key challenges in their measurement. A comparative analysis of popular knowledge assets measurement models in Section 2 assesses their strengths and limitations to determine their fitness for use in public sector developmental contexts. Measurement frameworks and models used by developmental organizations are reviewed in Section 3 and recommendations offered for improving measurement constructs and indicators. Suggestions are also offered for refining and integrating the human capital and social capital dimensions in knowledge assets measurement to better meet the needs of holistic development. Section 4 develops one national knowledge assets measurement model deemed appropriate for this developmental focus and discusses how it is applied for measuring national knowledge assets. In Section 5, a methodology for defining actionable performance measures and an action blueprint based upon the balanced scorecard are developed for building public sector competencies in measuring knowledge assets. The final section on conclusions and recommendations provides a synopsis of suggestions for improving measurement of national knowledge assets made in the paper. It also outlines a

future knowledge assets measurement framework for holistic development based upon more sophisticated understanding of human capital and social capital.

Section 1. Measures of the New Wealth of Nations

Knowledge measurement tools and methodologies assist nations in analyzing and benchmarking their competences and capabilities as knowledge-based economies. Such assessments can facilitate adoption of good policies and practices as well as growth of national knowledge systems for holistic development. Knowledge systems consist of national institutions, frameworks, and infrastructures that can facilitate effective use, sharing, creation, and renewal of knowledge for socio-economic growth. This section develops a preliminary understanding of knowledge assets and intellectual capital and outlines the challenges involved in their measurement.

What are Knowledge Assets?

Accountants define an asset as a stock from which a number of future services are expected to flow. Accordingly, *knowledge assets* are defined as (Boisot, 1998, p.3}: "stocks of knowledge from which services are expected to flow for a period of time that may be hard to specify in advance." In contrast to physical assets that may have a limited life because of wear and tear, knowledge assets may in theory last forever. Given their open-ended value, there is no one-to-one correspondence between the effort required to create knowledge assets and the value of services they yield. In other words, they are non-linear with respect to the effects they produce.

Distinction between the three terms – data, information, and knowledge – is relevant for explaining the contrast between physical assets and knowledge assets. Knowledge builds upon information that is extracted from data (Boisot, p. 12). In contrast to data that can be characterized as a property of *things*, knowledge is a property of *agents* predisposing them to act in particular circumstances. Information is that subset of the data residing in things that activates an agent through the perceptual or cognitive filters. In contrast to information, knowledge cannot be directly observed. Its existence can only be inferred from actions of agents. Similarly knowledge assets cannot be directly observed in nature – they need to be apprehended indirectly (Boisot, p. 12). Hence, in contrast to the emphasis on tangible input-focused measures of physical assets, knowledge assets require understanding in terms of quality and content of performance outcomes.

Boisot (1998) notes that knowledge assets are manifested in terms of technologies, competences and capabilities. *Technology* is defined a "socio-physical systems configured so as to produce certain specific types of physical effects." *Competence* denotes "the organizational and technical skills involved in achieving a certain level of performance in the production of such effects." *Capability* is interpreted as "a strategic skill in the application and integration of competences."

Knowledge assets can be thought of as a subset of dispositions to act, or 'potential for action' (Malhotra, 2004; Malhotra, 2002a; Malhotra, 2000a; Malhotra, 2000d) embedded in individuals, groups, or socio-physical systems with future prospects of value creation. National knowledge assets are the "intangible" assets of a country that have significant implications for future national growth and future value of the country to various stakeholders. There is growing realization about knowledge management (KM) as the enabler of innovation and learning (Malhotra, 2000c; Malhotra, 2000d) as well as national gross domestic product (GDP) (Malhotra, 2000b; Malhotra 2003c).

What is Intellectual Capital?

OECD (1999) defines intellectual capital as the economic value of two categories of intangible assets of a company: organizational ("structural") capital; and human capital. Structural capital refers to things like proprietary software systems, distribution networks, and supply chains. Human capital includes human resources within the organization and also customers and suppliers of the organization. Often, the term "intellectual capital" is treated as being synonymous with "intangible assets" or "knowledge assets." However, OECD considers 'intellectual capital' as a subset of overall 'knowledge assets' and this study proposes an identical perspective.

Stewart (1997) defines intellectual capital (IC) as "the intellectual material -- knowledge, information, intellectual property, experience - that can be put to use to create wealth". Alternative definitions (at firm level) interpret IC as the difference between the firm's market value and the cost of replacing its assets. Existing conceptualizations of IC and its various models share some common overall characteristics while maintaining substantive differences in details of implementation Malhotra (2003c). Some of the more popular measurement frameworks and models used for assessing firm level and national knowledge assets are discussed later. The differences between the current models arise from their effort at managing the complexity of measuring the intangibles. Some models focus primarily on financial metrics and offer a restricted notion of knowledge assets. Others take a more holistic view but require subjective judgment in determining a composite index that may be used for objective comparisons.

Challenges in Measuring Knowledge Assets

The compelling reasons for valuation and measurement of knowledge assets include understanding where value and its potential exist in the various sectors of the national economy. The accounting- and economics-based perspective of knowledge assets and intellectual capital can be appreciated by clarifying the two terms 'assets' and 'capital.' Assets are economic resources controlled by an entity whose cost at the time of acquisition can be objectively measured (Anthony and Reece, 1983). Valuation and measurement of assets is often based upon the comparison of expected flows of expenditure with potential revenues. The objective of evaluative criteria is to determine whether estimated rate of return is higher than alternative uses of an existing asset or purchase of a new asset. An asset – physical or non-physical – does not exist from a transaction perspective without some way of recording the fact that the asset acquired in one period generates revenue in future periods. For instance, in a system of accrual accounting, the accountants "record the prospect of future cash inflows as an increase in assets and as revenue whenever they have objective evidence of the future cash receipt" (OECD 1996a, p. 38-39). Hence, accounting conventions determine how the inter-temporal nature of investment is treated and assessed. Accountants realize that "the valuation of all assets is a subjective process – especially for intangible assets" (OECD 1996a, p. 43). Therefore, adequate guidelines and standards must be in place regarding valuation criteria, methods and disclosures to inspire confidence in the reliability and consistency of intangible asset valuations.

In the case of physical capital, present and future benefits are made comparable through the use of discount rates, while costs are measured through depreciation. However, in the case of knowledge assets, there is no way of counting costs and benefits over any period of time except in the immediate accounting period. Economic uncertainty characterizing the choice about how to use or invest in 'assets' is magnified in the case of knowledge assets. Fundamental challenges involved in parallel accounting treatment of knowledge assets and physical capital are attributable to the specific characteristics of human knowledge. As noted in an OECD report (1996a, p. 43), human-embodied knowledge is (i) non-physical, (ii) non-appropriable, (iii) not measurable directly, and (iv) incompatible with conventions and institutions that guide the day-to-day transactions recorded by financial accounting and reporting. Interestingly, these challenges reflect, in part, the three-part definition of an asset. An asset must be an economic resource,

the resource must be controlled by the entity, and its cost at the time of acquisition must be objectively measurable (Anthony and Reece, 1983, p. 36).

Measurement of National Knowledge Assets

Measurement of national knowledge assets is relevant to the valuation, growth, monitoring and management of intangible assets (Malhotra, 2000b). Such intangible assets include constructs such as information, knowledge, ideas, innovation, and creativity and other derivatives. These constructs were not treated as assets by traditional accounting standards. Interest in knowledge assets initially arose from the significant differences between the market value of firms and their book values that were based upon measures of their tangible or physical assets. Similar comparisons of national growth among various developed and developing countries suggested that economic growth cannot be explained just on the basis of tangible assets. In many such cases, high growth rates were often attributed to national investments in knowledge-based and information-based infrastructure, goods, and services. In this respect, knowledge assets represent the identifiable aspects of the nations that although "intangible" can be considered as adding some kind of value to it.

The initial focus of national developmental indicators related to information- and knowledge-based assets was on investments in tangibles, and availability of specific information- or knowledge-based 'devices' such as computers, servers, and other structural elements. However, there is growing realization about the amorphous nature of such structural elements wherein their management and utilization rides supreme over *mere* possession. For instance, in the recent *Business Week* special report on IT (August 25, 2003), Microsoft Corp. Chairman William H. Gates notes: "Everybody has always had access to the same technology. There's nothing new there. The fact is that some companies have taken technology and used it more effectively than others." Recent empirical research and theory development has dissected this issue in greater depth to understand the critical human and social processes underlying effective and ineffective utilization of ICT based systems, information, and knowledge (Malhotra 2004, 2001, 2000a, 2002a, 2002b, 2000d, 1999, 1998a, 1998b, 2002c; Malhotra and Galletta 2003, 1999, in press). Interestingly, understanding of these human and social processes – missing from most socio-economic developmental frameworks of human capital and social capital – may hold the key to alleviating 'knowledge gaps' and 'information problems' (World Bank, 1998) that must be overcome in the progress toward knowledge-based economies. Refined understanding of these behavioural and sociological dimensions of information and knowledge appropriation and use for value-creation can also inform national, governmental, and institutional policy initiatives.

While importance of knowledge assets has increased, understanding of the knowledge economy is shrouded in relative ignorance because of its treatment as a 'residual', something that could not fit the category of tangibles, industrial and agricultural. Often, characterized as the 'service economy,' this *residual* category accounts for 70% or more of most developed nations' economies. This definition introduced heterogeneity in the definition of the service economy from the beginning that has become more prominent in the 1990s. Accordingly, the increasing attribution of economic growth based upon multifactor productivity seems to reflect our increasing ignorance about measurement of uncharted macro-economic as well as micro-economic drivers of growth (Boisot, 1998).

Boisot (1998) provides an interesting distinction that highlights the transition in the role of the 'invisible' assets:

> "In the energy-based economy, knowledge and information had an important role to play, but it was a supporting role, and they were not the central focus of the transaction or exchange as an object in their own right. The function of information was to describe the object of the transaction as well as the terms on which it would take place. It was rarely itself an object of exchange."

He observes that information goods, even when difficult to produce, may be easily and inexpensively replicated, therefore they require different valuation procedures than those used for physical goods. Mere access to information or knowledge may not automatically result in value creation. Rather value has to be extracted from these assets through human and social actions that focus on meaningful value-creation. Accordingly, valuation of knowledge assets poses major theoretical and practical problems that need to be addressed (Romer, 1994). As economic growth is more dependent upon intangible or immaterial assets (Romer, 1996), there is imperative need for assessing the validity of existing measurement models and underlying theoretical frameworks. Such a review can help identify immediate areas for improvement and also provide a base for adapting appropriate tools for developmental needs of the public sector. This objective constitutes a primary focus of this study. The review can also help in appreciation of the challenges that must be met for more far-reaching improvements through definition of newer measurement models. This is the subject of recommendations discussed in the concluding section. The next section provides an overview of the more popular measurement models for knowledge assets and intellectual capital and knowledge assets.

Summary: Section 1 provided preliminary conceptualization and definitions of knowledge assets, intellectual capital, and national knowledge assets. Based upon an overview of the differences between physical assets and intangible assets, it also highlighted the challenges that are inherent in the process of measuring national knowledge assets. Section 2 and 3 focus on a comparative analysis of measurement models for knowledge assets and intellectual capital observed in current research and practice.

Section 2. Popular Measure ment Models in Research and Practice

The central focus of this section is on review and comparison of some of the more popular measurement frameworks and models for assessing knowledge assets and intellectual capital (Malhotra, 2003; Malhotra, 2003). Most existing methodologies for measuring knowledge assets and intellectual capital are motivated by research and practice in domains of accounting, economics, human resource accounting, intellectual property, and, real options, among others. Prior reviews of such models have focused at the firm level analysis with an accounting, economic, or strategic lens (cf: Bontis et al. 1999, Bontis 2000, Housel and Bell 2001, Sveiby 2002, Liebowitz and Suen 2000). Most of these models have not been directly applied for assessment of national knowledge assets. Many empirical research studies and institutional policy frameworks do however relate to the key elements of these models in their conceptualization. Despite increased awareness about social and behavioural issues relevant to national performance, surprisingly, there is sparse focus on integrating the sociological and behavioural perspectives. One objective of this study is to assess what we can learn from these models and how we can adapt their key elements in congruence with the public sector focus on holistic national growth and development. The outcome of this process will be some form of measurement frameworks, methodologies, and models that are appropriate for developing public sector competencies for knowledge asset measurement. This process starts with a review of how existing measurement models deal with the 'intangible' aspects of knowledge assets, in particular intellectual capital.

Historically, intangibles were classified as 'goodwill' in accounting practices and intellectual capital was a part of the goodwill. A number of contemporary classification schemes have refined the distinction and classified intellectual capital into categories such as external (customer-related) capital, internal (structural) capital, and human capital (e.g. Sveiby, 1997; Roos et al., 1997; Stewart, 1997; Edvinsson and Sullivan, 1996; Edvinsson and Malone, 1997). However, traditional accounting practice does not provide for the identification and measurement of these "new" intangibles in organizations. In response, the new measurement models proposed for firm level analysis attempt to synthesize the financial and non-financial value-generating aspects of the company for external reporting. Some of these new models are the intangible asset monitor (Sveiby, 1997); the balanced scorecard (Kaplan and Norton, 1992; 1996;

2000); and, the Skandia value scheme (Edvinsson and Malone, 1997). Most of the above models consist of three broad categories of intellectual assets - human, customer and structural capital.

The most common models for measuring intellectual capital emphasize that non-financial measures must complement the financial measures. Specific aspects of knowledge assets also need to be integrated in strategic analyses and execution so that relevant attributes are available for assessment and measurement. Most of these models consider intellectual capital as something that is not visible; that is based upon knowledge and experiences embedded in employees; and that offers better opportunities for future organizational success. In many of these conceptualizations, IC includes value embedded in the skills of the employees, the processes of an organization and the firm's customer relationships. Financial assets are not included as a part of IC. A key difference between various models is in terms of the priority given to measurement of internal and external human capital and social capital. Some of the models tend to focus more on customer capital, but these metrics can be adapted to include other stakeholders such as employees and suppliers. The following discussion provides an overview of some of the most popular models followed by a comparative analysis.

Skandia Navigator

Skandia is most known for its efforts for measuring knowledge assets. It developed its first internal intellectual capital report based upon the measurement model proposed by Edvinsson and Malone (1997) in mid-1980s. The company's later efforts at measuring knowledge assets and intellectual capital have relied upon this model for conceptualization of organizational value and performance. The Skandia Navigator defined by Edvinsson and Malone (1997, pp. 11, 34 – 37) divides the intellectual capital of an organization into three basic forms: *human capital, structural capital* and *customer capital.* Human capital includes collective competence, capabilities, skills and experiences of employees and managers as well as their creativity and innovativeness. Structural capital is the supporting infrastructure for human capital and includes organizational processes, procedures, technologies, information sources, and intellectual property rights. Customer capital includes the value embedded in firm's relationship with customers, suppliers, industry associations and market channels.

Early conceptualization of this model focused on five areas for improvement: financial, customer, process, renewal and development, and human capital. In the latest scheme, intellectual capital is a composite of human capital and structural capital. Structural capital in turn consists of customer capital and organizational capital that in turn is composed of innovation capital and customer capital This model is the subject of in-depth discussion and application in the subsequent section on developing a model for measuring national knowledge assets.

Balanced Scorecard

The Balanced Scorecard (Kaplan and Norton, 1992, 1996, 2000) aims to balance the traditional perspective of accounting for intangibles by adding four perspectives related to: innovation and learning, business process improvement, customer relationships, and, value creation in financial and intangible terms. In contrast to other tools, this model provides an integrated focus on both management and measurement of knowledge assets. It is one of the early tools that developed an integrated vision of measurement systems for management with focus on financial and non-financial indicators (market, internal processes and learning) relevant to organizational performance. The Balanced Scorecard (BSC) complements information provided by other tools with its process-based focus on how specific actions relate to organizational performance outcomes. Given that this model is particularly conducive for relating the strategic vision to core competencies and related success factors for organizational success, it provides one possible basis for developing an action blueprint for the public sector. The performance

outcomes oriented actionable blueprint is developed in the subsequent section on building public sector capacity for measuring knowledge assets.

Intangible Assets Monitor

Intangible Assets Monitor was developed by Sveiby (1997) and defines three types of intangible assets that account for the book value-to-market value discrepancy in the valuation of a firm. The 'residual' that is not accounted for by the book value is attributed to individual competence of employees, internal structure, and external structure. While Skandia Navigator treats culture and the management philosophy of the organization as a part of human capital, Intangible Assets Monitor classifies them under the internal structure. With its primary emphasis on people, this model is based on the premise that people are the only true agents in business and all aspects of structure, internal and external, are embedded in human actions. Application of this model is very context-specific and the indicators are chosen as polar descriptors (such as good or bad) that are specific to the contextual objectives that may make sense differently across organizations.

IC-Index Model and HVA Model

Roos and colleagues (Roos et al., 1997) proposed an IC-Index model which consolidates all individual indicators into a single index in contrast to prior models that provided for assessment of separate components of intellectual capital. More recently, Roos and his colleagues have proposed a Holistic Value Approach (HVA) based on the view that a narrow asset perspective, using traditional accounting methods without considering the usefulness of these in business performance is of little use as a strategic management tool.

Technology Broker Model

Technology Broker Model developed by Brooking (1996, pp. 13-14) divides organizational knowledge assets into four categories: human-centred assets, infrastructural assets, intellectual property assets and market assets. Each component of the model is examined through specific audit questionnaires about variables related to the specific asset category. In contrast to the other frameworks, this framework splits the second component (structural capital or internal structure) into infrastructural assets (processes, methods and technologies) and intellectual property assets (copyrights, patents, trade marks, and, trade secrets).

Other Measurement Models for IC and Knowledge Assets Assessment

There are other measurement models available in the IC literature such as Tobin's Q, economic value added (EVA), Market-to-Book Value, Intellectual Asset Valuation, Total Value Creation, Total Value Creation, Knowledge Capital Earnings, citation weighted patents, etc. (see for instance: Stewart (1997); Bontis (2001); Bontis et al. (1999); Lev (1999); Sullivan (2000)). These models are relevant to firm-level analyses of knowledge assets based upon market capitalization, return on assets, and other monetary valuations. However, they are of little relevance to our objective of developing national knowledge asset measures for holistic national performance. A brief description of most popular models is provided in Table 1. Some other 'tools' – such as the Knowledge Management Assessment Tool (KMAT) developed by APQC – had focused on attributes such as leadership, culture, technology, and management that have been integrated in the more recent models.

Table 1 provides a comparative overview of the measurement models discussed above. Summary description of each of the measurement models is given along with comparative analysis about their

strengths and limitations. The comparison helps in determining the suitability of available models for national and public sector contexts of holistic development.

Two of the more popular measurement models are of specific interest for the public sector given their early application in national knowledge asset measurement and in devising knowledge metrics in the public sector. Scorecard based techniques such as Skandia Navigator and Balanced Score Card can accommodate both quantitative and qualitative assessments based upon a mix of scientific measurement and judgment. Skandia's IC model has been already applied in assessment of knowledge assets of some nations and national regions (Malhotra 2000b, 2003d). Balanced Scorecard has emerged as a popular tool for development of holistic knowledge management and measurement and has been applied in hundreds of organizations across various economic sectors.

Summary: This section provided an overview and a comparative assessment of most popular measurement methodologies and models for assessing knowledge assets and intellectual capital that are discussed in research and practice literatures. This discussion focused on measurement models that have been applied in performance assessment of individual firms and private sector. Some of these models have been gaining increasing interest in government and public sectors and have been implemented in those contexts. In later sections, we develop the methodology for implementing these models for national knowledge assessment and development of public sector capacities.

Table 1. Existing Models for Measuring Knowledge Assets – A Comparative Analysis

Measurement Model	Overview of the Knowledge Assets Measurement Model	Strengths and Weaknesses for Public Sector Applications
Skandia Navigator *Edvinsson and Malone (1997)*	Like the Balanced Scorecard, it is a holistic reporting model with focus on human capital, structural capital, customer capital, and organizational capital. Analyzes each component of IC separately to ensure greater focus. The specific foci used for analysis include: financial focus, customer focus, process focus, renewal and development focus and most importantly human focus. Intellectual capital is measured through the analysis of up to 164 metric measures (91 intellectually based and 73 traditional metrics) that cover five components: (1) financial; (2) customer; (3) process; (4) renewal and development; and (5) human. Uses a balance sheet approach that provides a static snapshot and cannot represent dynamic flows in an organization. Inclusion of structural capital may provide incorrect impression that availability of resources (such as ICT) by itself results in competitive advantage (*regardless* of effective utilization).	These models are based upon **scorecard methods** wherein various components of intangible assets or intellectual capital are identified and indicators and indices are generated and reported in scorecards or as graphs. Composite index based upon synthesis of all components of IC may or may not be created. No estimates are made of dollar values of intangible assets. Given the objective of this study to develop models and measures of national knowledge assets for socio-economic development and human development, these models seem particularly relevant. *Strengths*: These models can provide a more comprehensive analysis of national knowledge assets and of national
Balanced Scorecard *Kaplan and Norton (1992, 1996)*	Translates an organization's mission and strategy into a comprehensive set of performance indicators for strategic management and measurement. Has focus on both financial objectives as well as building of capabilities and acquiring	

	intangible assets for future growth. The scorecard attempts to seek balance between external measures for shareholders and customers, and internal measures of critical business processes, innovation, and of learning and growth. Balance is also sought between relatively objective outcome measures and subjective / judgmental measures of performance. A company's performance is measured with indicators covering four major focus perspectives: (1) financial perspective; (2) customer perspective; (3) internal process perspective; and (4) learning perspective. The indicators are based on the strategic objectives of the firm.	performance than other models based upon financial metrics. These models allow measurement closer to actual inputs, processes, and outcomes, and reporting can therefore be faster. Hence, they are particularly suitable to the task of 'detection and correction of errors' in aligning the inputs and processes with outputs and outcomes. The indicators capture contextual nuances and result in 'rich' data analyses of which can provide useful insights for policy making. *Weaknesses*: The strengths of these measures that make them particularly effective can also be interpreted in terms of weaknesses of efficiency. Contextual influences that facilitate more corrective policy responses make comparison across different contexts somewhat challenging. Also, rich data that yield insightful observations on in-depth analysis may not be efficient in terms of quick analysis and may not easily yield a single 'standard' numeric or financial composite index.
Intangible Asset Monitor *Sveiby (1997)*	Shares many similarities with Skandia Navigator and Balanced Scorecard, but the primary emphasis is on people who are considered as the organization's only profit generators. Accordingly, *people's competencies* (similar to Skandia's human capital) are the key focus of the model and are converted in *external structures* (similar to Skandia's organizational capital) and *internal structures* (similar to Skandia's customer capital). Management selects indicators, based on the strategic objectives of the firm, to measure four aspects of creating value from intangible assets by *growth*, *renewal*, *efficiency*, and *stability*.	
IC-Index *Roos, Roos, Dragonetti and Edvinsson (1997)*	Focus is on monitoring the dynamics of IC. Provides a single index of several indicators based on correlating changes in IC with market changes. The four indices are: relationship capital,	

	human capital, infrastructure capital and innovation capital. Consolidates all individual indicators representing intellectual properties and components into a single index. Changes in the index are then related to changes in the firm's market valuation. Very context specific and limited in universality. Like other measures, depends upon value judgments. Takes past performance into account and may be influenced by major transitions that occurred in the past years.	
Value Chain Scoreboard *Lev (2002)*	A matrix of non-financial indicators arranged in three categories according to the cycle of development: Discovery/Learning, Implementation, Commercialization.	
Human Capital Intelligence *Fitz-Enz (1994)*	Sets of human capital indicators are collected and benchmarked against a database. Similar to HRCA.	
Technology Broker *Brooking (1996)*	Assesses the value of a company's IC through a diagnostic analysis of the company wherein IC is considered a composite of market assets, human-centered assets, intellectual property assets, and, infrastructure assets. First round of 20 questions to establish the need for strengthening IC and follow-up IC audit including 178 questions related to the four categories of IC. Requires a 'big leap'	These models are based on direct intellectual capital methods, i.e., they estimate the dollar value of the intangible assets by identifying its various components. Some of these models have limited use for assessing and analysing specific aspects of IC

	between qualitative results and financial monetary values. There are many similarities between Technology Broker IC audit questions which are subjective in nature and Skandia's IC measures that re objective in nature.	and knowledge assets. They may be used in conjunction with the scorecard methods when objective is to derive composite 'standard' financial or numeric indicators. However, such standards must be adopted with caution to ensure valid and reliable measurement and comparison. *Strengths:* These models allow valuation of separate components of IC; they allow for combinations of monetary and non-monetary valuations; they provide a comprehensive view of the organization's intellectual wealth; these are event-based measures and therefore better at relating cause and effect compared with financial metrics. *Weaknesses*: These measures are company specific and may be difficult to
Citation- Weighted Patents *Bontis (1996)*	A technology factor is calculated based on the patents developed by a firm. Intellectual capital and its performance is measured based on the impact of research development efforts on a series of indices, such as number of patents and cost of patents to sales turnover, that describe the firm's patents.	
Inclusive Valuation Methodology (IVM) *McPherson (1998)*	Shows the relationship between the company value, IC, and monetary measurements to provide an inclusive business valuation. Uses three value categories: intrinsic value representing the internal effectiveness of the company; extrinsic value measured by the delivery effectiveness of the company; and instrumental value that reflects impacts on the competitive environment. Attempts to provide an overall business value as reflected by the sum of IC and company's cash flows. Combined Value Added = Monetary Value Added combined with Intangible Value Added.	

The Value Explorer *Andriessen & Tiessen (2000)*	Accounting methodology proposed by KMPG for estimating the value of IC attributable to a company's core competencies. Based on allocation of value to following intangibles: assets and endowments, skills & tacit knowledge, collective values and norms, technology and explicit knowledge, primary and management processes.	compare and benchmark; Given much financial and non-financial data, they involve more effort and judgment in analyses.
Intellectual Asset Valuation *Sullivan (2000)*	Methodology for assessing the value of Intellectual Property.	
Total Value Creation, TVC *Anderson & McLean (2000)*	A project initiated by the Canadian Institute of Chartered Accountants. TVC uses discounted projected cash flows to re-examine how events affect planned activities.	
Accounting for the Future (AFTF) *Nash (1998)*	A system of projected discounted cash flows. The difference between AFTF value at the end and the beginning of the period is the value added during the period.	
Tobin's q *Stewart (1997)*	Tobin's q is similar to the market-to-book value except it substitutes book value with the replacement cost of tangible assets. A company with Tobin's q greater than 1 and greater than competitor's q is presumed to produce higher profits resulting from	These models are based upon **market capitalization**, i.e., they compute the IC as the difference between the firm's market

	advantage that is attributed to IC. Allows for adjustments to be made to overcome limitations of market-to-book value.	capitalization and stockholder equity. These are not of much relevance for IC and KA assessment for nations or for government and public sector organizations. *Strengths*: Good for illustrating the financial value of IC; Good for inter-firm benchmarking within an industry. *Weaknesses*: Do not contain information about the components contributing to IC; Exclusive monetary focus provides only partial perspective; Not suitable for the holistic socio-economic and human development approaches sought for this study.
Investor assigned market value (IAMV) *Standfield (1998)*	Takes the Company's True Value to be its stock market value and divides it with Tangible Capital + (Realised IC + IC Erosion + SCA (Sustainable Competitive Advantage)	
Market-to-Book Value *Stewart (1997)*	The market-to-book value is based on the difference between a company's market capitalization and its book value. Therefore, the key premise is that the market value represents the true value of the company including both tangible assets and intellectual capital. Generally accepted method in accounting and easy to apply.	
Economic Value Added (EVA) *Stewart (1997)*	Calculated by adjusting the firm's disclosed profit with charges related to intangibles. Changes in EVA provide an indication of whether the firm's intellectual capital is productive or not. It is a 'surrogate' measure of IC as it does not provide specific information of what is the contribution of IC to the firm's performance.	These measurement models are based upon **return on assets** or ROA. ROA is computed by dividing the pre-tax earnings of the firm by the average tangible assets and then comparing with the industry average. The difference is then multiplied by the

Human Resource Costing & Accounting (HRCA) *Johansson (1996)*	Calculates the hidden impact of HR related costs that reduce a firm's profits. Adjustments are made to the P&L. Intellectual capital is measured by calculation of the contribution of human assets held by the company divided by capitalized salary expenditures.	company's average tangible assets to calculate an average annual earning from the Intangibles. Dividing this average earning by the company's average cost of capital or an interest rate gives the value of a company's IC. These models are not of much relevance for IC and KA assessment for nations or for government and public sector organizations. *Strengths*: Good for industry benchmarking and for illustrating financial value of IC; Built on traditional accounting rules and thereby easily communicated between accountants *Weaknesses*: Do not contain information about the components contributing to IC; Exclusive monetary focus provides only partial perspective; Not suitable for the holistic socio-economic and human development approaches sought for this study.
Calculated Intangible Value *Stewart (1997)*	Calculates the excess return on hard assets then uses this figure as a basis for determining the proportion of return attributable to intangible assets. May be used as an indicator of profitability of the investments in knowledge assets.	
Knowledge Capital Earnings *Lev (1999)*	Knowledge Capital Earnings are calculated as the portion of normalised earnings over and above expected earnings attributable to book assets.	
Value Added Intellectual Coefficient (VAIC) *Pulic (1997)*	Measures how much and how efficiently intellectual capital and capital employed create value based on the relationship to three major components: (1) capital employed; (2) human capital; and (3) structural capital.	

Section 3. Developmental Models of National Knowledge Assets

Several national governments have launched national knowledge initiatives for developing and benchmarking measurement models to guide industry practices in managing and measuring knowledge assets (Malhotra, 2003c). The Government of Netherlands invited four accounting firms to conduct a "practice-oriented study of the intangible assets of a number of their clients, and to produce a trial appendix to the external financial annual report without allowing themselves to be influenced by existing conventions, legal regulations and accounting principles." The Danish Agency for Trade and Industry sponsored the preparation of a report to prepare firm-level "intellectual capital accounts" and development of more comprehensive IC indicators, based on the experience of several Nordic and Danish companies. Based on similar spirit of participation, the Government of Norway has sponsored development of a competence capital model including intellectual capital. Hence, the models discussed in prior sections also provide a broad foundation for government initiatives aimed at enabling the private sector for contributing to the national knowledge economies. As evident from successful transition of some European and Asian countries into vibrant knowledge economies, collaborative relationships between the public sector, private sector, and educational and research institutions play an important role in the success of the overall process. The primary focus of this study is on enabling the public sector's knowledge management and measurement capabilities and competencies. This section and the subsequent section provide an in-depth perspective on this theme. We begin with a review of the existing measurement models and indicators that more directly focus on the public sector and on national and regional socio-economic development.

Several knowledge assets measurement models – as well as models and indicators on related themes of intellectual capital, social capital, and human capital – have been proposed by world development organizations such as World Bank, OECD, and United Nations agencies. Some of these models constitute the knowledge assets management and measurement fabric for many countries and regions of the world. Originally, developed for the era of industrial and agricultural economies, these models do allow assessment, comparison and benchmarking of national economies of the world. However, their primary focus seems to be on tangible assets and structural capital. While some of these models have assessed national growth in terms of investments in ICT or investments in other structural artifacts that at best describe input- or process- related measures. Being relatively disconnected from the outputs and outcomes that determine national growth and performance, the validity and reliability of such indices and indicators needs to be re-assessed for holistic socio-economic and human development. The objective of the current review is twofold. First, an assessment of existing methods, models, measures, and indicators can build some perspective about their strengths and limitations. Second, critical analysis of extant measurement models and artifacts can help reconcile discrepancies between theory, practice, and policy which in turn can facilitate development of more valid and reliable measures and models. The remaining discussion in this paper builds on the first objective to suggest incremental improvements in existing models and measures. The lessons learned from reviews of various models are then used for developing a performance-outcomes-driven measurement methodology for the public sector. The concluding discussion suggests necessary but more fundamental improvements required in measurement models based upon better theories and understanding of practices and policy relevant to the knowledge economy.

World Bank's Knowledge Assessment Methodology (KAM) and Scorecards

World Bank's Knowledge Assessment Methodology and Scorecards represent a very comprehensive tool for reviewing world development data aggregated and compiled from several "authoritative" sources. Their methodology consists of a set of 69 structural and qualitative variables and they note that it can be used for benchmarking "how an economy compares with its neighbours, competitors, or countries it wishes to emulate" (World Bank Institute, 2002). The intent of the methodology is: "to identify the problems and opportunities that a country faces, and where it may need to focus policy attention or future

investments." The comparison of the 69 variables is available (through an interactive web site) for a group of 100 countries that includes most of the developed OECD economies and about 60 developing economies. The set of 69 variables serve as proxies for the four areas that are considered critical in the development of a knowledge-based economy:

- An economic and institutional regime that provides incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship.
- Educated and skilled populations of citizens who can create, share, and use knowledge well.
- A dynamic information infrastructure that can facilitate the effective communication, dissemination, and processing of information.
- An efficient innovation system of firms, research centers, universities, consultants and other organizations to tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new technology.

Knowledge Assessment Methodology also includes several variables that track the overall performance of the economy which "illustrate how well an economy is actually using knowledge for its overall economic and social development."

The main focus of KAM is on only 14 of the 69 variables compiled in the "standard" scorecards. The chosen 14 variables are expected to capture the four "critical" areas listed above as well as some performance variables. These "standard" scorecards attempt to capture "the essence of a country's preparedness for the knowledge-based economy." It cannot be determined from available information if the choice of variables resulted from judgment or from a causal modeling methodology based upon theory- and policy-based analysis. The 14 "standard" variables are listed in **Table 2**, followed by a critical analysis of some illustrative indices ("constructs") and indicators ("measures").

Table 2. Variables used in the "Standard" 14-variable scorecards

Performance Indicators

1. Average annual GDP growth 1990-99 (%) (World Development Indicators, 2001)
2. Human development index 1999 (Human Development Report, UNDP, 2001)
   - Longevity (measured by life expectancy)
   - Knowledge (adult literacy rate and mean years of schooling)
   - Standard of living (real GDP per capita in purchasing power parity)

Economic Incentive and Institutional Regime

3. Tariff and non-tariff barriers 2002 (Heritage Foundation, 2002)
4. Property rights 2002 (Heritage Foundation, 2002)
5. Regulation 2002 (Heritage Foundation, 2002)

Education and Human Resources

6. Adult literacy rate (% age 15 and above) 1999 (Human Development Report, UNDP, 2001)
7. Secondary enrollment 1997 (World Development Indicators, 2001)
8. Tertiary enrollment 1997 (World Development Indicators, 2001)

Innovation System

9. Researchers in R&D (UNESCO, 1999)
10. Manufacturing trade as percentage of GDP (SIMA, 2002)
11. Scientific and technical journal articles per million people (World Development Indicators, 2001)

Information Infrastructure

12. Telephone per 1,000 persons, 1999 (telephone mainlines + mobile phones) (ITU, 2000)
13. Computers per 1,000 persons, 1999 (International Telecommunication Union, 2000)
14. Internet hosts per 10,000 persons, 2000 (International Telecommunication Union, 2000)

Re-Assessing Existing Constructs and Indicators for Valid Measurement

The indicators used in KAM seem relevant to analysis of national performance in terms of overall economic and social development. However, some questions still need to be addressed about *what* the indices and indicators measure. This discussion's focus is on the above model, but *the critique is applicable for any other measurement model* as well. The questions posed in this discussion are pertinent to the validity of the measuring instrument.[1] They are also critical for the justification, or the lack thereof, of measurement modelling efforts (Churchill and Iacobucci 2001) and in retrospective determine the success or failure of such efforts.

Validity is synonymous with accuracy or correctness. The validity of a measuring instrument is defined as "the extent to which differences in scores on it reflect true differences among [nations] on the characteristic we seek to measure, rather than constant or random errors." First, we need to understand the rationale behind the selection of 14 "standard" variables? Why are these indicators most relevant? What is the rationale behind their selection? As noted by Churchill and Iacobucci (2001): "One of the most critical elements in generating a content-valid instrument is conceptually defining the domain of the characteristic… If the included domain is decidedly different from the domain of the variable as conceived, the measure is said to lack content validity." The question arises if the measures are derived from theory or policy about the knowledge economy: as the absence of theory (framework of justifiable and believable assumptions) that can support such measures would result in incorrect measures.

An additional concern is about the focus of most indices and indicators on inputs that may *or* may not be valid 'proxies' for outcomes that really matter. The challenge raised by the problem of using proxies is that measures may lack 'construct validity' which is "most directly concerned with the question of what the instrument is, in fact, measuring." Is the measure of investments in ICT a reliable and valid proxy for effective utilization of those 'structural' and 'process' resources or for real performance outcomes? There is increasing agreement between researchers and practitioners that this is not a valid assumption (See for instance, Malhotra (2004), Malhotra and Galletta (in press)). The same rationale is applicable for other structural resources – including those embodied in current metrics for social capital and human capital – that depend *upon* 'users' for their appropriation and effective utilization.

A related issue is that of causal influence on the processes, outputs, or outcomes, i.e., the issue of 'predictive validity.' This issue is *critical* as most investments in the public sector are based on the cause-effect rationale in terms of achievement of specific policy goals and targets. The missing focus on the inputs-processes-outputs-outcomes[2] in measurement models would make investments in public development projects hit-or-miss propositions. The question arises if these indicators do indeed represent "how well an economy is actually using knowledge for its overall economic and social development." Even if all the links in the causal chain cannot be measured, measurement models must be based on justifiable and believable measures that bear some relationship to expected performance outcomes. "Predictive validity is ascertained by how well the measure predicts the criterion: it focuses on the usefulness of the measuring instrument as a predictor of some other characteristic or behaviour. It is determined strictly by the correlation between the two measures; if the correlation is high, the measure is said to have predictive validity." A more critical issue that is apparent from current knowledge policy documents is if what we are trying to measure as 'effect' may in fact be the 'cause.' This is an important question as the shifting focus to social capital and human capital imposes need for better understanding of sociological and behavioural issues. It may be probable, for instance, that human well being and human development may represent the 'cause' *as well as* 'effect' for developmental models. Interestingly, the OECD (2001d, p. 9) report *The Well-Being of Nations* opens with the following note: "This report is concerned with human and social capital, not as ends in themselves, but as resources which can be used to support economic and social development."

There are additional concerns from the standpoint of valid measurement that can be easily solved with simple statistical tools such as regression analysis and factor analysis. For instance, existing indices suggest that there are multiple constructs and variables that overlap and interact with each other. Are we capturing the same variance multiple times that may artificially inflate the explanatory power of some measures? Are the five different categories (constructs) indeed distinct constructs with minimal overlap of variance? How do we explain the occurrence of same, similar, or identical variables (indicators) in multiple constructs? How do we 'explain away' the interactions, influences, and correlations of variables within same constructs and across different constructs? Given increasing emphasis on 'experiential learning' and 'real life learning' by various national governments (see for instance, OECD report on *Human Capital Accounting*), what matters more: "years of schooling" or "years of job experience"? It is possible, that the answer to such 'wicked' questions would depend upon further scrutiny of the context and additional variables that may not have been addressed in prior measurement models.

Existing 'mixed' units of analyses in current indicators pose an additional reason for concern. What is the rationale behind choice of different units of analysis for different indicators? Are 'per capita' measures a true measure of "national" performance? This is a very critical concern particularly for economies that are characterized by extreme variances[3] such as: very rich and very poor, very educated and illiterate, and, very positively productive and very 'negatively' productive. Given that the significant percentage of world population lives in countries characterized by such extreme contrasts (such as India and China), such 'per capita' measures could present significantly skewed view of the real state of development. *Human Development Report* (OECD 1999) notes that a decade ago, "20% of the richest humans owned more than 80% of global wealth and 20% of the poorest humans owned only 1.4% of the world riches. However, at the beginning of the 20th century, the ratio of the wealth ownership between the richest 20% and poorest 20% of the global population was about 10:1. Today, as we are about to enter the 21st century, the ratio stands at 75:1, and the gap is growing. The rich-poor gap is apparent within nations and among nations, irrespective of developed or developing nation status."

The scope of this paper allows discussion of only few illustrative issues about validity and reliability of the measurement models. There may not be easy answers to many of the questions that we raise. However, awareness about the critical issues that can determine the success or failure of measurement models is necessary for informing any attempt to devise such methodologies. In sum, the ongoing *assessment of measurement models and tools is as important as the specific phenomena that are the subject of measurement.*

The above discussion just scratched the surface in terms of pointing out the needed reforms in the measurement modelling processes and frameworks necessary for justifying the investment and effort. The current analyses would help address issues of feasibility and implementation for incremental and radical improvements in measurement models for knowledge assets: Is it doable? What it will entail to do well? What compromises are involved in balancing the need for 'effectiveness' and for finding 'efficient' solutions?

Previous discussion focused on the measurement issues with primary focus on the 'process' of measurement. The following discussion follows up on the 'subject' of measurement, i.e., *what* is measured. Here the focus is on developing theoretical frameworks for understanding the knowledge economy that are critical for developing valid measurement models. Many scholars, including Boisot (1998), have observed that, economics has no adequate theory for handling data – or information goods in general – as a factor of production.

OECD Measurement Models for Knowledge Assets and Intellectual Capital

The Organisation for Economic Co-operation and Development (OECD) has conducted several studies and produced several reports related to the development of knowledge-based economies. While their focus is primarily on developed countries, their reports are relevant to the concerns of underdeveloped and developing countries as well. The following discussion outlines some initial developmental work where progress is being made to devise better theoretical foundations for more appropriate measurement models.

The *OECD Science, Technology, and Industry Scoreboard 2001: Towards a Knowledge-Based Economy* (2001c) report recognizes at the outset that: "Investment in knowledge is by nature much more difficult to measure. A rough indication can be gained by including public and private spending on higher education, expenditure on R&D and investment in software. Investment in knowledge accounts for about 4.7% of OECD-wide GDP and would exceed 10% if education expenditure for all levels were included in the definition of investment in knowledge."

Their interpretation of what constitutes a "knowledge-based economy" seems to be guided by emphasis on the following indicators in terms of percentage of GDP investments:

- Higher education,
- Expenditure on R&D, and,
- Investment in software

In the formative phase of developing theoretically sound measures, OECD interprets the inputs -- rather than outputs or outcomes -- as representative of a knowledge-based economy. Their report notes that: "Sweden, the United States, Korea and Finland are the four most knowledge-based economies, as their investments in knowledge amount to 5.2-6.5% of respective GDP." In other words, the more a country spends on higher education, on R&D and on software, the more it represents a knowledge-based economy. This rationale seems problematic given that similar assumptions about firm-level investments in input resources (ICT) have been questioned and emphasis has shifted from financial investment to management and utilization of those inputs (See for instance, (Collins, 2001), (Malhotra 2004, Malhotra and Galletta (in press), (Carr 2003)). Many of the developmental organizations are equally concerned about the returns on their investments in terms of effective utilization of resources in pursuit of expected performance outcomes. Given the increasingly critical role of human and social processes in realizing the performance potential of structural capital, the following discussion reviews the progress made by OECD on this front and makes recommendations for further improvement.

Reconciling Knowledge Assets and Human Capital

What represents "production of knowledge" needs to be reconciled in terms of inputs-performance-outputs-outcomes indicators as well as interpretations offered across developmental frameworks with shared focus. The above OECD report observes that: "By this measure, most OECD countries are moving towards a knowledge-based economy, especially the Nordic countries, Ireland and Austria, which are allocating more and more resources to production of knowledge." This implies "investments in higher education, expenditure on R&D and investment in software" *in fact* result in "production of knowledge." This is a problematic conclusion, given that what is being measured are *inputs* that may have potential for being utilized for production of knowledge. However, they do not in themselves represent "production of knowledge." The above critique is of interest given that another OECD report *Measuring What People Know: Human Capital Accounting for the Knowledge Economy* (1996b) notes: "Even though in practice the rates of investment appear to be increasing, little consideration has been given to either the content or

quality of the investments being made in human capital." Interestingly, it also presents another interpretation of "human capital" as (p. 22) "the knowledge that individuals acquire during their life and use to produce goods, services, or ideas in market or non-market circumstances."

With its emphasis on "achievement-based evaluation" and "competence-based prior learning assessment," the second OECD report clearly recognizes need for assessing "prior learning, *regardless of the source*" (p. 60, emphasis added). In this perspective, regardless of investments made in formal education structures, formal or informal on job is equally relevant and important. This report also discusses case studies of countries such as Australia, Canada, France, and United Kingdom that now focus less on "traditional exams" and more on "judging people by what they do at work" (p. 63).

Measuring What People Know (OECD 1996b) report had recognized that: *inputs* with potential for economic growth need to be differentiated from the *real* performance outcomes achieved, that could be achieved *regardless* of those inputs. In other words, formal education is just another means for achieving the goals of 'lifelong learning' focused on performance outcomes. The 2001 scorecard however still focused on the 'inputs' and assumed them simply as proxies for performance outcomes. Investments in formal structures of education are important socioeconomic indicators in development schemes of most major development organizations, especially with focus on reducing illiteracy. Often out-of-date premises about school-bound education are used to advance the future of the knowledge economy. A review of existing education literatures would reflect that the new economy depends more on lifelong-learning, learning-on-demand, and, continuous learning and unlearning (OECD 2001, King and Malhotra 2001).

Important questions about the role and contributions of such investments go unanswered. Here are questions about some key indicators evident in most developmental premises but need to be reconciled with reality. Why are the systems of K-12 education in a state of disrepair in the most developed economies (such as the United States) despite higher level of investments? Why do the science and technology achievement scores for the most developed economies lag those for the less developed and developing countries (such as India and China) despite their lower teacher-student ratios? Why are the higher education programs in most developed economies (such as the United States), particularly in business management, reassessing their priorities given growing recognition of diminishing relevance of education that contributes to real performance and growth? (See for instance, Malhotra 2003b). These questions are not intended to be exhaustive, but are representative of reconciling the discrepancies between policy and reality as evident in the *real* outcomes.

These questions are relevant given OECD's (2001d, p. 20-22) observations that: "Qualification measures are a simple but weak proxy for human capital… and the measurement of human capital needs to recognize the limitations of many proxies. Investment in skills takes place in many different settings and stages of lifecycle… and cultural context affects learning. Increased expenditure on education needs to be complemented by other strategies to enhance performance. There may be diminishing returns to spending on education for higher levels of economic development. Lower class sizes do appear to yield higher attainment, but the effect sizes are modest... Social networks are important to learning [and] help to foster learning throughout life." Social capital and human capital seem to have shared effects on some indicators such as value-added learning.

Reconciling Knowledge Assets and Social Capital

There is growing recognition of human capital and social capital as two key aspects of national "well-being" (OECD 2001d). However, indicators of non-economic aspects of "well-being" are missing from most existing developmental models in use by development organizations. The OECD report defines 'well-being' in the following terms: "Well-being includes economic well-being but also extends to the enjoyment of civil liberties, relative freedom from crime, enjoyment of a clean environment and

individual states of mental and physical health." There are remarkable similarities between the holistic development pursued by the United Nations Millennium declaration – developed in the current study – and the broader interpretation of well-being. To advance the understanding about social capital, OECD has produced a Social Capital Assessment Tool (SOCAT, for short) and a related guide in collaboration with the Social Capital Initiative at the World Bank (World Bank, 2002).

In contrast to the human capital focus on the individual, the focus of social capital is on collective action and outcomes based on the themes of cooperation, collaboration, and coordination. Developmental efforts often rely upon specific communities of individuals who share specific concerns and interests facilitated by governmental and public sector initiatives. Social capital represents social structures and underlying attitudes based upon social interaction, trust, and reciprocity for producing collective outcomes to enhance human well being, and, promote opportunity through grass roots level empowerment. OECD defines social capital as the "institutions, relationships, attitudes, and values that govern interactions among people and contribute to economic and social development" (World Bank, 2002; p. 2). Government-mandated and facilitated social structures and organizations, networks, associations, and institutions represent the *structural social capital.* Public sector capacities can facilitate development of such entities by providing developmental support, legitimacy, and stability. More subjective intangible and subjective elements such as generally accepted attitudes and norms of behaviour, shared values, reciprocity, and trust represent the *cognitive social capital.*

The social capital measurement proposed in the above guide combines qualitative and quantitative assessment by observing collective activities. The methodology includes focus groups, community mapping, institutional diagrams, key respondent interviews, household surveys, interviews, and scoring on quantitative and qualitative questionnaires related to three types of proxy indicators listed below. The three indicators may be combined into a single index, however, separate analysis of each dimension is recommended.

- *Structural Social Capital*: Memberships in local associations and networks (input indicator)
    - Measured in terms of
        - Density of membership,
        - Diversity of membership, and
        - Participation in decision-making.
- *Cognitive Social Capital*: Indicators of trust and adherence to norms (input or output indictor)
    - Measured in terms of
        - Solidarity
        - Trust and Cooperation
            - Generalized trust or overall trust
            - Extent of trust in the context of specific transactions
            - Extent to which they would receive assistance from others
        - Conflict and Conflict resolution
            - Extent of conflict
            - Conflict avoidance
            - Contribution to common development goals
            - Extent of harmonious relations
- *Collective Action* (output indicator)
    - Measured in terms of
        - Extent of collective action
        - Type of collective activities
        - Overall assessment of collective action

Grounded in some empirical and applied work, the measurement model for social capital is a relatively new tool that needs further improvements. As in the case of intellectual capital and human capital, different (but compatible) interpretations from economic, sociological, and behavioural perspectives of social capital are yet to be reconciled.

Other Developmental Models for National Knowledge Assets

There are few other developmental models that are visible in the international, regional, and, national socio-economic development initiatives. Many of these models are at a conceptual stage and may lead to specific methodologies and indicators in the future. A handful of such measurement methodologies that have received exposure for international replication or for innovativeness are briefly reviewed here.

United Nations Economic Commission for Europe (ECE) Models

To facilitate innovation and commercialization of knowledge assets, UNECE conducted a review of existing practices and methodologies for valuing intellectual capital. The review focused on valuation of intellectual assets (inventions), intellectual property rights (patents), valuation of managerial flexibility, stock market valuation of companies, and R&D project valuation (United Nations Economic Commission for Europe, 2003). While the primary emphasis was on valuation of intellectual property rights (such as patents), recommendations were made for a holistic realization of sustainable innovation processes. The holistic development view recognized that innovation was more about the human resources – it starts with them and ends with them. They urged governments to support human resource development, innovation and continuous adaptation of institutional, information and innovation systems. Realizing that "innovation and technological capabilities of a country are clearly correlated with long-term growth and social progress," this initiative emphasized that innovation and technological polices must promote value generation from knowledge assets. The concepts outlined in the above review have yet to be crystallized into specific measurement models and measures.

eEurope National Knowledge Assets Measurement Models

The eEurope action aims to create an information society for all and the 'most competitive economy in the world' based on knowledge. Its focus is on digitization of the government and everyday work life. It aims to achieve this by promoting an innovative entrepreneurial culture and a socially inclusive process for sustaining consumer trust and social cohesion. With primary emphasis on the inputs (means) for accelerating digitization, the plan explicitly specifies its focus on ICT related inputs:

> "At the heart of the knowledge-based economy, knowledge itself is particularly hard to quantify as well as price. While new knowledge will generally increase the potential output of the economy, the quantity and quality of its impact are not known in advance. There is no production function, no input-output formula that could approximate, however roughly, the effect that one unit of knowledge would have on economic performance."

Most of the metrics and indicators used in this plan, already adopted by some European countries, are similar to those included in the World Bank and OECD models.

European KM Forum Assessment Model

The European KM Forum attempted to develop a comprehensive KM assessment model and tool. Although the tool described itself as the "the initial concepts for assessing the maturity of organizations towards KM," it identified several socio-technical aspects of KM assessment that are relevant to the current study. Interestingly, it also focused on the human motivation issues that have been generally

neglected in other tools for knowledge assets measurement. Although interesting, most metrics and indicators from this forum are yet to be developed based upon a very comprehensive knowledge audit questionnaire.

e-Readiness Index

The Economist Intelligence Unit produces a comparative index of e-readiness rankings for countries "to compare and assess their e-business environments." 'E-readiness' is defined as the extent to which a market is conducive to Internet-based opportunities to demarcate areas where government policy can guide investment for growth. The popular interest in Internet and Web based interconnected infrastructures started with the worldwide discussions on development of National Information Infrastructures in early 1990s (Malhotra et al. 1995). Other countries have followed suite motivated by World Bank's recommendation for national digitization. There are many overlaps in the indices and indicators used in these comparisons with the structural and process aspects of ICT infrastructures evident in World Bank and OECD indices. However, ICT represents one of the structural inputs that must be leveraged by human appropriation and utilization for performance (Hildebrand, 1999).

There are other innovative national knowledge assets measurement and modelling efforts that are at a preliminary stage, such as Malaysia's *Knowledge Imperative Index* (KIX). Most such models show a growing appreciation of the socio-technical focus on holistic national development.

Summary: This section discussed some of the significant measurement models for national knowledge assets being applied for international and national socio-economic development. Models proposed and applied by World Bank and OECD, among others, were reviewed and critically analyzed to develop a foundation for building valid and reliable measurement frameworks and methodologies. The review indicates a growing interest in the social capital and human capital components of national knowledge assets. There is clear and growing recognition of these components as critical enablers of potential performance of structural capital, which had been the main focus of attention in prior models.

Section 4. A Model for Measuring National Knowledge Assets

Measurement frameworks, models, and methodologies facilitate not only measurement but also management of knowledge assets. Most measures of economic performance have relied upon GDP and factors of production – land, labour and capital – for analysis. The last few years have seen growing appreciation for adopting a more holistic focus of national socio-economic growth. The OECD (2001, p. 9) report, *The Well-Being of the Nations*, opens with the following statement: "Distinctions must be kept in mind between quantity and quality of growth, between its costs and return, and between the short and the long run… Goals for 'more' growth should specify more growth of what, and for what." The OECD study observes that in the case of developed economies: "Rapid economic growth has reduced absolute poverty… but well-being is broader than economic well-being… and economic well-being is broader than measures such as GDP. But review of data for developed countries suggests that well-being has lagged behind GDP. " Based upon prior observations about knowledge assets, we believe that a holistic focus on human capital, social capital, and well-being of nations is equally relevant to developed and developing economies. Skandia's Navigator reviewed in prior discussion offers one such measurement model for assessing both tangible and intangible assets. Based upon this model, the following discussion aims to develop a blueprint of a model for measuring national knowledge assets. The application of the model is then illustrated based on an empirical study sponsored by the United Nations Development Project (Bontis 2002).

Although modelling and measurement of national knowledge assets is still in its infancy, there have been prior efforts to measure related components such as country-level and regional human development (See,

for instance, http://www.undp.org/rbas/ahdr/.). Building upon prior intellectual capital frameworks (Edvinsson and Malone 1997; Pasher, 1999), Malhotra (2000) advanced the policymaking imperative for reliable measures of national knowledge assets to understand how they relate to future performance. In this model, there are four components of intellectual capital: market capital (also denoted as customer capital); process capital; human capital; and renewal and development capital. While financial capital reflects the nation's history and achievements of the past; intellectual capital represents the hidden national potential for future growth. According to Edvinsson and Malone (1997, p. 11), the relationships between the various components of intellectual capital are depicted in the following terms

Market Value = Financial Capital + Intellectual Capital where,
Intellectual Capital = Human Capital + Structural Capital

Human Capital: The combined knowledge, skill, innovativeness, and ability of the nation's individuals to meet the tasks at hand, including values, culture and philosophy. This includes knowledge, wisdom, expertise, intuition, and the ability of individuals to carry out value creating tasks and goals. Human capital is the property of individuals. An OECD report notes (OECD, 2001d) that this wealth is multifaceted and includes knowledge about facts, laws, and principles, as well as the less definable knowledge of specialized, teamwork and communication skills. The same report also cautions that metrics should include both the quality and quantity of individual stores of knowledge as well as the collective knowledge stores found within groups and collectives.

Structural Capital: Structural capital represents the knowledge assets that remain without consideration of human capital. It includes organizational capital and customer capital [also known as market capital]. Unlike human capital, structural capital can be owned by the nation and can be traded.

Structural Capital = Market Capital + Organizational Capital

Market Capital: In the original conceptualization, this component was referred to as customer capital to represent the value embedded in the relationship of the firm with its customers. In our conceptualization, it signifies the market and trade relationships the nation holds within the global markets. Relationships within and across countries enhance the ability to create, use, and create value from knowledge.

Organizational Capital: Organizational capital refers to the capabilities such as organizational structures, hardware, software, databases, patents, trademarks, and everything else that supports innovation and productivity through sharing and transmission of knowledge. Organizational capital consists of two components: process capital, and renewal and development capital.

Organizational Capital = Process Capital + Renewal & Development Capital

Process Capital: Processes, activities, and related infrastructures for creation, sharing, transmission and dissemination of knowledge for contributing to individual knowledge workers' productivity. It is defined in terms of the non-human storehouses of a nation's knowledge assets embedded in technological, information and communications systems: as represented by its hardware, software, databases, laboratories and organizational structures which sustain and externalize the output of human capital (UNDP, 1998).

Renewal and Development Capital: This component of intellectual capital reflects the capabilities and actual investments for future growth such as research and development, patents, trademarks, and start-up companies that may be considered as determinants of competence in the future.

While financial capital reflects the history and achievements of the past,

- Process capital and market capital are components upon which present operations are based;
- Renewal and development capital determines how the nation prepares for the future; and,
- Human capital lies at the crux of intellectual capital. It is embedded in capabilities, expertise and wisdom of the people and enables value creation from all other components.

The adapted framework for measurement of national knowledge assets is depicted in Figure 1.

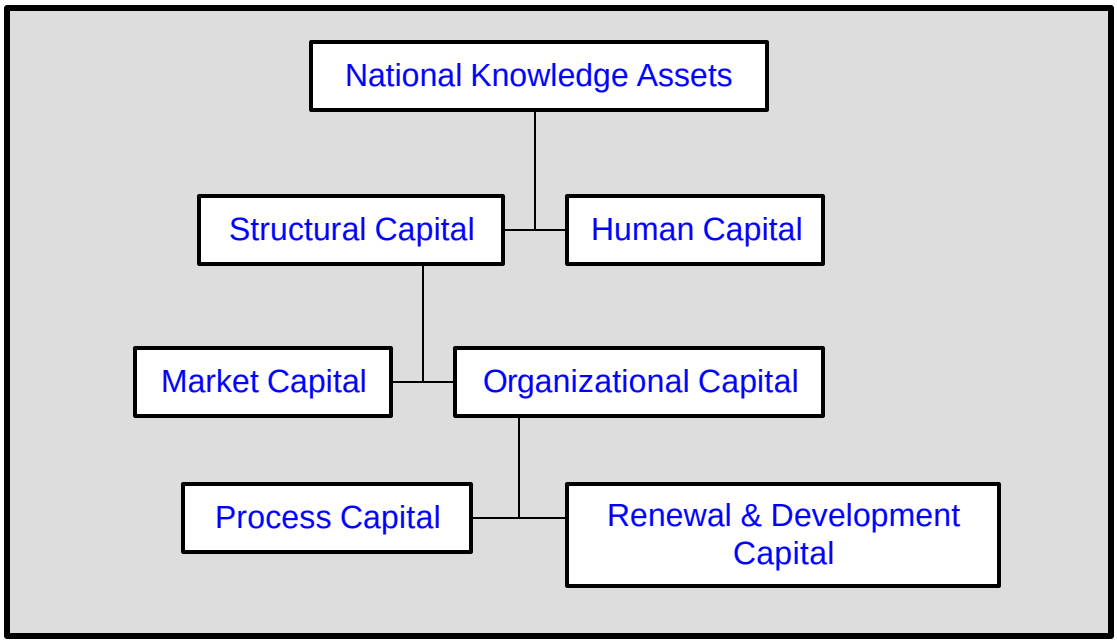


Figure 1. Components of National Knowledge Assets

(Based upon Malhotra, 2000b)

Application of the Measurement Model

The above measurement model is based upon lessons learned from prior applications for assessing national knowledge assets and intellectual capital (Pasher, 1999; Malhotra, 2000b). The national intellectual capital includes knowledge assets of individuals, firms, institutions, communities, and government that represent current and potential sources for wealth creation and improved quality of life. Bontis (2002) adapted this methodology for measuring knowledge assets of the Arab region. The transformation resulted in four separate national indices for knowledge assets, one each for human capital, process capital, market capital, and renewal capital. A list of the specific indictors used for the four indices is given in **Table 3**.

Table 3. Indices and Indicators of National Knowledge Assets

(Based upon Malhotra, 2000b; Pasher, 1999; Bontis, 2002)

Human Capital

Original Indicators	*Proposed Indicators*
	Organizational training and development per capita
Literacy rate	
Number of tertiary schools per capita	Training and development participation rates
% of primary teachers with required qualifications	% of GDP spent by level of education
Number of tertiary students per capita	Population at various age groups
	Quality of education and standardized testing results
Cumulative tertiary graduates per capita	
Percentage of male grade 1 net intake	Instruction time and length of school year
Percentage of female grade 1 net intake	Educational participation quality and results
	Ratio of student population at each level of completion
	Mathematics, reading, writing, and basic science

Structural Capital

Market Capital

Original Indicators	*Proposed Indicators*
High-technology exports as a percentage of GDP	Openness to different cultures
Number of patents granted by USPTO per capita	Number of foreign spoken languages
Number of meetings hosted per capita	Volume of tourist traffic
	Subjective measures of honesty and trust in business dealings
	Ease of launching new businesses
	International awards and recognitions
	Immigrant inflow and outflow
	Export of magazine, books, and periodicals
	World expositions and conventions hosted
	Professional Olympic athlete participations
	Students and scholarships in foreign schools

Organizational Capital

Process Capital

Original Indicators	*Proposed Indicators*
Telephone mainlines per capita	Computer literacy rates
Personal computers per capita	Digital storage per capita
Internet hosts per capita	Volumes of books in libraries per capita
	Transportation statistics such as paved roads per capita
Mobile phones per capita	
Radio receivers per capita	Availability and extent of software usage
Television sets per capita	Entrepreneurship and number of venture start-ups
Newspaper circulation per capita	Venture capital funding

Renewal and Development Capital	
Original Indicators	*Proposed Indicators*
Books and periodicals imports	Number of graduate students studying abroad who return
Total R&D expenditures	Ratio of patent applications to granted patents
Number of ministry employees in R&D per capita	Number of applications for registered trade marks
Number of university employees in R&D	Intellectual aptitude of the younger population
Tertiary expenditure as % of public education funding	

This following transformations were made to further adapt the model to the context of socio-economic development: market value was replaced with national wealth, financial capital was replaced with financial wealth, customer capital was replaced with market capital, and, innovation capital was replaced with renewal capital.

Three are many similarities between the indicators of this model shown in Table 3 and the indicators used in developmental analysis by organizations such as World Bank and OECD. Indicators that have been validated, refined and applied with success in multiple cases offer reliable metrics that can be applied in other similar contexts. In contrast, indicators that have seen limited empirical validation with mixed findings need to be tested and analyzed further to develop confidence in their reliability and validity. The key goal is to develop a parsimonious set of indicators to explain and predict how specific policy directives affect achievement of specific socio-economic and human development objectives.

Based on the analyses of collected data, Bontis (2002) highlights the importance of human capital as the "pre-eminent antecedent for the intellectual wealth of a nation." The significant role of the nation's citizens in codifying and internalizing the knowledge and applying it in course of various structural, institutional, and organizational activities, processes, and procedures needs further understanding.

Summary: This section reviewed one national knowledge assets measurement model relevant to the developmental focus and discussed its application for one world region. There are many similarities between this measurement model and the developmental assessment models used by major development organizations. This is not unexpected given that the objective of the adapted model based on Skandia's framework is same as that of developmental organizations, i.e., assessment of national socioeconomic performance based upon both tangibles and intangibles. There is need for an overall methodology for development and implementation of the process for applying knowledge metrics across public sector organizations. The next section develops such a methodology with focus on performance outcomes.

Section 5. Building Public Sector Capacity for Measuring Knowledge Assets

A review of knowledge assets measurement models in practice, research, and policy development in prior sections suggested various important areas for improvement. We find that most extant models primarily focus on inputs and structural variables with lesser attention to process, outputs, and outcomes. Expected performance outcomes are key determinants of investment decisions for public sector projects. In addition, despite the abundance of measurement models, there is dire need for connecting *measurement* of knowledge assets to their *management.* The raison d'être of the measurement process is to provide for better management of knowledge assets. Application of any knowledge measurement methodology requires understanding of the causal links between inputs-processes-outputs-outcomes as a pre-requisite. Understanding how performance metrics guide specific actions and behaviours to yield desirable

performance outcomes is the quintessential foundation that underlies successful development and implementation of measurement models.

In this section we develop the foundation for linking inputs to performance outcomes. On this foundation, we develop the overarching measurement and management methodology for linking national strategic vision with specific core competencies and the critical success factors that influence performance outcomes. For the implementation of this methodology, we develop an adaptation of the Balanced Scorecard model to depict the causal links between specific policy directives and expected performance outcomes.

How Knowledge Asset Metrics Guide Knowledge-Based Performance

In prior sections, we discussed how social capital and human capital play a key role in deriving expected performance outcomes from structural capital. Given this backdrop, we envision a national knowledge sharing culture that derives benefits for stakeholders in terms of learning, innovation, communication, coordination, and collaboration with the help of structural assets such as ICT systems. The primary focus of this vision treats people – as individuals and collectives – as the central focus of most processes and activities that leverage desirable outcomes from various aspects of intellectual capital.

Before the measurement models are applied, four important issues need to be addressed.

- ***What is being measured?*** Overall, the focus is on tracking the progress of the nation toward the realization of the vision of the knowledge society of which knowledge economy is a part. When the model is implemented at the organizational or institutional level, the specific criteria and causal links are defined at that level in congruence with the national vision.

- ***Why it is being measured?*** Different public sector organizations may have disparate needs in terms of how the measurement and management would facilitate their specific goals. Some may need the measurement model as a diagnostic for assessment of progress and for benchmarking while others may need it as a tool for building advocacy. Some may need it as a means for prioritizing investment allocations and others may need it for mobilizing political support for remedial action. Diverse needs, when understood in the relationship to the strategic vision and desired performance outcomes, would still address common and shared goals at higher levels.

    - ***How it is being measured?*** In many cases more than one model or set of indicators may seem appropriate for measuring knowledge assets. In other cases, there may be need for adapting existing measures while in some cases measures need to be devised from scratch. Despite these differences, the process should be based on the awareness that the primary purpose of the measures is informing and communicating the relevant stakeholders for realizing behaviours or actions that yield desired outcomes.

    - ***When it is being measured?*** There are two aspects of this issue: one related to the maturity level of the KM project and the other related to the specific causal loop of inputs-processes-outputs-outcomes. Different stages of maturity of the KM project may have different expectations about performance outcomes. At pre-planning phase issues such as strategy development and risk analysis may be relevant whereas the start-up phase may need greater focus on building championship and support for the project. The pilot phase may need to focus more on benchmarking and developing 'good practices' while the growth phase may require institutionalization of those practices and their wide spread use.

The causal loop of inputs-processes-outputs-outcomes has been mentioned in prior discussions. Understanding the causal 'loop' and what various KM measures represent is necessary for developing effective metrics for knowledge assets and management of their 'stocks' and 'flows.'

Measures for Knowledge Inputs-Processes-Outputs-Outcomes

A major limitation of many important measures and indictors used in existing developmental models is their over-reliance on inputs-based measures. Fortunately, we are observing a growing awareness that investments in input resources are not reliable proxies for actual performance outcomes resulting from those investments. For instance, findings from prior macro-economic studies that suggested increased ICT investments correlate with higher economic growth are increasingly suspect given findings from latest research studies that suggest an inverse relationship between ICT investments and business performance for best performing firms (Malhotra, 2004; Malhotra and Galletta, in press; Carr, 2003). Based upon related empirical studies and theory development that has focused on understanding the role of human behavioural and sociological issues in determining effectiveness of structural knowledge assets (ICT, information, and knowledge resources) (Malhotra 2004, 2001, 2000a, 2002a, 2002b, 2000d, 1999, 1998a, 1998b, 2002c; Malhotra and Galletta 2003, 1999), we believe that the causal linkage suggested in prior research between structural investments and performance outcomes are questionable in the knowledge economy. We also suggest that greater appreciation of sociological and behavioural aspects of social capital and human capital is necessary, an observation that is shared by findings from other studies related to socio-economic development (OECD 1996a, 1996b, 1999, 2001a, 2001d).

Important questions that need to be asked include: Are the knowledge resources being used? Are the resources being utilized in the expected manner? Is effective utilization of resources resulting in expected outputs? Do these outputs represent meaningful proxies for value-added performance outcomes? Such an iterative 'double-loop learning' process would ensure that the knowledge policies, knowledge frameworks, and measurement models are adapted and modified as needed for achieving intended developmental goals and objectives. The specific indicators representing KM inputs, processes, outputs, and outcomes that are implicit in above measurement related questions are clarified below.

Measures of KM Inputs Structural or financial investments for developmental purposes are considered as *inputs*. They are treated as inputs as they represent the raw material for getting the specific structural capital and process capital in place so that employees, customers, suppliers, or other stakeholders *may* utilize them. Compliance-based procedures or incentives may be used to persuade these 'users', however effectiveness of such 'manipulations' is often overrated as evident from insights based upon human behaviour studies (Kelman 1958; Kelman 1980; Malhotra 1998b; Malhotra 1999; Malhotra 2000a; Malhotra 2001; Malhotra 2002b; Malhotra and Galletta 1999; Malhotra and Galletta 2003; Malhotra and Galletta, in press). In existing measurement models, 'structural capital' investments in associations, public sector developmental initiatives, small business development programs; 'human capital' investments in continuing educational programs, schools, professional and vocational certifications, training and development programs; and 'process capital' investments in hardware, software, computers, Internet, telephones and televisions represent KM inputs. These may also include other ICT-based knowledge infrastructure or derivatives such as best practices directories, lessons learned databases, communities of practice, expert directories, portals, collaborative systems, expertise yellow pages, and e-learning systems[4].

Such knowledge-based assets have two interesting characteristics as inputs and they need to be distinguished from processes, outputs, and outcomes. First, they often derive their existence as result of KM *processes*. In other words, they need to be appropriated and used for getting them to a stage where they represent value-added inputs for value-added use. Second, as they are used more and more effectively, they morph into value-added *inputs* for the users and also represent value-added *outputs*. For

instance, a public sector organization could deploy an ICT-based virtual meeting capability to develop a community of practice (CoP) of small business entrepreneurs. The ICT-based capability or the digital 'shell' for the CoP does not represent value-added by itself. For it to 'accumulate' value, it needs to: a) be used for holding community meetings and sharing of knowledge; b) build up a critical mass of participants who can relate to the overarching developmental vision; c) develop a critical mass of questions, answers, and other knowledge artifacts to result in meaningful 'gain' and 'exchange' of knowledge; and, d) rely upon investments of time, effort, motivation, commitment and altruism of various stakeholders for its ongoing sustenance. If the expected socio-economic and human development related benefits were indeed realized (in terms such as enhancement of participants work life, money and time saved from knowledge used and knowledge gained, or general well being of the participants), these would represent value-added *performance outcomes*.

Measures of KM Processes KM process measures track the utilization of the specific financial, structural capital and human capital inputs. Process related indicators give an indirect indication of knowledge flows based upon effective utilization of resources. They can also highlight resources that are most popular and identify potential problems in use and usability that might limit participation. Process related indicators about 'structural capital' investments would include items such as the quantity and quality of utilization by the expected users, effectiveness of utilization, and, procedures in place to improve user participation and resource utilization. Process related indicators about 'human capital' investments would include items such as the volume of enrolment by expected community groups, quality of contributions made by enrolled users, and procedures in place to increase participation and value added for relevant stakeholders.

Measures of KM Outputs Effective utilization of the financial, structural, and human capital is expected to result in tangible or intangible outputs. KM output measures track direct process output for the targeted users and other stakeholders. They provide evidence of the specific outputs that the users derive from participation in, and utilization of, various intellectual capital assets. Output measures for 'structural capital' may include indicators such as learning acquired, knowledge gained, skills developed, knowledge resources acquired, business plans written, start-up funding obtained, and, relationships developed based upon participation in associations, public sector developmental initiatives, and, small business development programs. Output measures for 'human capital' may include indicators such as certifications or credentials earned, value-added skills developed, knowledge gained, self-development achieved, and, earning potential improved from enrolment in continuing educational programs, schools, professional and vocational certifications. Intangible outputs would often be related to qualitative judgments and perceptions of users about the value derived from their subjective 'experiences.' Quantitative metrics such as number of courses taken, number of business plans written, number of clients contacted, may represent more tangible outputs.

Measures of KM Performance Outcomes These are the measures that determine the impact of KM inputs, processes, and outputs and help determine the weak links in the inputs-processes-outputs-performance loop. They help assess the overall impact of knowledge assets on the effectiveness of policy implementation. They also track if the investments in inputs and processes are indeed yielding outputs that are perceived as 'valuable' in terms of socio-economic and human development. Performance measures for 'structural capital' may include indicators such as small businesses launched, new ventures developed, revenue sources generated, new jobs created, and quality of jobs improved. Performance measures for 'human capital' may include indicators such as quality of life improvements, gains in income, gains in quality of jobs, market value of skills, and, potential for future professional progress. Additional indictors may include costs saved, incomes generated, and time saved other measures of value-added at micro- and macro- levels.

Different combinations of inputs, outputs, and processes may result in identical performance outcomes. Also, depending upon the stakeholders, not only different indicators may have different connotations but may be perceived differently. As apparent, development of valid measures is not a perfect science and requires insightful judgments in modelling as well as applying the measures. The challenges involved in exact measurement of complex constructs can be appreciated from the sign that hung in Einstein's office at Princeton: "Not everything that counts can be counted, and not everything that can be counted counts." Similarly the challenges involved in exact computational models of causality are captured in another quote attributed to Einstein: "As far as the laws of mathematics refer to reality, they are not certain, and as far as they are certain, they do not refer to reality."[5] (A more precise technical interpretation is available in the Notes at the end.)

There is need for connecting *measurement* of knowledge assets to their *management* by defining the causal links between inputs-processes-outputs-outcomes. The subsequent discussion focus is on developing an overall methodology that can guide the development and implementation of knowledge metrics across public sector organizations.

A Methodology for Measuring National Knowledge Assets

The underlying methodology was originally conceptualized as a 'guide for measuring the value of KM investments' (Hanley and Malafsky, 2002) and applied by the U.S. Department of Navy Chief Information Officer (2001) for translating its Knowledge Centric Organization (KCO) into an 'how to' operational action blueprint. The modified version developed for the current study: a) advances a more complete perspective of knowledge assets in terms of human capital, social capital, and intellectual capital; b) adapts the generic template to match the concerns and needs of the public sector and national policy; and, c) focuses on holistic development for socio-economic growth and human development.

To recapitulate, the methodology for measuring national knowledge assets proposed for this study[6]:

- Advances a more complete perspective of knowledge assets in terms of human capital, social capital, and intellectual capital;
- Adapts the generic template to match the concerns and needs of the public sector and national policy; and,
- Focuses on holistic development for socio-economic growth and human development.

The process consists of four main phases. It is iterative and builds upon lessons learned in fine-tuning the strategic vision, goals, and tactics as well as the measurement models and tools used for charting progress. This framework may be adapted, expanded, and enhanced with inputs from other measurement models and conceptual and theoretical frameworks discussed in this paper.[7]

Developing a vision of the knowledge-based national economy

The vision of the nation's future as a knowledge-based economy is identified through brainstorming sessions and interviews with national leaders and domain experts in areas relevant to national growth and performance. A mix of individuals and entities representing traditional and new thinking is recommended for connecting the past and current trajectory of socio-economic development with the planned trajectory of future progress. Specific articulation of a vision could be, for instance, in terms such as building a highly competitive, developed, modern, democratic and pluralistic nation attractive to world community, investors, and citizens. A review of existing research and national policy initiatives reveals that many of the world's nations have already embarked on this phase. The national and regional knowledge assessment models discussed in the prior sections and included in the bibliography are representative examples. In most such cases, active involvement and support of senior national and regional leaders provides some evidence of commitment in this phase.

Identifying core competencies needed for achieving the vision

Based upon brainstorming and critical reflection about the nation's vision, an agenda is defined to identify, develop, and enhance specific core competencies. These competencies are expected to contribute to specific socio-economic, cultural, and human aspects of national development. Such competencies would address specific national and regional goals related to development of intellectual capital, human capital, and social capital. During this phase, collaborative interaction between the senior leaders of government, developmental institutions, public sector institutions, industry, research sector, and academia is recommended. Key stakeholders as well as their critical concerns are identified that are related to development of specific competencies. These competencies are mapped into 'clusters' along each of the dimensions of the measurement model. For instance, broader national goals deemed relevant for future growth may include enhancement of quality of life of citizens, and, improving national standing among developed nations. The former goal may depend upon developing competencies in terms of structural interventions such as enabling culture and regulations. The latter goal may depend upon building knowledge-based industries that can help spur economic growth.

Identifying key success factors for growing core competencies

The key competencies necessary for the nation's current and future performance may be clustered along the five components of the Skandia Navigator model discussed in a previous section: financial capital, market capital, process capital, human capital, and, renewal and development capital. Alternatively, those competencies may be mapped in terms of the Balanced Scorecard categories: knowledge management for learning and growth; relationship management for stakeholder satisfaction; internal improvement of business processes; and, net value creation through budget and cost management. Depending upon whichever measurement model is used, relevant competencies, success factors, and measures of inputs, processes, outputs, and outcomes need to be identified. Specific elements of the two models may be used in conjunction if needed.

The object of measurement models is not only assessment but also tracking the progress towards achievement of specific competencies. Specific socio-economic, human, cultural, and political development agendas and goals are then defined with focus on goals of the public sector institutions along with critical success factors relevant to building related competencies. An example of such success factors may include formal and informal relationships between the public sector, private sector, and structural institutions that need to be in place for achieving the charted goals.

Identifying key indicators for inputs, processes, outputs, and outcomes

The focus of this phase is on specific indicators needed for measuring the progress towards growth of specific competencies and the key success factors needed for supporting such growth. These indicators are derived from analysis of historical socio-economic growth data and projections about the future. A key challenge lies in identifying the indicators and relating them to inputs, processes, outputs, and outcomes. The input indicators that often measure investment in specific resource inputs may not represent valid proxies for outcomes. Measure of processes track what happens to the inputs or what is done with the inputs. Measures of outputs track results achieved from processing of inputs. The outcome measures determine the value creation that is attributed to the specific outputs. For instance, outcomes would relate to achievement of specific socio-economic and human development objectives derived from the national vision.

Subsequent discussion focuses on the implementation of this methodology with the aid of the Balanced Scorecard measurement model. This model is relevant to the proposed methodology given its popularity for linking the vision and strategy to human actions and performance outcomes.

A Balanced Scorecard Approach for Implementing the Methodology

This section develops a Balanced Scorecard model for measuring and managing knowledge assets for the public sector with focus on socio-economic development. Originally developed by Robert Kaplan and David Norton, the Balanced Scorecard (BSC) presents a holistic view of an organization's current state of health by monitoring its activities related to both tangible and intangible value creation. In contrast, most 'balance sheet' oriented models are restricted in their capability for linking people and performance. BSC can also help depict the causal links between practices and performance outcomes. In use by hundreds of organizations, this measurement model may be used in conjunction with other measurement models discussed in the earlier sections. For instance, the U.S. Department of Navy uses BSC in combination with several other metrics – each set of metrics is related to specific projects with relevant performance outcomes. The outcomes are then used for delineating the various combinations of outputs, processes, and inputs for which the most appropriate measures and indictors are then chosen. The BSC helps ensure that the focus of metrics for specific initiatives does not overly concentrate on any single component of knowledge assets to the detriment of the overall effectiveness. A set of key performance measures is defined for each of the four areas of the Balanced Scorecard and used for each of the major initiatives related to assessment and development of knowledge assets.

Figure 2 shows the proposed Balanced Score Card model developed for national knowledge assets management and measurement. As evident, it is not only a model for knowledge assets measurement but is also a model for knowledge assets management. The methodology for starting with the national vision and determining the competencies along with success factors and relevant indicators for inputs-processes-outputs-outcomes needs to be mapped on the four related perspectives of the scorecard.

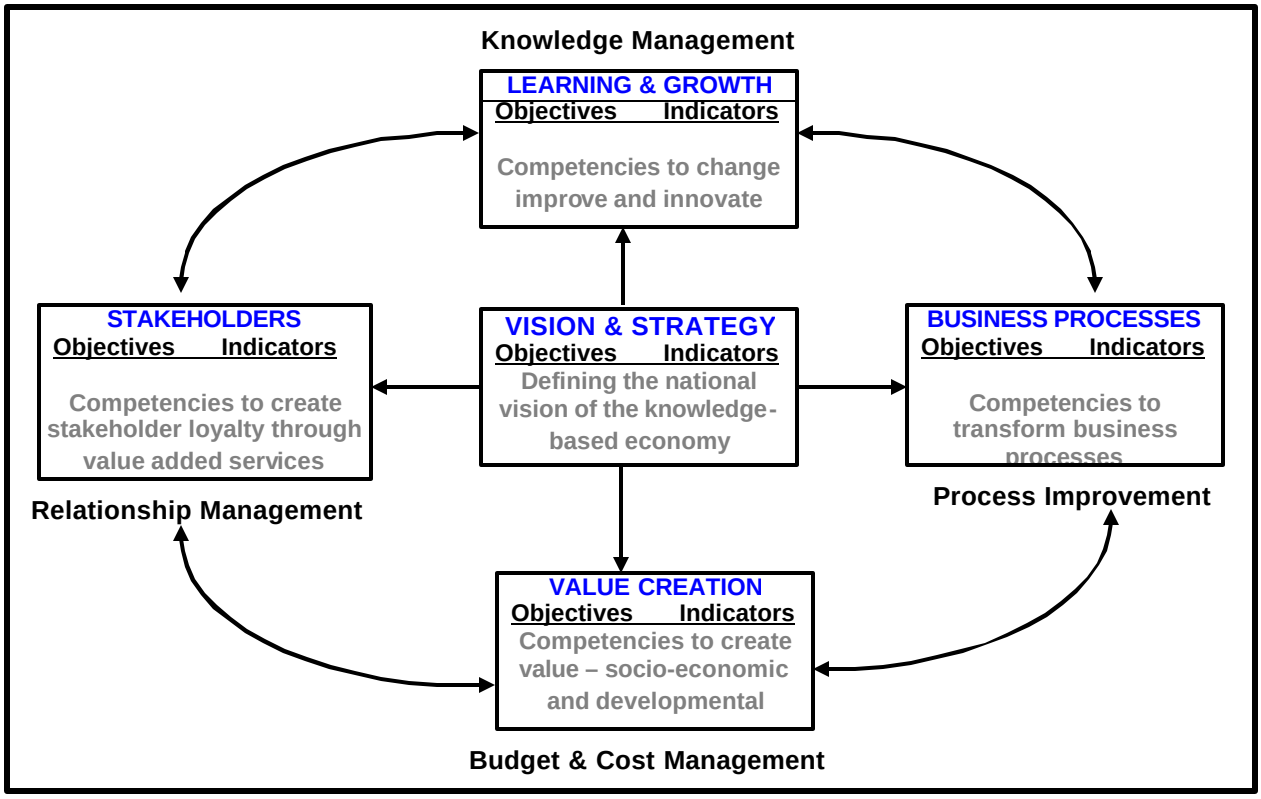


Figure 2. Balanced Score Card for Knowledge Assets Measurement and Management

(Based upon Malhotra, 2000b, 2003a, 2003b, 2004)

The BSC is more than a collection of measurement indicators as all the measures are linked through a chain of cause-and-effect that culminates into strategic success. The cause-and-effect hypothesis is fundamental to understanding the metrics that the balanced scorecard prescribes and how they relate to strategic success. Therefore, the policy analysts need to continuously assess if the chosen policies are correctly implemented (as determined by specific indicators) and then ensure that the assumptions made about cause and effect relationships are evident in practice. If the specific value-added performance outcomes are not achieved, the causal links need to be reassessed to ensure that the constructs as well as their relationships are valid.

The process of developing the BSC starts with the vision of the national knowledge economy that is interpreted through the four perspectives: learning and growth, business processes, stakeholder satisfaction, and value creation in terms of tangible financial results or expected intangible outcomes. The vision is translated into competencies relevant to each of the four perspectives along with an assessment of critical success factors and specific indicators that represent the inputs, processes, outputs, and outcomes for each of the four perspectives. The four perspectives of the BSC as related to development and measurement of knowledge assets for the public sector are described below (Balanced Scorecard Institute, 2002).

i) Learning and growth: BSC recognizes that innovation by creative citizens, presence of a learning and knowledge sharing culture, and formal and informal learning opportunities underpin the success of the knowledge vision and strategy. Learning and growth are fostered through knowledge management activities and initiatives such as strategic recruiting, hiring, training, team development, document management, collaborative communication systems, knowledge and skills audits of employees, knowledge base developments, and fostering of communities of interest within the organization

ii) Business processes: This perspective is achieved through strategic business process improvement activities that may range from moderate and localized changes to wide-scale changes in business processes, redesign of workflows to eliminate paperwork and achieve process efficiencies, and automation of routine transactions. Deployment of the balanced scorecard measurement system is itself one of these processes. It is anticipated that enlightened, skilled, and creative citizens would continuously improve the processes by re-assessing the underlying assumptions.

iii) Stakeholder satisfaction: This perspective is listed in the original BSC model as the customer perspective. Given that in one way or another all public sector stakeholders need the same care and relationship development generally reserved for customers, this perspective has been redefined as stakeholder satisfaction. For the governmental and public sector agencies, this is all the more relevant as they often need to negotiate implementation of specific policies by balancing diverse interests. The public sector agencies need to work closely with stakeholders and devise means for seeking feedback from them and continuously improving the stakeholder service processes. In addition, improvement of business processes by creative and innovative employees is expected to result in improved value-added outcomes.

iv) Value creation: This perspective is listed in the original BSC model as financial management and had its original focus on initiatives such as Activity-Based Costing (ABC), Functional Economic Analysis (FEA), Earned-Value Management (EVM) and other similar practices. The objective of such activities is to help policy analysts in tracking projects more closely and making improved cost and overhead estimates. With increasing focus on value creation expected from investments in public sector projects, this perspective is expanded to focus on value creation in both tangible and intangible forms.

In the above figure, the four BSC perspectives: learning and growth, business processes, stakeholder satisfaction, and value creation are executed through the following strategic management activities respectively: knowledge management, business process improvement, stakeholder relationship management, and budget and cost management.

Summary: This section developed a methodology for linking inputs to performance outcomes in knowledge assets measurement and management for public administration and development. This foundation was then used for developing the overarching measurement and management methodology for linking national strategic vision with specific core competencies and the critical success factors that influence performance outcomes. An adaptation of the Balanced Scorecard model was developed to depict the causal links between specific policy directives and expected performance outcomes for the implementation of this methodology.

Section 6. Conclusions and Recommendations

Review of research and policy literatures on knowledge assets and intellectual capital indicates growing interest in knowledge economies and knowledge societies that can promote holistic social, cultural, economic development and well being of citizens. This study reviewed the concepts of knowledge capital

and intellectual assets; compared and contrasted most popular knowledge assets measurement and management models and methodologies; critiqued the current models and indicators in use by developmental organizations; and proposed an actionable blue-print – containing models and methodologies – for developing public sector capacities in management and measurement of knowledge assets. We also made several recommendations related to the process, the content, and the substance of national knowledge assets measurement and its context-specific applications for the public sector. Much remains in terms of ensuring not only *how* we conduct measurement, but in developing clearer understanding of *what* we are measuring. The following discussion summarizes and recapitulates the recommendations made in previous sections and also provides directions for future research and development for further improvements in the measurement models.

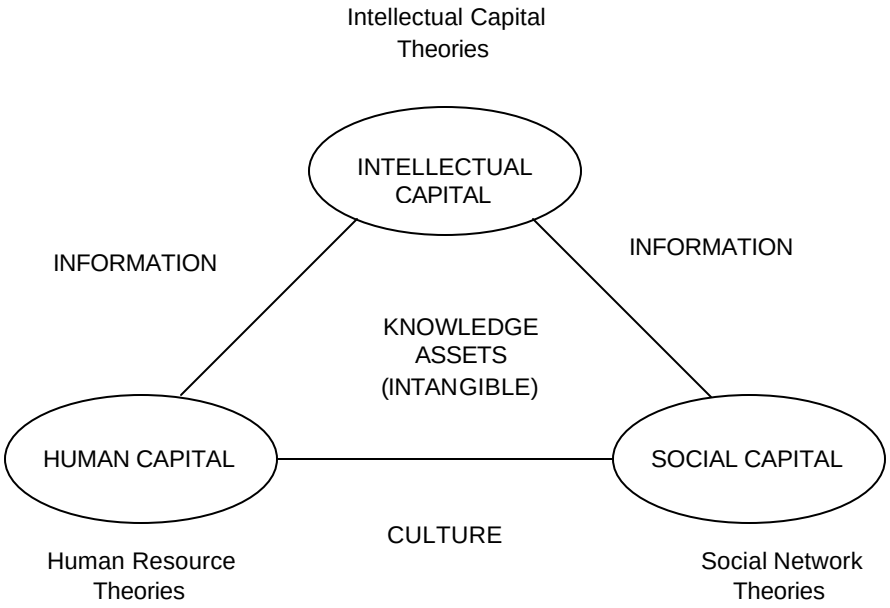
The key observations and recommendations based upon our review, analysis, and development of measurement methodology and frameworks for national assessment of knowledge assets are listed below. Many of these observations are listed in the form of questions as they represent critical 'thinking points' that can help define the contours and trajectory of the emerging knowledge economies. These questions define key issues that need to be further developed in terms of specific research agendas and policy applications.

a) Significant progress has been achieved in terms of development of measurement models of knowledge assets and intellectual capital for analysis at the firm level. There has been some progress in developing similar models for assessment of national knowledge assets and for enabling public sector capacity for measuring knowledge assets. Drawing upon a comprehensive review of the research and practice literatures as well as national policy documents, this study has attempted to fill this void.

b) Most existing models for measuring knowledge assets suffer from a critical 'disconnect.' Their reliance upon the inputs as valid proxies of performance outcomes raises a very critical issue: if they indeed measure what they attempt to measure. As discussed before, investments in public sector projects cannot be considered proxies for performance outcomes. Similarly, investments in developing structural artifacts and processes for 'getting things done' are not valid proxies for 'things that need to be done.' Also, what is actually done or delivered has to justify as value creation based upon prior expectations to conclude that performance outcomes have indeed been achieved. This study has proposed a model for linking inputs-processes-outputs-outcomes for measuring national knowledge assets and enabling public sector competencies for such measurement. Future research and development is needed for further improving the predictive validity of the measurement models and related indices and indicators.

c) While large number of empirical studies have been conducted around the world on intellectual capital, most of these studies have followed the accounting and economic perspectives. These disciplines share common criteria about evaluation of 'assets' and 'capital' even though conflicting national and regional accounting standards make cross-national comparison a challenge. There has been growing recognition about developing complementary perspectives from disciplines such as sociology and psychology that can provide richer assessment of social and behavioural issues. An encouraging development is the recent developmental studies by organizations such as the OECD that share the concern about better indices and indicators related to human capital and social capital. Sociological and behavioural issues such as social influence, persuasion, self-determination, commitment, and, intrinsic motivation are directly relevant to the content and quality of performance outcomes wherever human agents are involved. Better understanding of such 'intangibles' is needed to enrich and refine the constructs of human capital and social capital. Information and knowledge are the raw material in work and life activities and in knowledge processes that depend upon communication, collaboration, and coordination.

Ability and willingness are both ever more critical human traits for this world where information and knowledge are increasing exponentially and fundamentally transforming existing paradigms of work and work life. As depicted in Figure 3, Shared understanding of sociological, behavioural, and intellectual capital theories is needed for addressing theoretical and pragmatic concerns at their intersection.



(Based upon Malhotra, 2003c)

Figure 3. Needed Inter-disciplinary Understanding of Knowledge Assets

d) "What is the knowledge economy?" This question still begets an answer whether the focus is on "knowledge society" or "knowledge economy." Given that economic well-being is an important part of both constructs, it is yet to be understood what indeed is "knowledge economy?" While most existing measurement models define it in terms of 'residuals', more recent frameworks have tried to focus on the ICT investments based on the premise that they represent 'stores' of knowledge. Given fundamental problems implicit in such assumptions, the scope and scale of 'knowledge economy' is yet to be defined. A challenging problem is implicit in existing dichotomy between knowledge economies and industrial / agricultural economies. Does theory, policy, and practice define that knowledge economies are based on information goods only? Given that in most cases, the information and knowledge is intrinsically intertwined with the tangibles, can we really distinguish between the two? Does it make sense from a theoretical or policy perspective to consider knowledge as a separate entity as it always exists in *something* or *someone*? Are economies that intensively apply knowledge in production of industrial goods industrial economies or knowledge economies? Is there any homogeneous knowledge economy for countries characterized by extreme disparities of knowledge content of various work activities and work processes? Future research needs to better define the theoretical foundations for the knowledge economy and knowledge society. Theory guides measurement, and in case of inadequate or inconsistent theory, measurement as well as management of knowledge assets may continue to suffer.

e) While significant development of existing measurement frameworks and methodologies has occurred in the past years, fundamental theoretical concerns loom large. For instance, in absence of a generally accepted theory of knowledge, how much confidence can we place in measurement models based on assumptions about the linear logic and incremental change that characterize 'industrial thinking.' Growth of multi-disciplinary and inter-disciplinary theoretical foundations that can integrate the concerns raised in this study is recommended for analysis of complex constructs that defy the bounded logic of specific disciplines. Prior stream of research that has attempted to develop the sociological and behavioural understanding for linking information and knowledge to behaviours, actions, and performance outcomes seems relevant in this regard (See for instance, Malhotra 2004, 2001, 2000a, 2002a, 2002b, 2000d, 1999, 1998a, 1998b, 2002c; Malhotra and Galletta 2003, 1999, in press). As the emphasis of the knowledge society shifts to beliefs, behaviours, and actions that are more directly related to performance outcomes, finer understanding of the 'inner workings' of the knowledge economy is required. The sociological, organizational, and behavioural literatures have developed advanced understanding of these issues. However, many other disciplines have failed to keep up with advances in these theories.

f) Most existing measurement and performance models are founded on the premise of 'compliant' humans based on their command-and-control logic that is characteristic of 'industrial thinking.' (Kelman 1958; Kelman 1980; Malhotra 1998b; Malhotra 1999; Malhotra 2000a; Malhotra 2001; Malhotra 2002b; Malhotra and Galletta 1999; Malhotra and Galletta 2003; Malhotra and Galletta, in press). A world depending upon pro-active knowledge use, sharing, creation, and renewal – in contrast to the world of mechanized assembly lines – cannot depend upon continuous surveillance and control mechanisms that are good enough to see what can be seen. The cerebral world of thoughts and ideas coupled with the knowledge societies interconnected with invisible bit streams flowing through the ether present a surreal picture for those accustomed to 'industrial thinking.' How do you manage what you cannot 'see'? How do you control what is virtually uncontrollable? These questions are not only applicable to the nature of the *goods* and *services* that constitute value in the global knowledge society, but also to the inter-connected cerebral knowledge *processes* that appropriate, use, create, transfer, copy, exchange, and derive value from them. In the global knowledge society with inter-connected knowledge economies, how does one demarcate the boundaries for knowledge assets belonging to nations, firms, and individuals? How does one determine property and ownership rights in a world that is dependent upon knowledge sharing and knowledge transfer and is based on the premise that 'information should be free'?

g) The problems of determining 'average' indices of knowledge assets for economies with large populations and extreme heterogeneities were mentioned earlier. Wouldn't it be more appropriate to distinguish between the high performance and low performing sectors of such economies? For instance, computing an index that is a catchall for highly efficient and highly inefficient work processes and activities across multiple economic sectors provides an average that doesn't tell *anything* about *anything*? Do highly productive and highly unproductive sectors of agricultural economy add up to give an overall moderate-performing agricultural economy? Can knowledge-based economies exist in isolation from industrial and agricultural economies? Given that most humans would still need food to survive in the foreseeable future, does coming of the knowledge economy diminish the value of the agricultural economy? Given that most humans would live in abodes made of industrial products and work in offices with devices derived from the largesse of the industrial economy, does coming of the knowledge economy diminish the value of the industrial economy? What would happen if all nations advance knowledge based economies at the detriment of agricultural and industrial economies?

h) Is knowledge economy intrinsically more value adding than agricultural or industrial economy? Last week witnessed the longest and most severe blackout in the history of the most developed country of the world. This energy-based shortage brought 20% of the country of 300 million or so to a standstill and evaporated approximately a billion dollar in a day from the national economy. Doesn't this highlight the intertwined nature of the knowledge economy with 'energy-based' economy? Can the knowledge economy exist regardless of 'energy-based' economy and agricultural economy?

The primary focus of this research study was on developing measurement models for measuring national knowledge assets and for facilitating development of public sector capacities and competencies for such measurement. This study has achieved these objectives through developing context-specific methodology and measurement models for the above purposes. The above outcomes resulted from an understanding of strengths and limitations of the extant models through a critical analysis and comparative review. In addition to the above objectives, an additional important objective was to identify issues of theoretical, policy, and pragmatic concerns within which the measurement methodology, models, and measures are embedded. Review of existing theory, research, and practices has raised several fundamental questions that question the very premises underlying the concepts of knowledge, knowledge economy, knowledge society, knowledge assets, knowledge measurement, and knowledge management. It is hoped that future theory development supported by empirical research and pragmatic applications will chart the future progress of the national knowledge economies.

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Endnotes

[1] Although the more technical discussions on principles of measurement and psychometrics are beyond the scope of the audience of this paper, however given their critical importance, some very 'basic' issues that are critically relevant to efficacy of existing measurement models must be addressed.

[2] The inputs-processes-outputs-outcomes loop that relates measurement and management of knowledge assets is explained in detail in Section 5. In terms of socioeconomic causality, inputs refer to 'antecedents' and 'outcomes' refers to consequents.

[3] Variance is the range of difference between the maximum and minimum – for any given quantitative or qualitative attribute. The more extreme the differences, the more the measures tend to cancel out extreme 'negatives' and extreme 'positives' and tending to characterize everyone in the 'moderate' range. Also, countries with larger populations representing extreme 'negatives' would keep smaller 'very high positives' – that may be greatest contributors to national performance – outside the radar of policy analysts. It is a matter of concern that despite the developmental policies in place for the past few decades, the variances within the countries are in fact increasing for both the most developed countries as well as less developed nations.

[4] The *Metric Guide for Knowledge Management Initiatives* (United States of America Department of the Navy Chief Information Officer, 2001) defines a common action plan, performance blueprint as well as project-specific indicators for program and process management, program execution and operations, and for personnel and training issues. More specific input-process-output-outcome indicators related to ICT based process capital – such as best practices directories, lessons learned databases, communities of practice, expert directories, portals, collaborative systems, expertise yellow pages, and e-learning systems – are also available in the guide.

[5] In more precise terms (Churchill and Iacobucci 2001, p. 130-135), "We can never prove that X is a cause of Y. Rather, we always infer but never prove that a relationship exists. The inference is typically based on some observed data that should meet three conditions: concomitant variation, time order of occurrence of variables, and elimination of other possible causal factors. Evidence of concomitant variation refers to the extent to which X and Y occur together or vary together in the way predicted by the hypothesis. If they do vary as found from analysis of observed data, we can only say that the association makes the hypothesis more tenable, it does not prove it. Time order of variables implies: "One event cannot be a "cause" of another if it occurs after the other event. The occurrence of a causal factor may precede or may be simultaneous with the occurrence of an event; by definition, an effect cannot be produced by an event that occurs only after the effect has taken place." The elimination of other possible causal factors implies "when you have eliminated the impossible, whatever remains, however improbable, must be the truth," this type of evidence of causality focuses on the elimination of possible explanations other than the one being studied. This may mean physically holding other factors constant, or it may mean "adjusting" the results to remove the effects of factors that do vary."

[6] The underlying methodology was originally conceptualized as a 'guide for measuring the value of KM investments' (Hanley and Malafsky, 2002) and applied by the U.S. Department of Navy Chief Information Officer (2001) for translating its Knowledge Centric Organization (KCO) into an 'how to' operational action blueprint. The modified version developed for the current study: a) advances a more complete perspective of knowledge assets in terms of human capital, social capital, and intellectual capital; b) adapts the generic template to match the concerns and needs of the public sector and national policy; and, c) focuses on holistic development for socio-economic growth and human development.

[7] A critical weakness of most resource investments is that over-emphasis on inputs happens to constrain the attention on processes, outputs, and outcomes. This is particularly observable in investments related to structural and process capital (such as IC). It is therefore important that policy executives treat the strategic vision as the ultimate driver of inputs. The prevailing disconnect between knowledge asset inputs and knowledge performance outcomes, and how a strategy-pull model can be more effective for achieving these outcomes, are the subject of a forthcoming article by the author (Malhotra, 2004).

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III.3 Summary of Presentations and Discussion

III.3.1 "Measuring Knowledge Assets of a Nation: Knowledge Systems for Development"

Yogesh Malhotra, Syracuse University

Knowledge assets represent the fount of a nation's competences and capabilities that are deemed essential for economic growth, competitive advantage, human development and quality of life. There is also growing awareness about the role of social and human capital as the critical links between structural inputs and policy outcomes. Given their importance, it is essential to ask not only how do we conceptualize and understand but also how we measure knowledge assets.

Knowledge assets represent a number of variables depending on whom you ask. Some common definitions and characteristics include, 'stocks of knowledge from which services are expected to flow for a period of time that may be hard to specify in advance.' They can similarly be thought of as a subset of dispositions to act, or potential for action embedded in individuals, groups, or socio-physical systems with future prospects of value creation. In theory, knowledge assets may last forever, have open-ended value, and are non-linear with respect to the effects they produce. Knowledge builds upon information that is extracted from data. Knowledge is the property of agents and therefore cannot be directly observed. Knowledge assets require understanding in terms of quality and content of performance outcomes. Intellectual capital, a subset of knowledge assets, have been defined as the intellectual material that can be put to use to create wealth, and by others as the combined value of organizational or structural capital and human capital. Many knowledge assets are described as "intangible". Intangible assets include constructs such as information, knowledge, ideas, innovation, creativity and other derivatives. National knowledge assets include the intangible assets of a country that have significant implications for future national growth and the future value of the country to various stakeholders.

When attempting to measure knowledge assets multiple challenges arise. Physical assets are considerably easier to measure than intangible assets. OCED pointed out the difficulty in measuring human-embodied knowledge given its characteristics – non-physical, non-appropriable, not measurable directly, and incompatible with conventions and institutions that guide day-to-day transactions recorded by financial accounting and reporting. In traditional economics, intangible assets are measured as "residue" or what is left over after tangible assets have been measured. How to measure what you don't see (processes of appropriation, use, create, transfer, exchange, derivation of value) and how to demarcate between national and regional/global defy easy solutions. Further, the inter-temporal nature of knowledge assets makes measurement difficult. Measurement considerations should also include the identification of adequate proxies and the use of objective vs. subjective metrics.

To date, national development indicators related to information and knowledge have largely been measured in terms of investments in tangibles and availability of devices and focus on accounting and economics principles developed at the firm level for the private sector (which are not always transferable to the public sector). Even the more development oriented national knowledge asset methodologies focus on tangible assets and structural capital and noticeably absent are indicators of non-economic aspects of "well-being" (though OECD has a social capital assessment tool).

There is, however, a growing realization about need to account for the management and utilization of these resources and the behavioural and sociological dimensions of information and knowledge appropriation and use for value-creation. It is proposed that in addition to addressing these issues, and instead of focusing almost exclusively on inputs, new methodologies also establish a greater connection between the processes, outputs and outcomes of knowledge assets, themselves linked to the vision of the knowledge society, core competencies and the critical success factors that influence performance

outcomes. Categories of measurement that address a more holistic picture of national knowledge assets might include human capital, structural capital, national wealth, organizational capital, process capital, financial wealth, renewal and development capital. Ultimately, governments must ask what is being measured (are they actually measuring what they think they are measuring), why, how and when.

Finally, an interdisciplinary understanding of knowledge assets is needed though currently this would be difficult to achieve given the weakness of existing knowledge theory.

III.3.2 "Measuring Knowledge Assets: Malaysia's Knowledge Imperative Index Version 2"
K. J John, MIMOS BERHARD, Malaysia

As stated in its National IT Agenda Framework, Malaysia is striving to become a values-based knowledge society supported by a framework of people, applications and an infostructure which combine to promote access and equity, a qualitative transformation and create value. This framework is premised upon several assumptions: society is the primary building bloc and context is critical; information, knowledge and networking are factors for change and advancement from an industrial to a post-industrial or advanced industrial society; there exists a hierarchy of knowledge (data-information-knowledge-wisdom) which is also reflected in the phases of the information society, knowledge society and values-based knowledge society; these phases combine economic and societal factors and see governance, people and ICT as integral and enabling factors. In trying to determine whether Malaysia is progressing towards these goals, there have been attempts to measure aspects of the nation's knowledge assets (excluding tacit and contextual knowledge) and map its current trajectory.

The first such exercise was the development of the Knowledge Imperative Index (KIX) which was carried out through an internet subscriber study. At the same time, project level measurements were undertaken (e.g. projects concerning a neighbourhood watch, economic development, and the development of an e-bario). However, it was determined that there was not enough connection between the macro level KIX and the project level which had developed their own methodologies making comparison impossible. The human value dimension was also missing and therefore it was not possible to tell if the country was indeed moving toward a value-based knowledge society.

Therefore, a second version of the KIX was developed. It includes three dimensions: technology, or the informatization of society, which encompasses infostructure, application, and content; culture, or knowledge acculturation, which encompasses societal, economic, and political governance factors; and human value, or a values-based knowledge society, which is both universal and unique. This second version also allowed for greater alignment between the project level assessments and macro level or aggregate assessment. The variables used in the KIX represent a more anthropological approach to assessment with the technology variables accounting for the "what is" (e.g. computer, internet, e-forum, information); the cultural dimension variables accounting for the "do what, how and what way" (e.g. vote, change, deliberate, protest); and the human value dimension variables accounting for the "so what and why" (e.g. accountable, happy). These three categories of variables are weighted according to the following formula: KIX = ICT diffusion index (0.3) + knowledge acculturation index (0.3) + human value index (0.4).

The KIX has yet to be piloted but represents a possible model of interest to other organizations and countries.

III.3.3 Discussion

The concept of measurement of knowledge assets was recognized as useful but deemed very difficult on the whole for many of the reasons cited in the presentations. Measurements might better seek to capture the sum total of what is happening in society, i.e. what is being produced, circulated, institutions that adapt, and so on. Moreover, indices that provide knowledge about other development areas (e.g. health) and the vitality of the public sphere would enhance attempts to more fully understand a nation's knowledge assets. Ultimately though it was pointed out that when it comes to knowledge 1+1 does not = 2. Indeed, participants pointed to the need to better capture the dynamics and of the knowledge society and questioned if and how these could be measured. Given these difficulties, one participant made a plea to use the residual for measuring knowledge as a way of measuring our ignorance of knowledge. Finally, it was proposed that the public sector learn from the private sector in measuring knowledge assets, especially their failures, to the extent that the lessons are transferable.

IV. KNOWLEDGE IN THE PUBLIC SECTOR

IV.1 Overview

Government is an organization. It has specific functions that include consolidating and expressing the consensus view of the sovereign; responding with solutions to the needs, demands and proposals contained in the consensus; and, making itself transparent to the oversight body acceptable to the sovereign. At the same time, government consumes anywhere between 20% and 50% of GNP and its actions and behaviour have a profound impact on the way in which people live and work. Moreover, government is a large consumer and producer of knowledge. Over the last 10 years, governments have started to introduce ICT to their operations. These applications are focused heavily on raising internal administrative efficiency and effectiveness; on smoothing the process of provision services to the consumers of public services; and, specifically, on public administration's support to business activities. While commendable in its intent and initial impact, these developments have little in common with governments' perception of themselves as actual or potential "knowledge organizations" that focus on harvesting, creation and use of knowledge (as distinct from information) in ways that benefit their discharge of all three of their main functions. Despite a difference that exists between the public administration and business in terms of the objectives, public administrations at all levels - not unlike in business organizations - face revamping their internal structures and reaching to sources of tacit and explicit knowledge that reside inside and outside these administrations. A government that channels knowledge to its operations - including decision-making, policy formulation and implementation, enhanced and interdisciplinary service delivery - is yet to be fully developed, but the challenges and opportunities, as well as the basic principles and directions of this development may already be charted today.

Session IV presented a review of trends and case studies in the area of public sector knowledge strategies, policies, and practices. Also the current and future impacts of improved knowledge capture, management, dissemination and use, on public sector reform, good governance goals and the prospect for democratization were considered.

IV. 2 Expert Background Paper

Knowledge Management for Government: Enhancing the Quality of Public Service

Roland Traunmüller and Maria Wimmer
University of Linz, Austria

e-Government - a way towards the Knowledge Society

Entering into the knowledge era has significant implications on all fields of society – be it the economic, social, cultural and political realm. Up to now, the discussion has largely centered on the knowledge economy and IT-tools; yet to actively live the knowledge society is not a matter of isolated consideration restricted to the knowledge economy being supported with IT-tools for knowledge management. Realizing the knowledge society means embodiment of knowledge in our daily lives and activities as well as active management of knowledge resources not limited to IT support, respectively. Hence, knowledge enriched environments must become the focus of our interest in innovative developments where other directions than the knowledge economy become important as well. One of these is the introspection into the role of the public sector in producing and using knowledge. The respective topics span a big breadth and address a variety of issues. They range starting from governmental approaches using knowledge creation within an affirmative environment; going on with rethinking the role of knowledge in government and governance; closing with the question of formulating adequate strategies, policies, programs and partnerships within a knowledge enhanced environment.

The importance of such issues was the reason that an "Ad Hoc Experts Group on Knowledge Systems for Development" will meet to convene for achieving insight in this topic. The subsequent contribution "Knowledge Management for Government: Enhancing the Quality of Public Service" is intended to act as stimulus for debate.

The course of the contribution is that, at the beginning, some perspectives are sketched for the purpose of drawing an overall picture of the role of knowledge in the public sector comprising the following chapters:

- Focusing the "e" of Government
- Multidisciplinarity of Government and Public Governance
- Government and Public Governance need Knowledge Management
- Then, in a second part, we turn towards particular issues of knowledge and knowledge management in the public sector. So spotlights are cast on the following matters:
- The cosmos of knowledge types and repositories
- The knowledge part in administrative processes
- Legal ontologies and standards enabling data interchange
- Knowledge processes in planning and policymaking
- Providing knowledge enriched information and intelligent services to the citizen
- Feature requirements for managing knowledge in government and public governance.

Focusing the "e" in Government

e-Government – a shift of attention to services and knowledge

e-Government is key to modernizing public administration and to reorient public governance. In being functional and outcome-focused, e-Government builds on New Public Management (NPM). Yet, e-Government clearly overtakes NPM! Service provision is targeted not just towards the management of the production processes themselves. This is a clear distinction from previous administrative reforms that focused on managerial tasks and, therefore, kept sticking to given prevalent structures and processes. To describe the progress in other words: It is not the managerial level that is the primary target, but the level of action itself that is affected.

Administrative work itself coming under scrutiny in e-Government developments has far reaching consequences: knowledge embodied and used in governmental service provision and governance activity shifts into the center of attention. It is being reorganized, redistributed and redesigned. So it is not accidentally that, now, managing administration's knowledge is in the limelight. This evolution and need has emerged as a natural consequence and implication of redesigning administrative work.

In the knowledge era, the motto of e-Government and Public Governance must be fostering and cultivating the expertise of an agency. Max Weber, one of the founding fathers of administrative science, addressed such knowledge in his notion of Dienstwissen – a term which we call service knowledge or domain knowledge at the present time. In this sense, work in the public sector is expert work. Furthermore, public servants are genuine knowledge workers. So the "e" in Government can be understood as pointer and reminder as well: electronic means of governmental work need to support and implement expert work and, as a consequence, such systems become knowledge enhanced, intelligent systems.

Online One-stop Government – a big promoter of change

One specific development branch of e-Government is online one-stop Government. One-stop government is a concept of e-government that refers to the integration of public services from a customer's (citizen, business) point of view. It suggests that customers communicate with authorities through a single point of access using the communication channel of their choice (e.g. citizen center, call center, Internet etc.). Customers no longer need to be aware of the fragmentation of the public sector. The one-stop concept further attempts to reduce the number of contacts with the authorities per service consumption to a minimum - one single interaction at best. At the one-stop portal, customers are provided with sufficient information regarding their objectives of visit. The information and public services offered are organized and integrated in a customer-focused manner to address the personal needs and to cover the exact requirements of the citizens and business customers.

At the same time, the public sector is accommodated with a set of tools that allows the back-office processes to interoperate. The public servants use these tools in order to create and manage information and integrated public services that match the needs of their customers.

Online one-stop Government is a big leap forward; access structures no longer follow the intrinsic needs of service production but rather concepts of whole-person or life-event oriented, integrated service delivery. In that line, online one-stop Government becomes a big promoter for progress. In changing the access to services (which is the visible part of an iceberg), in reality, the whole machinery of Government is changed (including the back-office - the hidden part of the iceberg).

The implication is that internal operations are re-engineered and made seamless. With many efforts under way to redesign the system of public service provision one is approaching a distant goal: rethinking the institutional structures of government. In the long run, concerns with principles of *good governance* and with the productivity of the public sector will increasingly put the traditional institutional structure of the public sphere in question. This may as well lead to a profound restructuring entailing a substantial reduction of the ever increasing complexity of the public sector.

As a matter of fact, it is this ongoing conversion that spurs all the innovative and comprehensive approaches to administrative modernization and that introduces an essential change on every level of government. Eventually, public administrations will converge to a collective unit. *Virtual administration* and *seamless government* - intelligent knowledge enriched systems - become convincing metaphors of the near future.

The e-Government application scenery

With the shift to service and knowledge orientation in e-government and the trend towards virtual administrations and seamless government providing services via one-stop portals, key application themes of the public sector are touched:

- Promoting a knowledge based economy
- Rendering information and services to citizens and business customers
- Enhancing governmental cooperation.

Promoting a knowledge based economy: According to the eEurope[1] strategies on e-Government, a main objective is the provision of high-quality e-services that support the development of a competitive knowledge-based economy and that contribute to the enhancement of European job creation, productivity and overall competitiveness. A key theme in this strategy is openness and willingness to share information and experiences across Europe and worldwide. A number of current city online portals delivers information in multiple languages, supporting and promoting tourism and other economic activities. Employment is another issue; projects in this area focus mainly on freedom of movement for work across the European economic space. Another way of promoting economic development is given through support and advice for businesses, enabling access to global markets whilst providing a shop window for local goods. Other fields of application important for companies are electronic tendering as well as a more effective communication with tax offices. A globally networked economy based on knowledge enhanced, intelligent systems will strengthen local productivity and competitiveness of public and private society.

Rendering information and service to citizens: A better life for European citizens as defined in the eEurope 2005 strategy of the European Commission[2] focuses on the scale, scope and quality of access to government services. Thereby, e-Government implies promoting participation and inclusion of European citizens in policymaking and implementation. A general improvement in the quality of life for citizens, households and families is expected. The role of citizens in the democratic process has clearly grown and evolved with the introduction of e-Government. This is demonstrated well by a range of projects aimed at citizen voting and participation in the democratic process[3]. The internet in general and e-Government in specific come into their own in bringing together people and services. Particular in areas where communities are scattered and scarce resources do not allow multi-location attended service points, e-Government is big advantage. One has to be well aware that the aim of solutions is not only to increase the level of service provision and internal efficiency. Indeed, in the knowledge society, focus lies on user-friendliness, accessibility and bridging the digital divide. So, knowledge enhanced information and service provision based on user needs and understandability as well as on service self-explicability (a

matter of how to present service-specific knowledge to the general public in a well understandable manner) become key.

Enhancing governmental cooperation: For providing services according to user needs, enhanced cooperation between agencies is a categorical precondition. European, central and local governments focus on applications that already have or show clear potential to cut across different government levels and different types of government units to promote joined up services and borderless government. One example is the current reorganization of social security systems across Europe to provide a more open and responsive service to citizens, businesses and the government departments that administer them; This reorganization has required major business process re-engineering. It included back-office integration and the implementation of portals through which the new services can be accessed. Electronic systems for fraud detection is another example needing a lot of cooperation across local and national agency borders. Such systems can increase the detection rate by automatically carrying out checks and controls at vital points in the life cycle of a claim.

Multidisciplinarity of Government and Public Governance

Needs for a comprehensive consideration

e-Government is not an objective per se but an advanced instrument of the organization of public governance in order to better serving individual citizens, communities, commercial and non-profit organizations as well as public authorities themselves. Thereby, technology creates more efficient and transparent possibilities for more participation, a higher level for the control of public affairs and of those to whom people invest their trust. Yet, e-Government denotes a socio-cultural and socio-technical domain, where new roles and opportunities of human consultation and of citizen/customer - administration relations emerge. Therefore, it has to be developed in close correlation with the development of non-technical change requests.

Above all, the development of e-Government has to be based on feasible and reasonable change of governments. This is a strong argument in favour of a holistic approach to work-processes and work-situations in government, which are highly knowledge-intensive and which continue to rely on close forms of interaction between humans and IT. Human actors using "machines serving people for their comfort and convenience" is thus a top priority.

With current developments in e-Government, we still have to investigate and learn a lot to reach such ambient and convivial information systems.

Broadening the view beyond the "visible" part of administration

As already pointed out above, e-Government includes as well government-to-government relations within the executive and functions of management and of policy making which cannot always be neatly separated from policy implementation in the field of electronic public service delivery. Also, the important role which knowledge plays in enhancing the work of the executive branch of government is to be acknowledged[4].

In this respect, e-Government is to be perceived as a multidimensional and multidisciplinary field, where many interdependent factors impact its success and acceptance. Among others, the multiplicity of e-Government refers to multiple IT systems and architectures, multiple access channels, multiple devices, multiple process structures, multiple parties (authorities and clients) involved, and multiple other physical and abstract knowledge sources. Thereby, many issues to be addressed for successfully implementing e-Government arise. Hence, a holistic framework is required to understand the knowledge types, the

knowledge carriers and their interaction. Investigating and drawing a knowledge map of e-Government is to be guided by three key characteristics of e-Government:

- different user groups with diverging service needs and interaction requirements,
- distinct government processes, integrating front-office and back-office (organizational issues),
- supporting government with modern IT, etc.

Among the many issues to be identified, specified and put into relation with the others, the following seem of utmost importance and serve as starting point discussion[5]:

- Process perspective
- User perspective
- Technical perspective
- Organizational perspective
- Legal perspective
- Knowledge perspective
- Cultural, societal and political perspective.

Bringing together these perspectives will provide insight into the knowledge resources framing and shaping e-Government. Within a holistic framework for e-Government as discussed by Wimmer[6], these issues have to be reflected and put into relation. One also has to be aware of the fact that a change of one of these perspectives strongly influences others and, hence, impacts the success of e-Government developments as a whole. Hence it follows that many scientific disciplines and practical experiences have to be brought together to fully understand such a complex field. Such a critical mass of experts from distinct research disciplines, of development and application fields should cover administrative scientists, computer scientists, social scientists, HCI experts, CSCW scientists, management scientists, knowledge management and information systems specialists, lawyers, politicians and education experts.

In the following, the major characteristics of the above listed perspectives are described briefly.

Process perspective

Government's internal and external traditional business processes need to be adapted to electronic businesses processes. For the external perspective, this means to provide public services in a well-structured and well understandable way meeting the needs of the specific users (i.e. citizens, businesses, other organizations). Here, re-engineering of business processes for better serving the needs of citizens or enterprises in specific situations ("life-events, business situations") is an important option[7].

Implementing integrated e-Government means to adequately map external service structures to internal process structures of public authorities as well. Integrated service and process models are of utmost importance for achieving a seamless government. A great help in this respect is a logical and organizational separation of front offices, which bundle citizens demands and pass them on, and back offices, which satisfy these demands through adequate business processes and products.

In such a way, one-stop Government becomes possible, but new exigencies for standardization and reference models of integrated process and service models arise (see emergent cross-perspective issues below).

User perspective

Addressing the specific needs of different user groups not only refers to a superficial distinction of target groups such as citizens, businesses and governments. To better serve the users, electronic public services have to be developed in strong relation with the specific target groups such as public servants at one-stop service encounters, intermediaries (notaries, architects, lawyers, tax consultants), students, unemployed, families, pensioners, accounting staff of companies, etc.

Usability concerns, human-computer interfaces, socio-linguistic problems, education and know-how transfer (e.g. through network-supported dialogues and discussions as well as intelligent online help on demand) within virtual self-service shops need to be addressed.

A new regulatory framework for an e-Society and the new agora will be required to firmly anchor new service potentials in the real world.

Technical perspective

Modern IT is to be exploited to better - and appropriately - serve the various user groups including intelligent, knowledge enhanced and usable portals and virtual one-stop front-offices, adequate interfaces towards the backend as well as accurate back-office systems.

Here, standardization and intelligent functionality has to be provided for the portal, front-office (intake and communication) as well as the back-office.

To fully exploit the enabling potential of IT, attention should not be limited to what is on the market so far. Especially developments toward a second-generation Internet (e.g. IPv6) as well as mobile computing are important. Large efforts have to be deployed to create the necessary infrastructure, which, in general, demand action on a national (and even international) scale.

Specific attention has to be paid to small units of government in rural regions, which otherwise would never get a chance to use the required e-Government infrastructure (cf. also organizational issues).

In this respect, the need for cooperative, shared architectures and infrastructures to avoid lack of skilled resources and to lower investment and maintenance costs become important, too.

Organizational perspective

Introducing IT to the field of government strongly impacts organizational structures. Hence, organizational change needs to be carefully implemented, too. Old established, strictly hierarchical, cumbersome and bureaucratic structures have to be replaced by horizontal network structures, one-stop Government, and more efficient organizational work structures facilitating the service and customer orientation as well as transparency. In detail, such changes are contingent on the manifold administrative cultures and the shape of government institutions which exhibits great variance across Europe.

New forms of collaboration in the public service provision and delivery emerge: public-private partnerships (PPPs) are seen as a new option for making government and governance more effective and efficient and for better serving citizens and organizations. Yet so far, only marginal experience and competencies are available on this issue.

Despite of that, the adaptation, training and re-location of human resources to minimize the negative impact of the introduction of new technologies and more efficient labor schemes are required.

Legal perspective

Government activity is strongly regulated and driven by legal frameworks including national constitutions. With the use of modern IT and communication facilities, electronic public service provision and delivery require the adaptation of laws to make e-Government solutions legally binding.

Among the legal issues to be investigated are data protection, access to sensitive data, networking of authorities and databases, equal opportunities, electronic signature, etc.

The use of expert systems in helping public servants taking their decisions based on complex laws and regulations has to be addressed properly.

Knowledge perspective

Within the information and knowledge society, data, information and knowledge objects are the major resource to be elaborated. Therefore, appropriate design of the data, information and knowledge objects is required[8]. Standardization, interoperability, communicability and integration to distinct IT systems over a corporate semantic web become important.

With the strategies to provide electronic public services through virtual or physical self-service shops, knowledge needs to be transferred adequately so that citizens and businesses are able to use these facilities in a smart way. In this respect, semantic interoperability across governmental organizations (even beyond national borders) become of utmost importance.

Nonetheless do also public servants and administrative staff need accurate training on new facilities and knowledge support for their work (specific roles and methods of education and training that goes much further than simply handling IT-tools).

Cultural, societal and political perspective

e-Government is strongly shaped and driven by social, cultural and political factors on local, regional, national and supra-national (e.g. European) levels. Developments have to respect and enable these influences, which not only bear obstacles and hindrances towards a unique solution, but - more importantly - bear huge potentials for individualism, dynamism and creativity.

Emergent cross-perspective issues

Of particular importance is a smooth *integration of front-office and back-office developments* (in respect to all perspectives mentioned before) towards seamless knowledge enhanced e-Government through multi-modal and multi-channel access. Especially within many national and local e-Government initiatives, the main focus was put on the front-office. Only a few countries have recognized so far that the back-office reorganization and modernization has to have an equal significance in e-Government and that the integration of front- and back-office is a turn-key for the success of the next generation of knowledge enhanced e-Government systems.

Standardization (semantic and technical) of official proceedings, of data and information objects, of communication networks is such an example that has already been addressed in several perspectives above.

Another set of critical factors is constituted by requirements of *transparency, trustworthiness, traceability, security and privacy of data (T³SP).* Official records and archives are assets highly relevant

in e-Government that need to be addressed properly. Citizens have a right to receiving information about public affairs, financial data related to public investments; e-Government provides a means to make these information transparent. In order to enable T³SP, security mechanisms (technical and non-technical) have to be developed to provide the same quality and trustworthiness of public services through electronic means as through the traditional way.

The public sector is dealing with information and knowledge resources by large. Also, the perspectives raised before represent different shapes of knowledge on the same vision: e-Government. This knowledge has to be appropriately managed and smoothly integrated. Hence, *knowledge enhancement and knowledge management* options have to be integrated in e-Government developments from the beginning.

A holistic framework for e-Government

A good understanding of administrative processes is crucial for adapting public services to e-Government and any branch thereof such as one-stop government. Proper comprehension is no small problem, as in the field of operational administrative action, a huge variety of different processes and knowledge sources can be encountered. Most processes are rather complex due to several causes[9]. To begin with, the extra-ordinarily complex goal structure of public administration has to be underlined. One dominant reason is the high degree of legal structuring of administrative work. It allows for a high degree of transparency and accountability, yet may hinder plain and common ways of re-engineering. Besides, in comparison to the private sector, the amount of work that only can be performed in co-operation with other agencies is rather high. Administration is working via a complex tissue of co-operation of acting entities. As a result, the mode of administrative processes and decision taking becomes very particular. Thus, administrative work appears as complex and rather strange. Here, an appropriate reference framework is required that facilitates the understanding of the complex structure and network of public services and governmental units.

The holistic reference framework as shown in Figure 1 is based on the socio-technical approach of Cherns[10], the BMRM of Schmid[11], the Information Architecture of Mok[12], and the discussion of Lenk[13]. What we can learn from these approaches is the multidimensional consideration (from the strategic layer to the technical layer) of distinct aspects (organizational, judicial, security, process modeling, access, services, workflow, ...) and the core phases of an electronic process (from information to transaction and settlement - including an aftercare phase). The strengths of these approaches have been merged to the e-Government holistic reference framework. This concept supports the understanding of complex administrative processes from three distinct points of view:

- Abstraction layers: different points of detail
- Progress of process: different phases of an electronic process
- Different Views: distinct foci on issues

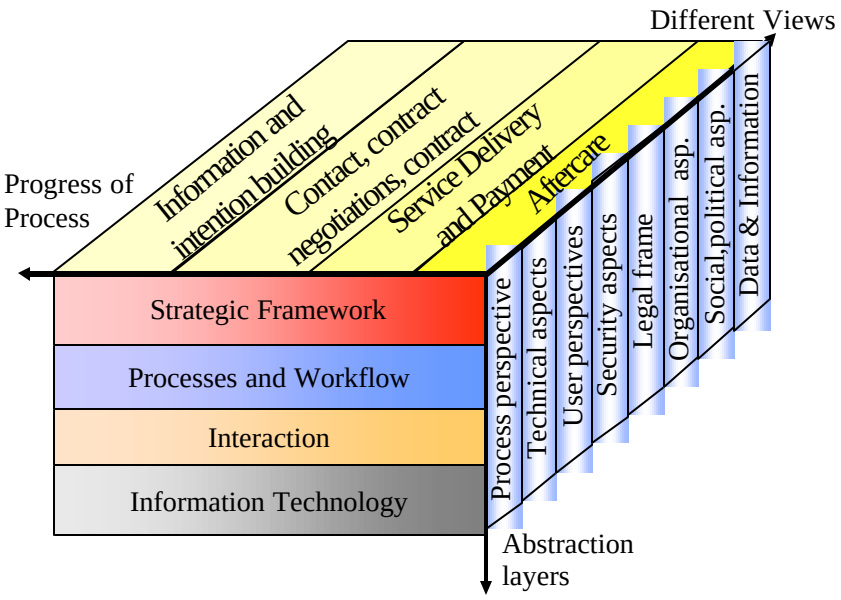

Figure 1: The holistic reference framework for e-Government

The abstraction layers

A complex socio-technical system such as one-stop government can only be managed through different abstraction layers. The holistic approach integrates the following perspectives:

- *Strategic Framework*: This layer represents the view on the basic organizational requirements (the strategy, basic roles, the strategic decisions and constraints) for realizing an e-government system. It integrates as well the governance part of the public sector. Concepts to support developments in this area are amongst others New Public Management[14], Human Relations Management and Business Process Reengineering[15].
- *Processes and Workflow*: On this layer, the general business strategies and basic roles are substantiated. This means that processes and their workflow are specified. Thereby, the roles and their collaboration, the steps of the process, the co-ordination of input, throughput and output and the adaptation of the processes to the legal framework are defined and settled.
- *Interaction*: On this layer, the interest lays on the concrete process performance, i.e. the integration of the process models, the people and information technology involved and the data and information objects belonging to the process. So, interaction and information flows are investigated. Further, the interfaces between different concepts (people, data & information, processes, etc.) are object of study.
- *Information Technology*: This layer is concerned with the technical implementation of the IT components of the e-government system such as the portal, the service and knowledge repositories, a standardized data and information exchange format etc. It also contains the communication, transaction and transportation infrastructure respectively their interfaces.

The evolution of an administrative Process

For quite some time, several (not necessarily contradicting) discussions on how to approach different stages in electronic service providing have been existing (e.g. the BMRM[16], the OL2000[17], Lenk's discussion[18] and also the EC addresses four different stages in the list of prioritized public services to be implemented at first hand[19]). The approaches can be generally divided into concepts that focus on aspects of development, i.e. simple information portals, providing communication facilities and, finally, fully realizing one-stop government transactions. The concepts refer to the maturity of electronic services (e.g. the EC approach). The other group of approaches addresses different degrees or stages of electronic service consumption, i.e. from simple information provision via download of forms to interaction and finally transaction services (the most difficult part but final objective for providing online services). In these concepts, an electronic service is divided into different stages of progress (e.g. the BMRM). Some other discussions further elaborated the stages of progress of a process and added an aftercare phase (OL2000 and Lenk), i.e. full support for electronic service delivery does not end with the service delivery and payment, but facilitates also customer relationship management, complaints management, etc.

The holistic reference framework enables an electronic public service to be approached in four phases:

- In the *information and intention building phase*, the user searches for information regarding possible intended public services. S/he can read information about the service itself, how to apply for it, whom to contact to get more detailed information and what the preconditions are. Further, information is provided on the different possible ways to make a transaction (e.g. online; downloading a form and sending the form via ordinary mail; or appearing personally at the service counter) and about which documents s/he has to provide. Despite of the one-way information consumption, the customer can get in contact with an authority in order to acquire further information regarding the procedure to apply for a specific pubic service, etc.

- In the *contracting phase*, the user already knows what s/he needs to do. S/he either fills in the online application form or downloads the corresponding form from the server and fills it in. Sometimes, contract negotiations may take place in order to set up the obligations of each partner (service level agreements). These agreements are signed in a contract and are obligatory for both sides. However, most times the citizen or business partner directly hands in the application for a public service, which is to be considered as the contract. This can be done by means of an online transaction, in written form electronically or via ordinary mail or personally at the administration counter. In case an electronic medium is used, attention has to be paid to authentification and authenticity. With this action, the customer activates an administrative process, where, at first hand, the public authority proves the completeness and correctness of the application. In case some material or data is missing or incorrect, the applicant will be asked to refine the data or to provide the requested material. In case of acceptance, the application is passed from the front-office to the back-office for further handling (see next phase).

- In the *service delivery and payment phase*, the processes to complete the service are performed, the results are conveyed to the customer and the customer pays for the service. Possible results can be e.g. adjudicating a social benefit, issuing a document, transferring information, etc. This phase is the most complex and complicated phase within the four stages, since it has to realize different types of processes from simple and well structured routine processes to weakly structured processes of decision making and negotiation[20].

- The last phase of the holistic reference framework addresses an *aftercare phase*, where aspects of citizen (or customer of public administration) relationship management and complaints management are addressed. Furthermore, aspects of filing and information delivery for statistical purposes within the net of public authorities have to be supported. Often, a public service is not a matter of a single consumption, but of repeated contact and of e.g. monthly delivery of service (e.g. social subsistence benefits, grants for studies, etc.). Aspects of this concern are to be taken care of in this phase, too.

The user does not need to run through all above-mentioned phases. On the one hand, depending on his/her situation the user might only want to gather information about a process (only information phase) or s/he might already know the procedure to apply for a service and, hence, starts with filling in an online form (starting with the contracting phase). On the other hand, also the aftercare phase is not always required and may not be performed by an authority. The two basic criteria for navigating through these four stages of progress of an online public service are 1) the level of know-how the customer already has about a specific service and 2) the characteristics of the service under consideration.

Different viewpoints

In order to carefully deliberate the requirements and developments for e-government systems, a distinction of different views is required as discussed in the previous subsection 0. Apart from the principal focus on the processes and services of public administration, the holistic reference framework supports the following foci:

- technical viewpoint (focusing on the technical implementation of the system)
- view on people (deliberating the needs and requirements for the different user groups: citizens, businesses, public administration employees)
- security aspects (deliberating the security requests for public services and for the one-stop government system)
- legal issues (investigating legal constraints, frames etc.)
- organizational aspects (structural fragmentation of public administration and division of domain expertise, responsibilities, etc.)
- social and political aspects (considering political decisions, social impacts, etc.)
- view on data and information (designing information objects, databases etc.).

Bringing together above discussed perspectives will provide the knowledge resources required for making e-Government success. Within a holistic framework for e-Government, these issues have to be reflected and put into relation. One also has to be aware of the fact that a change of one of these perspectives strongly influences others and, hence, influences the success of e-Government developments as a whole.

Government and Public Governance need Knowledge Management

Integrating Government and Public Governance

The issue of public governance draws more and more attention. Also the views about Government become broader and comprise legislature, executive and judiciary as well as sustaining democratic deliberations. The notion includes democratic policy formulation, citizen involvement, the execution of policies and the evaluation of their results so as to improve future policy making. In the same line goes the growing interest in e-Democracy and e-Voting. This has led to a broader scope regarding the whole governance cycle.

Further, the standpoint of governance is a necessary counter-position to the service view. The State is to be considered as one of the largest organizations to be managed and governed. Yet all too long, administration's activities have been subsumed under the header of public service provision respectively. This is surely not the case when the State collects taxes and when traffic wards issue parking fines. One has to recall the principal rationale: the activities of diverse branches of government (legislature and the judiciary included) contribute to the balancing of societal interests and maintaining the stability of patterns of societal life. This is reached often by using authority and by the state monopoly of legitimate use of physical coercion. Public governance is the underlying principle guiding and ruling government activity in general.

A new view on Government calls for a new type of public governance as well. It is the impact of globalization from ”above” and of the organization of the civil society from “below” that make good governance to dictum.

Knowledge is key in Government and Governance

Exerting authority and control can be understood as cycle. Viewing governing as cybernetic model has been widely used as it is a good means for explaining control in government and administration. Control loops can be visualized in the following way: starting with observing a specific domain and gathering of administrative data, then comparing incoming data with values provided from norms set, and subsequently turning to appropriate actions in order to control the events in the domain.

In reality, countless cycles exist - in parallel, nested, on diverse levels. But one fact is in common: for every cycle, informational input is the key for action. In this connection, one has to recall the breadth of Government and Governance to imagine maze of cybernetic feedback. And all these loops have one goal - ensuring social stability. Government has to guarantee (and enforce) a well-organized, structured and safe society as well as standards of quality of life within a common culture and society. Basic goals of its action include:

- proper functioning of legislation and jurisdiction;
- promotion of economic development;
- protection of principles of civic rights;
- preservation of nature;
- emergency management, etc.

The goals to be attained are set politically and they are partly rooted in the national constitution. Managing the implementation of these goals and the assessment of success thereof is a responsibility and activity of public governance. As such, public governance can be understood as governing and managing a society via the instrument of government, i.e. the implementation of goals.

Sometimes, goals are ambiguous and even in contradiction with other goals, yet public governance has to cope with that. So when public administration executes political demands, this may often enough demand the ironing out of potentially contradictory requests.

As a matter of fact, Government and Governance as a whole can be understood as a large knowledge-intensive organization. Public agencies host a particularly high percentage of professionals and special staff who command important domains of knowledge-based activities, especially in ministerial departments, in the judiciary, and in regulatory agencies. Many public organizations are chiefly “intelligence organizations” and officials can be considered as knowledge workers par excellence. Complex decisions are particularly knowledge demanding. Decision making is a public official’s daily

bread. For any agency, its specific domain knowledge is an asset of key importance. Here, one aspect comes in that is of utmost importance: acting and decision-making in the public sector are not a prerogative of management! Complex decisions are made at the operational level, and this is precisely where most knowledge demands originate.

Managing knowledge: crucial yet still underrated

Drawing the conclusions from the key role of knowledge in public administration means that, for all levels of Government, knowledge management is of prime concern. In general, scarcity of knowledge is the driver for introducing management. Knowledge Management aims at managing knowledge distributed within and outside an organization with the purpose to establish an organizational memory. This is done in a systematic way according to a lifecycle of knowledge production, integration and validation. In praxis, the development process is an ongoing and adaptive interaction with the instrument of a knowledge base. Moreover, an organized transfer of know-how, skills and expertise has to be arranged in a proactive way; a learning organization is the goal which one has in mind. Technical means for that are KMS (Knowledge Management Systems) which integrate diverse concepts and tools. For more on Knowledge Management and KMS we refer to the literature[21].

Turning to the public sector as application domain for KM, one has to say that public administrations are not yet mentally prepared to that development. Crucial as it is – knowledge management is underrated in this field. It starts with most administrators not being conscious that, in their agencies, respectable and extensive riches of knowledge – a real bounty of worth and benefit - is hoarded. Gloomy as it may appear, administrators do not conceive themselves as knowledge workers and so, they have little concern for knowledge as an asset. There are several reasons that dealing with knowledge finds little regard: not many administrations will evaluate "their knowledge" in financial terms, others see themselves not responsible for that issue. Sometimes even a high esteem may be the cause: knowledge is seen as so high appreciated and so complicated that only someone in the higher ranks can cope with it.

These aspects bring us to the second part of this contribution: we dig deeper into particular issues of knowledge and knowledge management in the public sector.

The breadth of administrative knowledge: A cosmos of knowledge types and repositories

First perspective: A coarse distinction in clusters

One may regard the plethora of knowledge residing in long-known procedures and existing data collections. More, a lot of distinct knowledge types are quite unique to public administration. The high distinctiveness of legal administrative knowledge due to features special to public administrations is already addressed before. Hence, first question posed is about the knowledge types relevant to administrative work. A first coarse distinction gives three clusters of repositories: registers, legal information, management information.

Registers: A big sector of administrative data is given by traditional registers, so covering the basic items such as persons and land, then going to refinements as real estate, property rights and entitlements, and ending up with the maze of geographical data. Also repositories on income tax, corporate tax, tariffs, duties, excise etc. are registers that have been always basic to authorities.

Legal databases: Another big realm is the legal one. The traditional way of implementing political decisions and – at the same time - of observing standards of Rechtsstaat (rule of law) and public safety is legislation. The legal structuring of administrative work has several functions. It can be seen both as a restricting and as a guiding force. In the concept of the Rechtsstaat, norms serve to protect basic freedoms

of the citizenry from public interference. At the same time, legal norms are a standard vehicle of communication between government and executive agencies. Especially in continental Europe, public administrations are highly regulated by legislation which is enacted on European, national, regional and local levels. This leads to a multitude of legal databases that have to be taken into account.

Management information: A further area to mention are the plentitude of repositories containing controlling and management information. Such data are mainly financial in nature; yet the traditional controlling is changing and a broader view arises. Only in coupling with other data, new planning systems are possible that cover the full domain "citizen-politics-administration". Departing point for the development are the existing systems with major numbers of the budget, from which - over traditional procedures of the accounting - key numbers are derived. What is necessary is a connection to other tiers and the creation of new key numbers. To give an example, further data may be added to a controlling system from the environment, geographic information or also soft data from opinion polls.

Second perspective: A view on the layers of Government

Governance as strategic-political layer: Legislation is enacted on various layers. Governance defines and assesses the strategic decisions using the law and regulatory instruments in the realm of politics. So the repositories of this layer comprise legal databases as well as socio-economic planning data.

Administrative bodies as tactical layer: Implementation at the tactical layer is given in the way of policies (policy formulation and the managerial part of policy implementation). In concrete, it means applying the framework of law. The issue of policy formulation, the knowledge types and tools available are treated in section 0. With regard to repositories, additional ones concerning organizations and process structures come in. At the tactical layer of the administrative bodies, the procedural workflow is being defined specifying (and enforcing) work processes to be performed at the executive layer. It should be mentioned that - in defining a workflow - often some de facto changes with regard to the wording of the law may occur. So in design, categories are specified and indefinite law terms are defined; hence the room for discretion becomes restricted (e.g. grades of fines are being defined, but no continuum is allowed; etc).

Agencies as executive layer: In public agencies, the executive staff exerts diverse actions in order to carry out the policies of the administrative bodies. The executive layer is the world of action and a plentitude of knowledge types is involved: laws and regulations, organization models, process models (workflow), information objects of all kind, human resources with their skills, competencies and experiences (Dienstwissen). At the execution level, process knowledge is central and the motto is best practice. The issues of administrative action are treated in the next perspective.

Third perspective: A closer view on administrative action

Considering the dynamics of administrative work, one may discern the environment, the own action of an administration, potential addressees, states concerning the administration itself, and the boundaries of the own action. So administrative action involves manifold types of knowledge:

- Knowledge on legal regulations
- Knowledge about the respective environment
- Knowledge on the own means for action
- Knowledge on the effectiveness of various measures
- Knowledge on modalities of administrative action
- Knowledge how to protect basic citizen rights.

The handling of information in the public sector deserves great care and has to be characterized through remarkable consideration. Several knowledge categories and/or knowledge types with relevance to the administrative action may appear (more details are treated in section 0):

- Knowledge about the legal basis and on the use in administrative decision processes.
- Knowledge concerning the cases to which the actions of the administration are directed.
- Knowledge about the potential effects that the communication of an administrative act entails on the environment of the administrative body.
- This includes also the knowledge about the own resources and abilities in order to influence this environment as well as to enforce the law.
- Knowledge about the internals of the administrative system in general. This is approximately in the sense of an internal accounting and evaluation.
- Expertise knowledge when applying the general knowledge to particular cases.

Knowledge management has to be understood as a continuous work. It needs a lot of steps building up institutional knowledge. Several tasks have to be completed such as categorizing knowledge, integration of content and planning ways of dissemination.

Questions about the various knowledge sources and containers are central and so systematization comes first. For domain ontology, a rich kit of methods for knowledge representation exists: taxonomies, semantic nets, semantic data models, hyper links, knowledge based reasoning, time models and process graphs. Regarding Public Administration the problem is that sizeable formalized ontologies are scarce. In a recent research and development project at Linz University, we have handled the task of modelling an ontology for the complex “life events" metaphor and associated "administrative processes”[22]. Such a highly formalized description has become necessary as a request out of an international project whose software has to run in several countries. Modelling in an accurate way has further advantages as the domain under consideration is difficult: live events and processes have multiple relationships. In addition, the processes have to cross various administrative boundaries. A lesson learnt is that the effort in modelling has been rather high. This experience leads to a core concern: administrative work in general lacks such precise descriptions. Being short of formalized ontologies is a key imperfection in present systems and causes multiple consequences.

Content integration has to follow meaning the tough task of connecting the countless existing data collections. Mostly a collection of rather heterogeneous data repositories is entailed that contains data of diverse type formats that are originated from different sources. Content integration engages all sorts of conventional ways of keeping data: files, databases, legacy information systems. Efforts for content integration are rather high and the basis is a sophisticated content management. Minor or major obstacles are common just as to mention rendering information visible by use of one browser for all diverse data types and formats involved. Rather problematic becomes the question of joining different content - as the semantics of data in a particular application often have been defined long time ago. Such problems accrue in automatic such as in data mining, when semantic inconsistencies in data may lead to statistical artifacts causing misinterpretations.

Disseminating knowledge means orientation towards the addressee; information on actual and potential users is necessary for a matching of offers and demands. It is a pro-active approach that is needed ensuring a sufficient flow from sources to demand. To promote this idea, the somehow placard-style notion of a knowledge pump[23] has been invented. For administrative data some additional questions arise:

- How to prepare knowledge for public display?
- How to ensure data protection?
- How to secure inspection rights of citizen?
- How to balance contents to have it comprehensive and readable?
- How best present geographical databases and environmental information?

A layered concept to knowledge identification in Government

In an attempt to develop a comprehensive concept for understanding the various kinds of knowledge in the public sector, the authors suggest a three-layers concept as depicted in Figure 2. This systemic view on a productive system such as e-Government reflects many knowledge aspects which are combined to reach the intended goals.

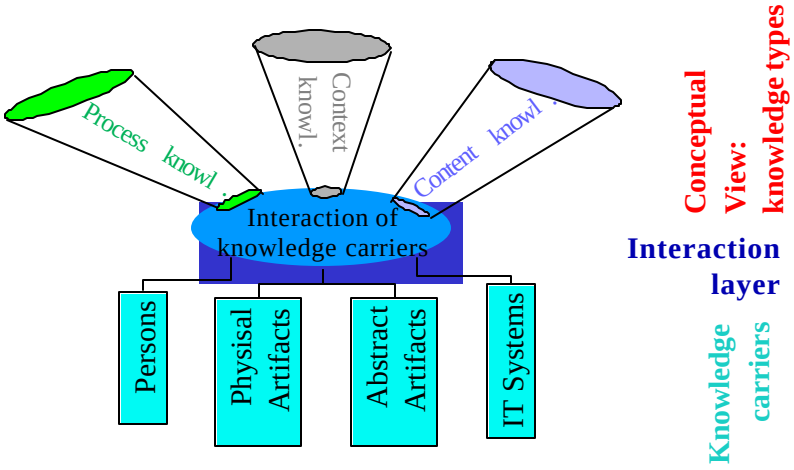

Figure 2: Three-layers concept of knowledge identification

The conceptual layer (knowledge types) provides a general distinction on three different categories of knowledge: process, context and object knowledge. The interaction layer discusses the combination of different knowledge categories according to the systemic view on a productive process. We understand that knowledge is embodied in different types of artifacts that interact to perform a specific process. The representation layer treats aspects of knowledge reflected in different knowledge carriers and how these components are interwoven. Such knowledge carriers may be IT systems, where knowledge is embodied in workflow systems, information systems, specific application systems, databases, controlling systems, management information systems, etc. Equally to knowledge in IT systems, knowledge is available in people's minds and in physical and abstract artifacts belonging to the system. From the people's point of view the third layer of Figure 2 comprises specific know-how, expertise, skills intuition and information. Putting focus on material and ideal artifacts, manuals, equipment, formal rules and laws etc. would be reflected. In a holistic view, the layered concept can be considered as a three-dimensional space addressing on one axe the three different layers, on the second axe the different types of knowledge and on the third one the different knowledge stakeholders: people, IT systems and other material and ideal artifacts belonging to the productive system.

It is the interchange between the conceptual layer of knowledge types and the knowledge representations that attracts our attention, because an adequate mapping of knowledge concepts and flow of knowledge is a prerequisite for attaining a proper functionality of the productive system. Key traits of knowledge types and knowledge stakeholders mark and emboss the interaction in the interaction layer. In that way, a determining influence is exerted with broad effect: on the particular tool, on the interoperability of tools and on the way tools are used in co-operation. A further strong influence between the layers is that a highly achieved functionality has always a history of adapting and tuning, i.e. a dynamic evolution of knowledge is an important matter.

In the next sections, we will dig deeper into these types of knowledge and knowledge carriers from a domain specific (public sector) point of view.

The knowledge part in administrative processes

Interweaving knowledge and processes

Administrative decision-making exhibits characteristics which depart from well-structured bureaucratic production processes. In the latter, interpretation of the law plays only a minor role whilst in a typical decision process, legal premises and knowledge holdings are brought together in ways which often defy their structuring beforehand. The legal premises are themselves objects of knowledge which apply to both, the decision content and the process structure in which the decision-making processes evolve. There is a hard-to-define relationship between law, facts of the case, knowledge about law & facts, and decision-making. This relationship has to be clarified either by a single decision-maker or in a co-operative act: Knowledge and law strongly shape the decision and the process in which the decision is reached. Also, co-operative patterns may be of importance if the decision is not taken by a single actor.

Categories of administrative processes

When comparing operational administrative action with the common view on production processes (such as in SCM) several distinctions become visible. First of all, a huge variety of different processes can be encountered. Then, a tension exists between fully structured production processes and complex decision processes. Most actual processes fall in between these two extremes. Numerous cases exist where at the moment when a process starts, it is far from clear how complex it will eventually become. Although many ways exist in which different agencies make their distinct interventions into the social fabric.

A comparison with the common view on a conventional production process (such as modeled by workflow management systems) shows the necessity for major revisions. Some revisions to conventional processes may be sketched: In the case of well-structured recurrent processes an extension to open decision processes is necessary. Also negotiation and consensus building of the administrative process need a blending of procedural and collaborative work modes. In public services additional views of customers have to be added. A very coarse-grained distinction may differentiate four basic categories of administrative processes[24]:

- Recurrent and well-structured processes (somehow routine-processes)
- Processes with decision-making on individual cases
- Negotiation and advice processes
- Weakly structured processes in the field of policy-making including democratic deliberation.

Processes in the view of knowledge

The various process types identified above exhibit certain characteristics with regard to the knowledge required in carrying them out. We will not deal exhaustively with all types of knowledge of some relevance for service provision and for administrative and democratic decision-making. Rather, we highlight some typical coincidences. The use of knowledge depends on the type of process.

In an earlier publication[25] we have treated typical problems arising for diverse types of processes in the context of knowledge management:

Process type	*Issues in Information and Knowledge Management*
Routine processes	Knowledge from interaction and citizen information
Individualized decision making	Knowledge of law and "process memory"
Negotiations	Knowledge-enhancing platforms for group decision-making
Democratic deliberation	Basic civic information / structuring debates

The dynamics of legal knowledge

From the standpoint of knowledge, the picture of influences and transformations is amazing. In closer regarding one may start with the point that in administrative decision-making both, legal norms and a predefined schedule guiding the course of administrative processes, play an essential part. With respect to law this may be seen evident, as it is the basis concretizing administrative decisions; concerning the process the workflow is dominant. But both influence each other and one sees an interwoven fabric of regulation, process and knowledge. Legal knowledge exerts multiple and dynamic influence in administrative processes. In several ways, e.g. consensus seeking or using earlier decisions as precedence for later ones, even feedback loops are created; thus legal knowledge is both, influencing and becoming influenced. The influences occur in multiple forms – sometimes stamping, sometimes subtle: yet their comprehension is necessary for the sake of achieving a good design.

The exertion of various influences

The mutual interdependencies between processes, regulations and knowledge are sketched next in outlining some influences[26]:

- Almost all processes are shaped by legal rules; in the regulations there are parts defining the (workflow) routing of documents and the course of decisions within the workflow systems.
- Consequently, the external structuring of the flow is derived from the legal regulations in general as well from the particular procedural rules valid for a certain agency.
- Forms intertwine processes and data and so exert a substantial influence. Part of the influence is effected by stating, which pieces of information are in and which are out (quod non est in actis non est in mundo).
- In some cases, also the material contents of the legal norms might determine the flow prescribing, which particular expert persons or agencies are to be involved.
- Such demands make the process open leading to the creation of a "process memory" (which later on might influence the course of the process).
- Also general legal requirements such as data privacy or the request for transparency may have a specific influence on the definition of the workflow.
- The mutual influence between process and law can be very subtle. With the modelling of an administrative process, inevitable ambiguities in regulations must be cleared.

- In establishing a workflow, discretion rooms are limited in multiple ways: giving categories, declaring default variables, encircling indefinite law terms; substituting them by defined types.
- An additional mutual interdependence is given by the fact that every agency tries to edit decisions that are in some way consistent.
- In that way, former decisions influence later and discretion rooms are limited. Such limitations may be given in a direct form by guidelines, yet, may also occur when glancing at former decisions.
- It is a mark of consensual procedures that collaboration is high. So in an actual procedure, convergence of opinions will come through an internal discussion of the civil servants.

Approaching the final point: decision taking

Decision taking is what knowledge is aimed at. Generally speaking, administrative decisions are the result of combining factual and legal information in more or less well structured processes. Here the ambiguity of the term "decision" should be mentioned denoting choosing particular options per se as well as processes of such choice acts. A decision can be seen as the result of using different pieces and different types of knowledge. The focus on decision making determines the whole process.

In administrative decision-making, formal and material factors combine: formal structures depend on administrative procedures whereas the content of the decision is influenced by legal norms applicable to the specific problem domain. In addition to legal interpretation, handling individual cases is characterized by a higher degree of communication with certain dynamics. Taking building permits as examples: On the whole, there is no routine: much legal interpretation becomes necessary and communication becomes intense. The big difference to the recurring and well structured processes is that, at the beginning, the process sequence is not always foreseeable.

Legal ontologies and standards enabling data interchange

The way towards standards is via legal ontologies

If one compares the public and the commercial domain one can see both, differences as well as commonalities[27]. The later ones occur at the technical level; at the application level, the complexity may significantly surmount the private sector. All in all, standardization has to be seen with a broad focus including several issues: establishing a common understanding of processes, while building on widespread administrative concepts, ensuring interoperable platforms, having a workable administrative domain ontology, defining formats for data interchange. Standardization is an enormous task yet from its accomplishment, all partners involved will gain.

The core of the problem is not on the technical level, it is at the conceptual level as one has to capture the semantics of legal-administrative concept and norms. It is the characteristics of a web that data that formerly have been used locally before these have become used globally. It becomes necessary that data carry along their specific legal-administrative context. So there occurs a lot of automatic data interchange when regarding a case (e.g. civil marriage) handled via online one-stop Government.

So for the life situation of a civil marriage, many transactions and numbers of repositories are involved. They may be dispersed over many locations under the competencies of diverse agencies and residing on several systems. Before the event takes place, several documents located in different agencies have to be checked; afterwards, a lot of updates have to be sent (change of name, civil status, common domicile) to documents that are also distributed on diverse locations. Interstate e-Government makes the example even

more complicated. One may imagine the case of two persons with different citizenship marrying in a third country. For the aim of maintaining a smooth running of system, interchange has to be done automatically. Such an automatism is only possible if both, semantics and rules, are in the systems.

On closer inspection, one can see that standards are not a technical problem only; moreover it is an issue of accountability and privacy as well. In some way releasing data can be seen similar to opening Pandora's box. As often the data are sensitive releasing data in the custody of an agency has to be founded trust in a reliable system preventing misuse. To say it frankly: standards are a core issue from many aspects. In fact, the initiatives and projects of the European Union have spurred a lot of discussion on this topic and one can be proud on the progress already achieved; nevertheless – it is still unfinished business.

Defining standards – an exercise in knowledge engineering

Standardization has to be seen with a broad focus. Ensuring interoperable platforms and defining formats for data interchange are one part; establishing a common understanding of administrative concepts and processes is another. Standards at the technical level are often common to the public and the commercial domain, but vexing problems are posed by standards for a multitude of applications which imply forms of interaction between human actors and software which are extremely manifold. Standardization is an enormous task and sophisticated domain knowledge is indispensable for their development. From its accomplishment, all partners involved (public agencies, software industry, private companies) will gain in the long run.

There is a long history of data interchange with EDI as most renowned pioneer. It has enabled smooth computer-to-computer exchange of standardized information items and of transactions, yet demands on description have grown. So current interest points at other exchange features such as extensible markup languages together with resource description facilities (XML and RDF). With them it is possible to build standards for rather complex structured concepts. So it becomes the basis for a Governmental Markup Language (GovML)[28], i.e. a language for defining administration specific content. Such a language has to provide a common, flexible and extensible syntax for administration-specific content.

However, defining legal concepts is not easy due to the inherent intricacy and complexity of law. So troubles start on the basis with legal terms themselves that all too often are not adequately defined. This is due to several reasons: vagueness that may be on purpose, genuine inconsistencies and fuzziness, dynamics in law, planned discretionary power of street level bureaucrats etc. Further, mapping administrative semantics is full of more or less inhibiting difficulties: profound differences in legal systems, adequate meaning of terms, different connotations of terms and non-existence of counterparts.

Knowledge processes in planning and policy making

Planning and policy making

Policymaking is normally taking place through multiple processes of negotiation, ranging from cooperative search for acceptable solutions to outright clashes in interests. Decision making in public policy is a process which more often than not is characterized by a mix of commonality in interest and struggle. It is rarely abiding to well-behaved teamwork.

The amount of negotiations, their length, as well as the amount of parties they involve seem to be constantly increasing. Many negotiations in public policy span organization boundaries. The classical policy triangles involving parliamentarians, administrators and field representatives has emerged to a net.

The negotiated character of policymaking becomes apparent in all phases of the policy process, even in as early phases like information collection and analysis. During these phases, divergences of interests and positions do not yet reveal themselves very clearly. On the other hand, agreeing on some kind of information and demarcating the search space for further information may preempt substantial decision-making which characterizes the following phases of agreeing on some policy and of implementing it.

Mostly taking decision is characterized by a mix of commonality in interest and struggle. One type may resemble a litigation process with clear-cut roles of opponents acting in a quasi zero sum game. Labour relations and international conflict are often of this type as are many judicial processes. In other cases, positions may seem contradicting at first glance, but a skilful mediation process might lead to an acceptable compromise. Town and regional planning provides ample evidence for conflicts, which may be resolved in that way. Related to this is enhancing democratic participation in planning processes and other decision making which can be achieved in reasonable time frames through better support. Parliamentary commissions are another case in point. Other types of negotiations have the goal of achieving a common strategy such as it may be the case in a board meeting. At the implementation level, policy negotiation may also occur, although strategies are given. Discretionary behaviour at street level is normally accompanied by negotiation with clients. Other cases include boards in charge of case-bound decision-making.

Knowledge used in planning

Supporting the most various settings in which planning and policy deliberations take place is a must. It goes in two directions, bringing in the knowledge and sustaining the cooperation. The amount of knowledge used in a concrete planning decision is mostly extensive. There is a high dependence on organizational goals and on the situation. Some aspects are listed below:

- Pending tasks and general expectations about them
- Situation of the institution and the world outside
- Key numbers from controlling and result of evaluation and inquiries
- Expertise gathered from operating processes and handling citizen contacts
- Stakeholder in decisions (institutions and persons) and their interests
- Discretion for actions given by legal rules
- Familiarity with the organization, its structures, personal compositions and traits
- Possible procedures and directives, grip on resources
- Control of effectiveness and monitoring of directives
- Anticipating the effects of decision options

There is a rich collection of instruments for support:

- First and foremost, tools should sustain the decision taking part by itself by modelling (expert systems, software agents etc.).
- Other tools necessary in decision taking manage knowledge repositories (e.g. databases and document management systems)
- Important is the support of collaborative problem solving (argumentation systems such as Issue-Based Information Systems (IBIS)). Mindmaps and semantic nets are graphical means to be used as well.

- Further tools are still in their infancies yet will become important such as to mention support for categorizing, retrieval and navigation with advanced systems for categorization, fuzzy retrieval and case based search.

Sustaining cooperative decision making

What has to be sustained is cooperation in the broad. Support of computer-mediated cooperation in a comprehensive sense means sophisticated tools, multi media and video-contact become a must. First, the meeting activity per se may be performed via video techniques – so economizing on travel costs and time. Next, many activities associated with meetings can be largely improved by tools using multimedia. Examples are plentiful: clarifying procedural questions; scheduling of meetings and implied sub-activities; supporting the agenda setting and spotting experts, supporting brainstorming sessions, structuring issues etc.

A difficult point is connecting procedural activities and meetings, both supported with quite different types of software causing interoperability issues. Considerable extra effort occurs when there is no direct information import and export between the two subsystems of workflow and meeting systems. This is in striking contrast to the real office world, where meetings are heavily interconnected with work processes. All in all, it is an infrastructure of general services that has to support collaborative work: Basic demands are open communication and shared workspaces for providing common views on a particular subject. Main functionality supporting collaboration may comprise:

- appropriate and convenient management of electronic documents shared workspaces for providing common views on a particular subject
- various forms of conferencing on the desktop (bulletin boards, simultaneous conferences, video conferences)
- collaborative writing and white-boarding enabling revisions, comments, and annotations in a shared document.
- idea processing and argumentation focusing on the material content of negotiation and decision making.

Providing knowledge enriched information and intelligent services to the citizen

Poor usability means poor up take

Next point is content - providing information to the public. There is no much use offering information on the web just in an exclusively administrative-legal wording. This is a wrong attitude yet often found. It is the information scope of the administration that dominates. The consequences are disturbing:

- Inadequate structuring and inconsistent design
- Unreliable and outdated pieces of information
- Lack in targeting the audience
- Missing translation to the everyday life world
- Lack of comments and inadequate examples.

Experiences show deficiencies in usability. The typical interaction process on the Web revealed harsh insufficiencies. Users were unable to cope with the logic of administrative thinking and did not comprehend the legal language. What the users lack in particular is a customized assistance, i.e. help that meets the individual situation and competence. Giving mere textual information does not suffice, information has to be "palatable" for citizens. A priority request is to translate the demand for a service from the citizen's life-world to administrative terminology. This is part of a very common conflict situation: an urgency of a citizen's request and the limited explanatory capabilities of the system to provide the necessary in-depth explanations in an unambiguous way.

Knowledge enhancement

Thus usability becomes a main concern and improvements go several ways. Some are less spectacular as building on past experience and applying common sense. So even plain rules will contribute to usability such as "Less is more" and "Keep it straight and simple". But there are complicated interaction processes needing a deeper analysis. In case of giving information to citizens, design may use several means, mostly it means putting more intelligence in the application.

Such knowledge enhancement is particularly necessary when legal information is presented. There are too many users who are neither familiar with concepts of law nor with the logic of administrative thinking. They need active help in finding the information items they are searching for. This means translating demands of the everyday-world in the legal-administrative jargon and vice versa.

Legal information touches some matters of principle. The law as a citizen right has to be promoted as a matter of principle. Not only that the ethical legitimacy of law has a high priority; it also urges for transparency according to the principle "ignorantia legis non excusat". Further, an active participation of the citizens in democracy can only be achieved on the basis of knowledge. This is not easy to solve, because for legal knowledge a paradox exists: only those who participate can know and only those who know can participate.

In praxis, several modes are viable for improvement. One would construct clarifying dialogues, and describe illustrative scenarios. Also detailed knowledge (on both, on the field in question and on the interaction) can be embodied in software agents. All this works in actively helping users in accomplishing their tasks. Finally, very advanced future design will result in intelligent multi-lingual and multi-cultural personal assistants being integrated in electronic public services portals.

Tasks with Potential for Improvement

Thus, present support capabilities cannot cope with the real demands – so knowledge enhancement has to be high on the agenda. Providing a solution means improvement for several distinct parts of the task. So we will consider several task with high potential for improvement:

- offering an integrated access management;
- improving the general information capability;
- interchanging governmental documents;
- routing the citizen demand to the relevant place;
- enhancing the interaction task in public services;
- improving the specific advice capability of the system;
- invoking assistance of human experts in complex cases.

Offering an integrated access management

An integrated access management has to adapt to diverse preferences: some persons may stick to writing letters; others might transfer the dominant written mode from mail to Internet; numerous citizens want to personally expose a problem to an official; some do it during an actual visit and others via a multimedia linkage. No wonder that the following become crucial points: how is the actual access point arranged in its physical setting and how is the organizational framework. So the delivery of services may be provided in various forms such as:

- Municipal neighbourhood one-stop offices functioning like miniature town halls;
- Purpose-oriented offices, such as a central office mediating the electronic inspection of administrative records kept by any agency;
- Multifunctional service centers working like a travel agency (offering public services as well as commercial services like insurance or banking);
- Some sort of virtual offices, where several formally independent agencies are made to appear as a single one. The citizen who enters the office of one agency would get immediate access to the services of all of them.

Taking care of the routing part

One of the first steps is to route automatically to relevant knowledge repositories or to the agency with competencies in the legal sense. The concrete target may be diverse: a plain database, a sophisticated software, a staffed service center or an official in a particular agency. An annotation should be made that demands of the agencies have to be considered as well: offering access options and rights, indexing and profiling, providing assistance in tracking etc.

From a technical point of view various means are possible such as comparing keywords of requests or evolving scenarios of life situations. Also avatars should be mentioned with their capability for guiding user. They are animated human like characters in intelligent presentation systems. Further for designing the interaction, both, meta-dialogues aiming at structuring tasks and artifacts in communication are important. A core problem of routing is that formalized ontologies are scarce; often stricter features such as detailed taxonomies, semantic nets and semantic data models would be required. Generally, being short of formalized ontologies is a deficiency in present systems and causes multiple consequences.

Adequate interaction in public services

Citizen services have to be viewed in as an interaction between agencies and citizens someway resembling the world of Commerce. Schmid has defined a Business Media Reference Model pointing out the different phases of transaction in both, e-Commerce and e-Government[29]:

- Information: This phase deals with providing necessary information to customers. This includes push- and pull-services, adequate representation on the web, search mechanisms, etc.
- Intention: This phase covers the representation of supply and demand. In the case of e-Government, this means that it should be easily possible for the customers to map their intentions to the offered services.
- Contracting: The agreements taken in this phase have to be in a form that it is clear for both parties, what they want and what they are obliged to do. Since the contact that is signed here is

obligatory, this phase includes the problems of the identification of persons and the authenticity of documents.

- Settlement: In this phase the agreements of the contract are realized. This includes exchange of goods, money, documents and/or information.
- Aftercare: Claims-management, caring for the client as well as a feed-back on the quality of service deserve special attention.

Increasing advice capability

After the routing of the demand according to administrative competencies as next step advice capability comes in focus. Here a caveat at the beginning: supporting the advice part is by far more complicated than the routing part. Up to now, only few development projects have centered at the core issue of advice giving. Several strategies become apparent, small steps and big leaps:

- A lot of improvement is possible with minor resources and in small steps: working on better comments, drawing clearer scenarios, adding help-functions.
- Giving the complexity of the field, there is need for substantial improvements as well. So intelligent pieces of software may act in performing clarifying dialogues. One could also envisage service portals which comprise intelligent multi-lingual and multi-cultural personal assistants.
- A software-only-solution for advice is not the only option, another is using multimedia for contacting human expert.

Invoking human expertise

Given the complexity of cases, a purely software driven solution for advice is not an ideal option. Indeed in the public sector, many situations exist that require the intervention of a human mediator. So, knowledge enhanced portals should facilitate and redirect communication dialogues with human experts:

- Mediating persons at the counter of public one-stop-service shops improve their capability for advice by using the system. For the designer, this means not only to focus on the citizen but to regard also the people behind the counter.
- Remote expert know-how is accessible when needed for a specific case. Such expert dialogues may be enabled via advanced multimedia technology.
- With mediating persons and remote experts themselves using knowledge repositories ultimately human and machine expertise become totally interwoven. This is knowledge enhancement at its best.

Feature requirements for managing knowledge in government and public governance

In an earlier investigation[30], we have treated administrative work as knowledge work as well as the sophisticated intertwining of process, legal norms and administrative domain knowledge in detail. We now go one step further and confront administrative knowledge work with the features offered by KMS. The proposal on KMS features requirements[31] is used for this comparison. Hence the further discussion pursues the following division:

- Domain ontology
- Content repositories
- Knowledge dissemination
- Content integration

- Actor collaboration
- Security.

Above schema is juxtaposed with administrative work considering both: administration requirements in common and three examples of specific applications. Administrative work in common has been discussed in depth in literature[32]; here we only sketch those applications used for explanation in the following part:

1. *Application 1: Decision Making Centered on Individual Cases:* For many officials it is the principal work activity consuming a large amount of their office time Individualized case processing takes into consideration the particular circumstances of a situation and there are manifold cases in point: child allowances, tax cases, building permits etc. In praxis borders blurry: the same case that is routine for person A, for person B may become complex on special factual or legal grounds. Additional, interaction with stakeholders is often not foreseeable in detail at the beginning. To bring it to the point: there is a basic distinction between recursive production processes and complex decision processes. For later ones at the date of the initiation of the process the later stage cannot be anticipated, neither in its actual course nor in its accumulated complexity, getting advice from further experts or involving additional agencies may become necessary.

2. *Application 2: Policy Formulation*: Preparing processes of policy formulation is important for legislative and administrative work. Examples are bills of parliament, answers responding to parliamentary inquiries or complex political decisions. Also in the higher echelons of administrations cooperative decision processes are a common way of work. Policy making and its complex processes represent a case of weakly-structured processing with quite unique constraints.

3. *Application 3: Citizen Information:* Citizen information is a core part of an integrated service access management as envisaged in online one-stop Government. As organizational mode several forms are possible: kiosks, municipal neighbourhood one-stop offices, multifunctional service offices as well as home and mobile access. Many particular functions are included such as: citizen information at various stages, choice of the favoured access channel, aid for filling in forms, matching of the citizen's demand with the administrative structure, invoking human mediators for help etc.

Having outlined the examples, attention is directed toward the KMS features starting with the prime component – domain ontology.

Domain Ontology

Administration Requirements in Common: For domain ontology a rich kit of methods for knowledge representation exists[33]: taxonomies, semantic nets, semantic data models, hyper links, knowledge based reasoning, time models and process graphs. Here we raise the basic question of advantages and obstacles.

- *Sizeable formalized ontologies are scarce:* Regarding Public Administration, most needed features are taxonomies, semantic nets and semantic data models. As already pointed out, have handled the task of modeling a sizeable ontology for the complex “life events" and associated "administrative processes” in a concrete project[34].
- *Lack of commitment:* An obstacle is that - in contrast to e-Commerce where efforts have brought to bear ebXML[35] - Public Administration shows less commitment. Reasons are many: fragmentation of administration, competing claims on resources with high priority, intrinsic difficulties of the domain in question.

– *Intrinsic features:* Intricacy and complexity of law itself is one reason. So troubles start on the basis with legal terms themselves that all too often are not adequately defined. This is due to several reasons: vagueness that may be on purpose, genuine inconsistencies and fuzziness, dynamics in law, planned discretionary power of street level bureaucrats etc. Further, mapping administrative semantics is full of more or less inhibiting difficulties: profound differences in legal systems, adequate meaning of terms, different connotations of terms and non-existence of counterparts.

Application 1: Decision Making Centered on Individual Cases: This application depends heavily on internal and external data exchange. In reality this means using workflow and EDI as tools. Therefore domain ontologies are central:

- *Formalized legal domain ontologies:* Although this is an urgent request, scarcely work on such elaborate models can be found. Often rather coarse taxonomies and makeshift classifications are used deducted from the every day work of users.
- *Taxonomies need detailing:* Sharpening is urgent as coarse classifications – although often used and sufficing for certain applications - are inadequate as requirement for KMS. Just to give an example, for running workflow a coarse grouping may do: distinguishing information objects whether they belong to the case and to the process (one class describing all the facts pertaining to a particular case, the other guiding the administrative process). Yet turning from workflow to KMS a more detailed distinctions becomes mandatory.
- *Taxonomies for information gathering:* Taking decisions means including all available information in the decision process that makes information gathering crucial.

Application 2: Policy Formulation: Turning towards planning the need for ontologies is apparent as well:

- Information gathering: For policy formulation the realm for information search and investigation is rather unlimited; collecting all relevant information might include exhaustive seeking for information sources. Collecting expertise and preparing information for decisions is a tough part: gathering as well internal and external information, furthermore both factual information as well as "deontic" information. Especially the latter one is crucial and manifold: norms, prior decisions, binding expectations etc.
- Taxonomies for documentation: For documenting negotiations and decisions is a small example is given concerning the legal status of the documents. References of legal relevance have to be marked in an unmistakable way: authorized status of minutes, binding character of decisions, liability of the decision body etc.

Application 3: Citizen Information: Following examples may give an idea about the need for a proper ontology:

- *Automatically routing of citizen demands:* The goal is an automatically routing either to relevant knowledge repositories or to the agency with competencies in the legal sense. The concrete target may be diverse: a plain data base, a sophisticated piece of software, a staffed service center (e.g. a call center) or an official in a particular agency. Nowadays this is done in comparing key words, yet mapping requests by means of domain ontologies is preferential.
- *Adding comprehension:* Taxonomies must be “palatable” for citizens. There is no much use providing information on the web just in an exclusively administrative-legal wording. Web-design has to resolve conflicting demands: a) citizen’s requests commonly posed in a rather

urgent situation, b) the need for an in-depth explanation in an unambiguous way, c) and the limited explanatory capabilities of the system.

- *A basis for static and dynamic help:* Support can be both, static and dynamic, yet an underlying ontology is needed anyway. Instruments for dynamic help are software agents or human mediators.
- . A static support means thoroughly editing, commenting and illustrating the taxonomy in question.
- *Continuous improvements for interaction:* Perfection starts with small steps, so with working on better comments, drawing clearer scenarios, adding better help-functions. Considerable steps concern incorporating knowledge into software. Final developments will comprise intelligent multi-lingual and multi-cultural personal assistants being integrated in electronic public services portals.

Content Repositories

Administration Requirements in Common: As to content repositories quite a lot of KMS features aim at one goal - enabling the exchange of data between diverse administrative bodies. Here we consider two topics, data interchange features and the inclusion of internal repositories, and start with the former ones:

- *EDI:* Evidently, in a cosmos of increasingly fragmented public organizations data exchange between administrative agencies has become the rule. Inter-organizational linkage of content repositories has been a dominant concern since decades. There is a long history with EDI as most renowned pioneer. EDI has enabled smooth computer-to-computer exchange of standardized information items and of transactions.
- *XML and RDF:* Current interest points at other exchange features such as extensible mark up languages together with resource description facilities. With them it is possible to build standards for rather complex structured concepts.

Organizational learning needs several internal repositories. They act as internal memory and may assist in many decisions:

- *Repositories filled by internal processes*: Administrations also have to maintain their organization and for this aim several supportive activities have to be taken. There is a pure occupation of an organization with their own internal business and often this is a legitimate objective.
- *Repositories filled by incomplete processes:* Many observing and information-gathering activities take place without producing tangible results. Then observable facts go in an internal memory especially when incomplete processes are involved. So many collected pieces of information are valuable; although never used directly for action they may contribute to organizational learning within an agency. Observations gathered by pure chance are a good example and not even a rare one. Such pieces of information should be considered part of a puzzle game with one piece more added.

Application 1: Decision Making Centered on Individual Cases: Here two subjects are considered, interconnection of agencies and documenting the procedural states:

  - *Connecting administrative data:* It is a key topic and is touched in several sections of this contribution. Data involved in a specific administrative decision are dispersed over many locations, under the competencies of diverse agencies and residing on several systems. As for the central importance the topic has been tackled in several projects. They all aim at diverse

aspects of information exchange and include a variety of approaches. The following selection of references may illustrate the diversity: eGIF[36], IDA[37], RDF[38], XML Person Record in Austria[39], OSCI initiative in Germany[40].

– *Version control:* There are other vital matters as well. As a key point we present documenting the respective states of an official file during its procedural course. This objective is achieved via strict version control where all alterations of a document can be traced – a prime request for safeguarding legal validity.

Knowledge Dissemination

Administration Requirements in Common: Stating requirements on the general level is difficult: knowledge dissemination in Government is rather intricate and a lot of options and conditions have to be considered. Potential appearances and forms of design are numerous; in addition they are very depended on addressees and framing conditions. Here some parameters are listed that shape a concrete design:

- Tradeoffs between push- and pull-approaches
- Choice of the access channel which suits best
- Diverse organizational forms and physical settings of demand (office, kiosk, home)
- Balance of human and software mediators/knowledge bearers
- Routing of offer/demand according to administrative competencies
- Intricacies of the subject matters (legal norms and decisions)
- Translation from administrative/legal jargon to everyday world and vice versa.
- The following applications 1 and 3 illustrate the dependency on users and circumstances. In the case of decision making the users are administrators and legal retrieval is a pull only situation; for the case of citizen information quite divergent aspects of dissemination come out as relevant: routing, assistance, comprehension etc.

Application 1: Decision Making Centered on Individual Cases: Main requests derives from the influence that is exerted by legal reasons on administrative decisions. Yet this demand is not easy to fulfil. Many legal information systems exists, yet the praxis shows little usage: Consequently new ways have to be explored:

- *Requests for advanced retrieval systems*: Poor usage of common retrieval is explicable because present systems are keyword oriented and lack any further elaboration in view of the particular circumstances of the case to be decided. To be frank, at the moment there remains only yearning and hope.
- *Expecting new developments*: Actually, one can find developments in the direction for retrieval that is case-oriented and handles analogy. Regrettably such approaches still belong to the scientific realm: case based retrieval, deontic logic, probabilistic measures, neuronal nets.

Application 3: Citizen Information: As stated before in the beginning of this section many options are open. For citizen information, quite distinct design will result[41]. To shorten the discussion, here we will only sketch a vision of an advanced system as to illustrate the ample capabilities:

– *A vision as guidance:* We envisage a advanced system using multimedia. A citizen may go to mediating persons at the counter of public one-stop-service shops. The mediators will use the system with its diverse repositories. In case the issue is too complex it is possible to invoke

further expertise from distant experts via a multimedia link between the service outlet and back-offices: dialogue becomes trialogue. As the accessed expert himself may use knowledge repositories human and machine expertise become totally interwoven – knowledge enhancement at its best.

– *Further expansion:* Above scenario may be expanded on several sides: the citizen posing ma make contact from the home-site using multimedia; for the routing of demands using software guidance (avatars) is possible; the agency may act in proactive way setting the initial step.

Content Integration

Administration Requirements in Common: Regarding content integration two requests are central, coping with the heterogeneity and achieving comprehensiveness.

Heterogeneous data repositories: Content integration means handling a collection of rather heterogeneous data repositories containing data of diverse type format that are originated from different sources. Content integration involves all sorts of conventional ways of keeping data: files, databases, legacy information systems. Efforts for content integration are rather high and minor or major obstacles are common:

- Content integration needs sophisticated content management. A first step is making accessible the diverse data spread over various locations.
- Joining different content may be rather problematic. The semantics of data in a particular application often has been defined long time ago. Now with the Web, data originally used locally have to be used globally.
- Problems accrue in automatic processing (e.g. in data mining), when semantic inconsistencies in data may lead to statistical artifacts causing misinterpretations.
- Another point: With many diverse data types and formats involved rendering information visible is not easy.

Comprehensive integration – a systemic view: An important point is including data from all fields of administrative action. Being well aware of privacy restrains the question points at possibilities in general. For illustrating the wide span to be covered a systemic view on administrative work may serve. Accordingly the six basic stages in executive decision processes are regarded[42]: observation, substantiating facts, decision to act, administrative intervention, execution for enforcement, evaluation. As the schema appears rather abstract some remarks may be useful:

- Above schema is conceptual and can hide a lot of complexity: e.g. substantiating facts is a stage where in reality the effort going into legal interpretation and negotiation may become massive.
- The actual weight of stages differs with the type of application. So observation and evaluation are mostly essential for policy making - yet rarely significant in decision making in individual cases. In contrary, for decision making in individual cases attention predominantly circles around substantiating facts and intervention.
- The means of administrative actions are a rich collection of various instruments: legal methods comprise norms, directives, permits, obligations; financial measures are impeding (duties and levies) or provide stimuli (allowances and grants).
- In some stages physical-technical actions can occur as well: observation via monitors; intervention by setting up of road-signs; execution in forcible way of tax collection.

The systemic view given here may illustrate both, the span of information sources and the variety of repositories involved. Some aspects are more detailed below.

Stages, information sources and repositories: Evidently the connections are plentiful such as to give some examples:

a) *Observation and collecting information:* Obtaining information is a key condition for governance in general such as to observe the behaviour of the society or a group of citizens. So sources are copious and countless diverse repositories are involved for capturing administrative information.

b) Substantiating facts: The material gained from such observations is evaluated in the light of legal and policy premises. In this way, by initiative of an agency a "case" is constituted as concrete action. In an alternative way, numerous cases are initiated by citizens themselves: claim for an allowance, request for a building permit, applying for civil marriage. In any case, substantiating and proving facts is a crucial and tough activity. In the course of action numerous dossiers are created and many repositories are involved. Repositories may concern observations (mentioned in a), may compile the data on citizens or may pertain to the internal memory. More on b and c is pondered in application 1 below.

c) Decision to act: When enough material is collected and combined with the facts, administrators have to take a decision for action. The decision is documented and become part of the accumulated dossier. Decisions will go into several repositories due to the innate importance of decisions and their multiple consequences. Such repositories and their design have to mirror and balance quite differing aspects: integrity and durability of information; sensibility for privacy protection; decisions as precedence cases; access for organizational learning; freedom of information etc.

d) Intervention: Intervening in the fabric of society is the final goal of administrative action. This can be made by legal binding declarations of various form: granting permissions, declaring obligations, setting financial measures etc. For most administrative acts the results of the decision-making process are simply communicated to the addressees. In rare cases the intervention will mean physical action.

e) Execution for enforcing: If some addressees do not comply with the orders, an execution of the order may become necessary.

f) Evaluation: In the last step it has to be checked whether the action taken had the intended effect concerning the influence on the society. Opinion polls, case studies and claims management are examples. The results of this evaluation are collected in particular databases used for improving both, administrative decision-making and the rules guiding it.

Application 1: Decision Making Centered on Individual Cases: This application can be seen as a particular instance for the stages b, c, d. We discuss it for the life situation of civil marriage:

- *Instantiation of the systemic view*: Regarding above schema and taking civil marriage as example one gets a rather "simple case" that will commonly comprising initiation by citizens, proof of legal grounds, proclamation.

- *Variety of transactions and repositories:* Yet, it is just the opposite from simple when the view of on-line one stop service is taken. It is essential for one stop service that data are brought together from /disseminate to diverse data sources. This means that for the life situation of civil marriage a lot of transactions and number of repositories are involved. So before the event lots of documents located in different agencies have to be checked; afterwards a lot of updates on documents have to be made (change of name, civil status, common domicile etc.)
- *Interstate e-Government:* Making the example a little more complicated one may envisage two persons with different citizenship marrying in a third country. In this case the respective transactions cross state borders and so difficulties for on-line one stop service will build up.

Scenario 2: Policy Formulation: Out from several issues we will touch three:

- *Knowledge portals:* The diversity of knowledge sources, types and containers make the user feel uneasy. Hence, meta-information, the information about information, is needed and best molded directly into the portal. This leads to the idea of dedicated knowledge portals that guide to the respective contents.
- *Joining different types of knowledge:* Combining the different forms of knowledge is not easy as hard and soft data have to be joined. For the former ones figures from controlling pose as example, for the later ones opinion polls and estimations.
- *Unique browser:* Even as it looks to be a mere technical problem it has to be mentioned. One has to ensure that a single browser copes with the multitude of heterogeneous data repositories and different data formats that are involved.

Actor Collaboration

Administration Requirements in Common: Actor collaboration features are essential in nearly every administrative scenario. Two basic requests are treated here:

- *Blending different modes of cooperation:* There is need for a wide spectrum of possibilities, depending whether strictly structured cooperation (workflow) is involved or more informal collaborative modes (message exchange, discussion fora, meeting rooms). A smooth transition between both modes and the inclusion of auxiliary functions such as filtering and calendaring is mandatory.
- *Usability:* This is a key word and includes a list of particular requests. Each of them, taken for its own, appears to be rather minute; yet collectively they are important for smooth work. Examples of advanced attributes include: malleability of mechanisms as an adaptability to personal preferences; indicators reminding the basic status (such as what, where, how) when managing subtasks simultaneously; semantic conformity of notational primitives corresponding to the context of usage.
- *Application 1: Decision Making Centered on Individual Cases:* The main request is to have phases of strictly structured cooperation (workflow) are interwoven with phases of informal collaboration:
- *Enabling informal collaboration:* A key priority for internal work due to the intention to reach consensual decisions and a tendency to have consistent decisions for similar cases. Also external negotiations with clients needs collaboration.

Application 2: Policy Formulation: Key requests emerge from two dominant characteristics:

- *Unpredictable amount of negotiations:* The amount of negotiations necessary, their length, their course, the amount of parties they involve are often not foreseeable. This is because policy formulation normally takes place through multiple processes of negotiation. The negotiated character permeates all phases of the policy process and spans diverse organizational boundaries.
- *Meeting support:* Most important to policymaking activities are meetings. In order to reach adequate support environments, one has to blend conventional decision support with collaborative functions. Support system should have a set of highly-modular components as the particular nature of a task is often not foreseeable.

Security

Administration Requirements in Common: Knowledge security features are obviously of high relevance for agencies. Consequently actual KMS should integrate diverse security components such as encryption, access control and electronic signatures.
Applications 2 an 3: Policy Formulation and Citizen Information: For both applications demands for safeguarding data security and privacy are stringent. These directives are not easy to fulfil as they sometimes contradict other demands such as planning needs for data integration. In the same way the need for privacy may conflict with other goals such as transparency and freedom of information for the public.

Outlook: Confidence and Caveats

Closing a tour d'horizon on the enabling capabilities of Knowledge Management one comes back to the point of departure: Will Government use the potentiality offered by concepts and technology? Let us recall the opportunities:

- providing proper information for planning and achieving better decisions;
- better information and services for citizens;
- civil servants empowered to improved work;
- surmounting organizational boundaries of public agencies;
- tailor-made service delivery for citizens or companies;
- citizen feedback as part of quality-oriented policies;
- measurable effectiveness and quality of public interventions;
- stakeholder participation in zoning and planning processes.

The crucial point in this question is not the state of technology; it is the state of awareness and concern of the leading administrators, of those who have to blaze the trail in the right direction. They have to be convinced: it is knowledge that they need for accomplishing their professional task. At the moment mixed signals are coming in. There are encouraging pilot applications, yet for administrative practice change is slow. Thus change management becomes the key to success. Only so the public sector will make a leap in innovation.

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IV.3 Summary of Presentations and Discussion

IV.3.1 "Knowledge Management for Government: Enhancing the Quality of the Public Service"

Maria Wimmer, University of Linz

Many governments have begun to pursue e-Government initiatives which seek to apply the tools of ICT to better serve citizens, business, communities, as well as public authorities themselves. They have turned attention to concepts such as one stop shop government, seamless government, improved knowledge flows and information services, transparent participation, and intelligent and restructured systems. Among the many requirements to achieve these ends is knowledge enhancement and knowledge management.

The goals of knowledge management in government are multiple and include: managing knowledge within and outside the organization; establishing organizational memory; establishing a lifecycle of knowledge production, integration and validation; creating an ongoing and adaptive interaction with the knowledge base; allowing for organized and proactive transfer of skills, know-how and expertise; creating a learning organization; instituting support through integrative technological means (e.g. knowledge management systems). However, there are several problems found to face the public sector in implementing knowledge management which encompass unawareness of the knowledge riches that agencies posses, lack of understanding that government workers are knowledge workers, and inadequate concern for knowledge as an asset. Many administrators also do not evaluate their knowledge in financial terms and others see themselves as not responsible for these issues. Moreover, there are cultural and contextual challenges and those associated with incorporating citizen's views and ideas, privacy and security, and turning knowledge into action.

When formulating a knowledge management strategy or practice, there is a broad range of knowledge types and repositories to take into account. They range from distinctions in clusters of information (registers, legal databases, management information); to viewing knowledge from the perspective of layers in government (strategic-political, tactical, executive); to types of knowledge about the policy field to be influenced, the respective environment, the means and modalities of action, legal regulations, effectiveness of various measures and evaluated effects of previous actions, protecting basic citizen rights, standards, attitudes of stakeholders, and so on.

In order to move from concepts to actual knowledge identification in government, there are several factors that must be examined from knowledge types (such as processes, context and content knowledge), to knowledge carriers (such as people, physical and abstract artifacts, IT systems), to the interaction layer between the two. It is critical to remember that these are technical *and* social systems that should be pursued within a holistic approach to government. With regard to the weaving of knowledge with administrative processes in particular, governments must consider both the dynamics of knowledge and the various categories of administrative processes which range from the recurrent and well structured, to individual decision-making, to weak processes in the field of policy-making and democratic deliberation. A framework for tackling these issues has been proposed and is based on the following variables: domain ontology (e.g. taxonomies), content repositories, knowledge dissemination, content integration and actor collaboration.

Ultimately, knowledge management provides for information planning and improved decision-making, enhanced services for citizens and increased stakeholder participation, surmounting organizational boundaries, empowered civil servants, and increased quality of public interventions.

IV.3.2 "Myths and Findings: Results of the Knowledge Management Practices of Central *Government in OECD Member Countries"*

Elsa Pilichowski, OECD

The OECD undertook a study of 20 countries, including 132 central government departments or ministries, in order to learn what their member states understood as knowledge management, the level of efforts made by central governments and the achievements of organizations as compared to expectations.

Knowledge management has raised high expectations. Improved work efficiency and productivity, improved transparency, increased decentralization and horizontal cooperation, lifelong learning, improving the attractiveness of public organizations are among the perceived benefits of knowledge management cited. Also, knowledge management is seen as a way to integrate new knowledge from the outside, i.e. citizens. Knowledge management has also enjoyed the support of management, which has largely signaled it as a top priority, institutionalized it in the form of knowledge management strategies (half of the respondents have them completed with the others targeted to be completed by 2005) and reflected it in language. Effective knowledge management also requires assigned responsibilities for its implementation. The survey found that generally responsibility lies with either top managers, a human resources team, a knowledge management unit, or IT team. For the almost 20% of the entities where no responsibilities were assigned, this poses a considerable hindrance.

Amongst the specific practical efforts of governments to improve their knowledge management practices are examples of reduction of bureaucratic divisions, mobility and flexibility of staff, personnel training, establishment of coordination units, communities of practices, networks, and databases, initiatives to promote sharing with outside organizations, and establishment of e-government. There is also evidence that the attitudes of staff and managers have changed and that there is increasing reliance on outside information sources. Yet, the budget picture is more mixed with a lack of understanding of actual costs of knowledge management and diminishing budget allocations over the next five years. The survey also noted the difficulties of implementation which center on issues such as privacy of information, internal resistance, difficulty in capturing undocumented knowledge, and limited rewards for sharing knowledge. Moreover, knowledge management can actually have negative side effects such as information overload, difficulties using ICTs, and dilution of responsibilities, which must also be overcome. Finally, there exists a gap between expectations and what has been realized by governments to date particularly with regard to change of vertical and silo structures of governments.

In attempting to measure efforts and the level and quality of knowledge management practices, there is a weak correlation between efforts made at improving knowledge management and perception of results. Countries that rank high on both indicators tend to be large and relatively well functioning governments and have a stable organizational and cultural environment. Sectors that rank high on both indicators have taken on more of a coordinating role and tend to be more outward looking.

In conclusion, the survey found that knowledge management is a nebulous concept and that there is a discrepancy between understanding and reality. Several other observations and recommendations were made. In improving organizational memory through knowledge management there also arises a tradeoff between the need for organizational adaptation to a changing environment and the internal organizational stability that favours a knowledge management framework. The effects of public sector management on knowledge management practices should be systematically acknowledged. Despite large differences in the functions of ministries, there were strong commonalities amongst most ministries of a particular country indicating that government wide knowledge management matters. Newly labeled knowledge management initiatives are not as important as long term evolutions in work practices and values. Factors that relate to institutional stability and shared values are more important than knowledge management

labeled devices. Becoming a learning organization requires much more than good knowledge management practices as adaptivity is at the core of learning.

IV.3.3 "Information Sharing: Toward Collaborative Governance"

Donald Lenihan, KTA Centre for Collaborative Government

Given the complexity and inter-dependency of society in Canada due to forces such as globalization, ICTs, migration, and environmental impacts, and as policy capacity is becoming more distributed, service provides more numerous, governments, civil society and business more connected, and policy fields more interdependent, there is a growing need to work together. This can be achieved through better sharing of information to improved management, policy and governance, and through the establishment of multi-stakeholder forums and new knowledge fields which respond to the need for more collaboration.

Information should not only be viewed as a resource, but it should be viewed as a public resource. There is a cascading relationship from information, to knowledge, to policy. Better information will lead to better programme design and delivery, transparency and accountability; better knowledge will lead to better policy and ultimately to new knowledge-fields that will contribute to growth and development. The challenge for government is to mine its vast resources of information to achieve this cascade. Doing so will require overcoming current practices of controlling access to government information resources and organizing information around the interests and priorities of citizens.

Information sharing that will lead to new knowledge fields poses more than a management challenge, it posses a governance challenge and therefore must be supported by the right kinds of governance structures, as well as a change in existing political and public service cultures. Starting in the right place and understanding that these changes only happen in degrees will be critical to success. It is suggested that governments should begin by distinguishing information sharing initiatives that rest on collaboration (favourable subjects might include children, sustainable cities or other "horizontal" issues of importance to citizens) from those that lead to a political tug of war over territory and responsibilities. Designing a governance framework in the form of councils where governments - multiple sectors and layers - and other stakeholders could begin by working together to set the principles, goals and values that would guide information sharing should follow. Doing so, however, involves a complex mix of analysis and political choice.

The experience of Canada reflects the difficulties in achieving the above but also illustrates interesting possibilities for the future of collaborative councils. In an example indicative of the challenges involved in collaboration, the Canadian National Health Council attempted to collect, integrate and share information on the performance of the health care system as a whole in Canada with a view to ultimately leading to better policy development, programme evaluation, and accountability to citizens. However, health care is under the jurisdiction of the provinces and issues of territory vis a vis the federal government arose and therefore the political tug of war ensued. With regard to future possibilities, there is a proposal to establish a "Crossing Boundaries National Council", a new kind of forum to champion the transformation and improvement of government and governance in the 21st century. The council would be composed of senior public servants, elected officials from federal and provincial governments, representatives from municipal governments, territories, Aboriginal organizations, and eventually civil society and the private sector – all of whom will serve in their individual capacity. Its mission would be to promote more inclusive governance through the use of deliberative processes, and the transformation of government services and practices to make government more citizen-centred, outcome oriented, transparent and accountable. Information and knowledge sharing and ICT tools are key for achieving this transformation. Pilot projects will be undertaken across jurisdictional boundaries.

IV.3.4 Discussion

The discussion on knowledge in the public sector concentrated on the issue of cultural and structural change. While cultural change is necessary in most cases, there may be some instances where there are good reasons why government structures are not changing and some justifications for hierarchy. These very same reasons, along with different mandates and constituencies, and may also explain why the public sector lags behind the private sector in knowledge management initiatives. In addition to cultural issues, governments are advised to focus on the competence aspect and to bear in mind that while technology is an important factor in knowledge management, in OECD countries between 70-100% of all large technology projects failed. It was also suggested that knowledge management is ultimately only a facilitator and that good governance remains the most important factor in improving the functioning of the public sector.

V. CONCLUSIONS AND RECOMMENDATIONS

The Ad Hoc Expert Group Meeting on Knowledge Systems for Development illustrated the difficulty with addressing the many facets of the knowledge society in a cohesive manner in that there are multiple interpretations of what this means and many different prescriptions for the realization of its potential, especially given the contextualized nature of knowledge. In bringing together experts from different backgrounds and approaches, the meeting represented a microcosm of some of the views one might find at the national level. What became clear is that there is considerable interest in this subject and there is a need for further discussion and refinement of concepts. The meeting resulted in a more fluid debate where topics were interwoven and commonalities in positions identified, rather than specific recommendations reached under each theme. Following are several general issues and conclusions which emerged from the discussions and which many of the experts and DPADM feel warrant closer examination.

A New Vision of the Knowledge Society

Many discussions of the knowledge society tend to frame the debate as one of "transitions", especially transitions to the more one dimensional - but still important - knowledge economy. Yet it has become evident that this is not an entirely accurate portrayal of the state of knowledge capacities in societies, nor is it reflective of the complexities of the knowledge society. Knowledge as a whole is not something that exists in some places and not in others. It is not the monopoly of the North or West. Additionally, the knowledge society, while having certain signposts, is not something that has definitive goalposts. Indeed, it is not something that a country transitions into as such.

Moreover, it was felt that explanations of the knowledge society in terms of traditional economics is restrictive and does not properly take into account the unique dynamics and features of knowledge as distinct from standard goods and services. Knowledge largely does not obey economic models developed for the industrial era. The value of knowledge and the combination of factors and ideas is exponentially increased and not linear in nature (1 mind plus 1 mind does not equal 2 minds, but can equal hundreds of new ideas). Indeed, there was a strong call for new definitions and theories to explain the knowledge society that are interdisciplinary in nature.

It was recommended an alternative vision of the knowledge society is adopted, one that is predicated upon the following values, principles and understandings:

- All societies are knowledge societies.
- Knowledge societies should seek to maximize human development.
- The knowledge society should espouse the values of openness, diversity, tolerance and inclusiveness, as well as respect creativity and accept some uncertainty.
- The knowledge society is highly dynamic.
- It is necessary to find common ground between the "I" (advancing the individual) and the "We" (advancing the community) approaches to knowledge society development.
- Knowledge societies should maximize public value (versus rent seeking in the public sector or pure private value).
- Knowledge societies depend on embracing different types and forms of knowledge from varied sources.
- Social knowledge is as important as economic or productive knowledge.
- It should be recognized that knowledge is political.
- Governance of the knowledge society and policy matter.
- Ethics and the attempt to prevent against misuse and abuse must be better addressed.

Reframing the debate of the knowledge society in these terms focuses discussion on human dimensions, on a more holistic vision of where we want to go that is consistent with the Millennium Declaration, and it has implications for the practical steps in how to get there.

Governance of the Knowledge Society

In attempting to move from broader ethical frameworks to concrete reality, the issue of governance of the knowledge society - from the perspective of creation, exchange and utilization of knowledge - must be addressed. As "one size fits all" models are not appropriate for development in general and the development of the knowledge society in particular, various structures of knowledge governance which are responsive to local needs and conditions and result in nationally appropriate policies and priorities are necessary to establish.

The meeting emphasized that the knowledge society must have in place a sound system of governance that adequately allows for competing values to be heard, acted upon and integrated into official policy. This is critical given that consensus may be difficult to achieve and different parts of society will have divergent views as to what constitutes valuable knowledge. Governance frameworks should also respond to questions of what aspects of the knowledge society can and should be governed (e.g. economic, cultural, and social elements), who decides on priorities, what are the channels of participation, how are society's transaction costs determined, how is funding allocated, and the like. However, another function of such a knowledge governance framework would also help to ensure that *public value*, as opposed to private value or elite public value, is captured.

Though the meeting did not discuss in depth the specifics of knowledge governance, there are several factors that were highlighted and warrant greater study in the future.

The critical importance of *institutions* in the knowledge governance process was cited. Institutions can be formal and informal, political and social. Of the formal and political types, they play a myriad of roles from developing infrastructure, to setting enabling policy, conditions and incentive systems, to making available public stores of information, to investing in research, development and education. However, whether these traditional institutions and their functions are adequate for the demands of the present day and emerging knowledge society remains questionable. Indeed, new imperatives have arisen which require a greater flexibility and responsiveness of these institutions. Also, with a new multidisciplinary knowledge theory, as called for above, and based on experiences with multisectoral knowledge policies, it is evident that new or enhanced mechanisms of institutional coordination and collaboration should be sought. Further, in a globalized world, greater efforts need to be made at connecting the national with the international governance regimes and institutions. Examples of institutions meeting these new realities, the conditions under which they been successful, and how social and informal institutions – existing and new – support and direct the development of the knowledge society should be further explored.

In addition to addressing the necessary institutional development and capacity building, there is also a need to concentrate on the *role of the individual and civil society* in the governance of the knowledge society. It is widely recognized that much knowledge resides within the individual. Additionally, in terms of determining the direction of the knowledge society within the human development framework, the participation of the public is indispensable. Knowledge processes should support what people want - as opposed to what is good for a single sub-sector - via definition, examination, challenge to and possible adjustment of purpose. Therefore, new channels for participation of the individual as a social citizen and playing various roles such as that of producer, end-user, mediator and decision maker should be sought. This raises issues of democratization of the knowledge society and a need for the creation of a public space where citizens can contribute to "politically useful knowledge".

Knowledge *networking* as one form of governance has been proposed as a means of meeting the institutional and participation challenges, as well as being philosophically aligned with the proposed new vision of the knowledge society. Networking is seen as a means to engage the local and grassroots, communicate tacit knowledge, encourage democratic debate, and lead to the creation of new coalitions of partners and collaboration. It can potentially represent a model of inclusiveness and better capture social and cultural processes of knowledge development, utilization and dissemination. Examples of networking abound but questions remain as to how these are connected to policy making and implementation. However, with regard to knowledge dissemination and education and especially where the infrastructure does not yet support networking, traditional media should not be marginalized.

In the end, how a society organizes itself and the development and building of these institutions and an inclusive governance architecture will likely come down to *political processes* and decisions and will ultimately depend on the will of key stakeholders. Moreover, issues of rule of law, trust in government and other fundamentals of good governance cannot be ignored.

Acceleration of the Knowledge Society

Under the proposition that all societies are knowledge societies, one can differentiate between nations according to their *rate of creation, dissemination and utilization of knowledge* (explicit and tacit) and broadly categorize them as: regressing – societies organized not to know; stagnating – societies that are chaotic, random or accidental in their organization; and advancing – societies that are organized for acceleration. Recently, by application of ICT, the rate of acceleration has increased exponentially so that a qualitative gap appears between those that organize to know (and use what they know) and others. At a point still difficult to define, they start to appear and behave differently, hence the illusion that they and only they are the "knowledge societies" or that they and only they are "advanced" in the process of "transition" to it. However, a knowledge society is not a phase of development that should be achieved, proclaimed as a success and protected. With human creativity at its basis, it can be a process that can advance and even accelerate endlessly.

The rate of production, distribution and utilization of knowledge has always been possible to regulate in part by adopting appropriate policies and practices. Such policies demarcate the space in which creativity can flourish and in which the broadly understood cost of knowledge is low and falling. Policies can expand this space or shrink it. The meeting highlighted the types of policies and practices which can support the acceleration of the knowledge society. Some examples follow:

- A single cohesive approach to a knowledge strategy that encompasses all aspects of the knowledge society remains elusive and may not be practical. Policy and strategy should be realistic and accompanied by a strong implementation plan.
- Understanding the dynamics between and connecting different sectors and policies through integrated frameworks is as important as developing and implementing sectoral policy.
- Niche identification in knowledge production and contextualization of knowledge policy and practices is essential, as is learning - not copying - from other countries facing similar conditions.
- In addition to considering knowledge for economic production, policies should focus on sectors and industries that promote other forms of creativity and innovation.
- Tradeoffs of knowledge related policies (stability vs. adaptability, access to knowledge vs. privacy) should be addressed and negative effects ameliorated.
- Policies concerning access, use and effective use should be further distinguished.
- Access costs to knowledge, be they technical, institutional, cultural, or the like, will help determine the progress of the knowledge society.

- Competence of individuals, the private sector and the public sector to create, disseminate and use knowledge and to develop and implement knowledge policy should be a central focus.
- Enhancement of creative thinking and learning are essential.
- Foresight policies and anticipation of future knowledge demands are important to acceleration.

Further research on the degree to which most national approaches are in fact meeting these objectives is needed.

In considering the variables that might constitute elements of a national knowledge system, the meeting also examined whether there are possibilities for measuring knowledge assets at the national level and developing an understanding of where a society stands on this regressing-stagnating-advancing continuum. Efforts to benchmark and measure national knowledge assets and capacities may better direct policy and practical interventions towards acceleration.

There are multiple methodologies available for measuring knowledge assets, some of which have made efforts at capturing national level and public sector aspects of the knowledge society, and many of which take a firm level or private sector approach. However, if a new vision of the knowledge society is being promoted and new theories and definitions being proposed, measurement methodologies should reflect these new frameworks. In line with the human development rubric of the knowledge society, methodologies should first determine what variables are worth measuring and what can be measured (are, for instance, tacit knowledge and knowledge dynamics measurable). Methodologies might attempt to answer the feasibility of measuring the rate at which societies are accelerating and the expansion of the public space for knowledge creation as key indicators of progress.

Knowledge in the Public Sector

To date, many governments' considerations of knowledge and knowledge management have come in the form of discourse and initiatives on e-government. However, when speaking of the role of knowledge within the public sector, e-government is only one component. In some cases governments, such as many OECD member states, are beginning to pay greater attention to how knowledge differs from information, how it can best be captured, transmitted and used, and how it affects policy development and implementation and public sector reform.

Governments largely see the benefits of employing knowledge more effectively and knowledge management in public sector to include improvements in: organizational memory, learning, transfer of expertise, integrating information from the outside (including from citizens), planning, decision-making, public services, empowerment of civil servants, efficiency, transparency, horizontal cooperation, and the attractiveness of public organizations.

Yet, implementation has posed a number of challenges and many expectations have not yet been met. Experience thus far has yielded a number of lessons and challenges:

- Public sector management and knowledge management should be considered together.
- Developing a common understanding of knowledge management and identifying different types of knowledge, as well as different government functions and processes - e.g. recurrent administrative, individual decision-making, and democratic deliberation - and how they can be integrated, is fundamental to any knowledge management scheme.
- Information and knowledge should be seen as a public resource.
- Government agencies tend to be unaware of the rich knowledge they posses and lack understanding that government workers are knowledge workers.

- Knowledge is not generally viewed as an asset by many government agencies.
- In terms of implementation, support of management, adequate funding and accountability is critical and generally government wide knowledge management efforts fare better.
- It has been found that the greater stability of an organization supports knowledge management efforts.
- Knowledge management is not about technology.
- Privacy and security implications of knowledge management must be addressed.
- There still remains a significant challenge in converting knowledge into action.
- Culture, long term commitment and adaptivity are more important than knowledge management labels.

In addition to knowledge management initiatives, governments must carefully examine what increased knowledge flows will mean for processes and functions of governing. There are significant implications for the ways in which government does business. It has been suggested that successfully using knowledge to improve policy making and implementation may require more collaborative and multidisciplinary mechanisms for governance across broader "knowledge fields". This may necessitate the development of new governance structures such as multi-sectoral forums or councils.

However, while the role of knowledge in the development and effectiveness of the public sector is multiple, its potential will be severely limited if at the basis of these initiatives, public sector reform and a commitment to good governance is not being pursued.

Another indirect effect of the knowledge society for governance is that in creating a public space for politically useful knowledge to be exchanged, as called for above, the good governance agenda itself is advanced by encouraging participation and inclusiveness and upholding certain human rights at the national level such as freedom of expression and even international human rights norms such as the right to information. To the extent that knowledge is very localized and contextual, any effort to properly tap and distribute it in a meaningful way necessitates greater consideration of decentralization issues – a very important component of good governance reform.

Moreover, in actively acquiring knowledge from citizens on a variety of development related issues, governments may be better able to more effectively meet the socio-economic Millennium Development Goals.

Looking Forward

In accelerating towards a participatory and human centered knowledge society, there are a number of steps that governments and the UN system can undertake.

National governments should actively:

- Consider and promote the knowledge society in the framework of human development and the Millennium Declaration.
- Actively pursue appropriate knowledge related strategies and policies.
- Maximize public value in developing their knowledge agendas.
- Create public spaces and mechanisms for participation in the knowledge society.
- More effectively use knowledge within government processes and integrate knowledge creation, management, and utilization with public sector reform and e-government efforts.

In the vast landscape of the knowledge society, both the governance of knowledge and the impact of knowledge on governance are two areas where DPADM hopes to contribute to the ongoing debate.

As such, the following activities may be pursued in order to create useful analytical frameworks and tools for UN member states:

- Examination of the nature and prevalence of: policy measures that accelerate the knowledge society; practices and tools that accelerate (institutions, partnerships, diagnostic assessments, learning processes); and skills that accelerate.
- Examination of the knowledge practices in the public sector that enhance: learning organizations, new structures of collaboration and multi-disciplinary policy development and implementation, decentralization, and participation.

VII. ANNEX

Agenda

Thursday, 4 September 2003

Day One

9:30 – 9:45	**Opening Session: Welcome and Introduction to the Meeting** *(15 minutes)* Speaker: Mr Guido Bertucci, Director, DPADM/UNDESA Speaker: Mr. Jerzy Szeremeta, Chief, Knowledge Management Branch, DPADM/UNDESA
9:45-11:00	**Session I: The Knowledge Society** Keynote Presentation *"The Knowledge Society: Theoretical and Historical Underpinnings"* *(35 minutes)* Speaker: Joel Mokyr, Northwestern University Discussant **"Rethinking Ethics of Development: A Human Centred Knowledge Agenda"** *(25 minutes)* Speaker: K Gill, Brighton University General Discussion *(Approximately 15 minutes)*
11:00 – 11:30	Break
11:30 – 13:30	**Session II: National Knowledge Systems** Keynote Presentation "Futures of Knowledge for Development Strategies: Moving from Rhetoric to Reality" *(35 minutes)* Speaker: Paul Dufour, IDRC Discussant "**Beyond National Knowledge Systems: Designing a Framework for Knowledge Societies of the Future"** *(25 minutes)* Speaker: Shalini Venturelli, American University

Discussant
"Knowledge Based Estonia"
(25 minutes)
Speaker: Kristi Hakkaja, Estonia Research and Development Council

General Discussion
(*Approximately 35 minutes*)

13:30-15:00 Lunch

15:00- 16:15 **Session III: Measuring Knowledge Assets**

Keynote Presentation
"Measuring National Knowledge Assets of a Nation: Knowledge Systems for Development"
(35 minutes)
Speaker: Yogesh Malhotra, Syracuse University

Discussant
"Measuring Knowledge Assets: Malaysia's Knowledge Imperative Index Version 2"
(25 minutes)
Speaker: K.J. John, MIMOS, Malaysia

16:15-16:45 Break

16:45-17:30 General discussion
(Approximately 45 minutes)

Friday, 5 September 2003

Day Two

9:30 – 11:30 **Session IV: Knowledge in the Public Sector**

Keynote Presentation:
"Knowledge Management for Government: Enhancing the Quality of Public Service"
(35 minutes)
Speaker: Maria Wimmer, Linz University

Discussant
"Myths and Findings: Results of the OECD Knowledge Management in Government Survey"
(25 minutes)
Speaker: Elsa Pilichowski, OECD

Discussant
"Information Sharing: Toward Collaborative Governance"
(25 minutes)

Speaker: Donald Lenihan, Crossing Boundaries, Canada
General Discussion
(*Approximately 35 minutes*)

11:30 – 12:00 Break

12:00– 13:00 **Session V: Conclusions and Recommendations on the Role of the UN**

Presentation of conclusions:
"**What have we Discovered? What have we Agreed?"**
(25 minutes)
Speaker: UNDESA

Discussion and closing of the Workshop