TRANS-DISCIPLINARY INDUCTION.

The Competitiveness of Nations in a Gl

TRANS-DISCIPLINARY INDUCTIO
A Primer on Knowledge

Harry Hillman Ch

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Content

Abstract

The article presents a model of ‘knowledge about knowledge’ constructed using

trans-disciplinary induction. Knowledge is first treated as a Monad based on the undifferentiated biological human need to know, the immeasurability and incommensurability of knowledge and its general expression through inherently limited and biased human languages including mathematics. The Monad breaks out into a Dyad of two distinct yet inter-related and inter-penetrating realms of knowing by Science (reduction) and Design (construction). Knowledge takes form as a primary Triad of personal & tacit, codified and tooled knowledge. These forms, in turn, find expression as economic inputs (personal & tacit labour, codified & tooled capital and toolable natural resources) and as final outputs of a knowledge-based economy (the Person, Code and

Work). Each form takes its content from a set of knowledge Qubits. A qubit (or four-fold bit of information) is used in physics, genomics and analytic psychology. From the event horizon of five disciplines of thought and sixteen of their sub-disciplines plus etymology six knowledge qubits were identified (etymological, psychological, epistemological, pedagogical, legal and economic). The model as a whole (MDTQ) is quintessentially subject to the changing policy posture of government as custodian, facilitator, patron, architect and/or engineer of the national knowledge-base including the national innovation system.

Introduction

Methodology is the organized means by which k
about something is acquired. That 'something' ma
subatomic foundation of a chemical reaction, intellectua
rights among Fourth World peoples, altered states of cons

the history of the automobile, echoes of the Big Ban meaning of truth, love, beauty, destiny or justice. The means to know about something varies according to t under investigation as do the rules of evidence and the instruments for its collection in any given discipline of When that 'something' is knowledge itself, however, or meta-methodological dilemma. Understanding a system requires a perspective or vantage point higher than or co above the object under investigation. How can one attain that transcends knowledge? How can one know all its do forms or all its faculties of acquisition? Such questions metaphysics, itself, of course, a discipline of thought.

To acquire 'knowledge about knowledge' I develop disciplinary induction (TDI). It is, in a way, the logical o my research career to date. TDI may, or may not, prove other scholars facing a meta-methodological dilemma. but only they will be able to tell. In this paper I define briefly compare it to 'traditional' interdisciplinary res Piaget (1973). I then report, in progressively more a form, results of TDI's application to the question of my di the competitiveness of nations in a global knowle economy.

Definition

Trans-

I begin with the prefix 'trans' which derives from meaning "across, to or on the farther side of, beyond, biochemistry and biology, it has the additional me 'transfer', *e.g.*, of genes across species, *i.e.*, trans-gene *trans*-, prefix, 10. Biochem. and Biol.). In addition, as an trans- conveys the sense of 'beyond, surpassing, transcen trans-human. I use the word in the sense of transferring 'k about knowledge' across disciplines in the hope of a transcendent understanding or overview of 'knowled knowledge'.

Trans-, however, must be contrasted with 'inter-' Piaget's 1973 *Main Trends in Inter-Disciplinary Researc* too is a prefix deriving from the Latin but meaning

among, amid, in between, in the midst" (OED, *inte*
etymology). In this sense, inter-disciplinary means
between disciplines and sharing, not transcendi
observations and findings. Piaget also restricts consid
inter-disciplinary studies among the natural & engin
experimental sciences with a concluding extension to th
sciences'. He thereby excludes the Arts and the human
consideration. Furthermore, his analysis is rooted in the '
tradition of Logical Empiricism in which empiricism is
linguistic terms as the common rules of grammar, vocab
syntax

used by different disciplines to 'prove' their findings. This
of course, non-linguistic, non-codifiable forms of knowl
as the aesthetic experience, which disappears under analys
ignores what David Baird calls 'thing knowledge' (Baird 2
rather what I call 'tooled knowledge', *i.e.*, knowing th
existential extension of our physical selves using sensors,
toys.

Disciplinary

The word 'discipline' derives from the Old French
"instruction of disciples". Discipline is concerned with th
or exercise of a disciple in contrast to 'doctrine' whic
property of the doctor or teacher" who is concerned wit
theory or dogma (OED, *discipline*, etymology). Put an
discipline concerns what is practiced and doctrine concer
taught and thought, *i.e.*, a body or system of principles
How it is taught is pedagogy, *i.e.*, "the art or science of
(OED, *pedagogy*, 1).

For my immediate purposes, discipline will be def
department of learning or knowledge; a science or
educational aspect" (OED, *discipline*, n, 2). Such departm
to be institutional, not just abstract. Since Plato's Acad
have been reified as organizational and physical structures

Now, as then, entry and exit is controlled, initiates s
and doctrine regulated. Once admitted, initiates ris

hierarchy first teaching what once they were taught
administering the organization and/or adding to the
interpretation of doctrine. This corresponds to: "the s
method by which order is maintained in a church, an
exercised over the conduct of its members; the procedure
this is carried out; the exercise of the power of censure, ad
excommunication, or other penal measures" (OED, *dis*
6a). Put another way, the organization of disciplinary kno
by definition, institutional, with barriers to entry erected
admission and then supervise training, qualification and p

Disciplinary practice in the Church took the
doctrinaire monastic orders – Benedictine, Cistercian, C
Franciscans, Jesuit, *etc.* (Cantor 1969). This changed with
of the self-governing university, independent of Church
during the twelfth and thirteenth centuries of the Com
(C.E.). At its beginnings, the university was an inc
association of teachers, as in Paris, or of students, as i
(Schumpeter 1954, 77-78). Oxford University, the firs
university, founded in 1167 C.E., was modeled on the Un
Paris. The university broke the monopoly of knowledge h
Church and its monasteries. The universities quickly a
libraries of their own including works not approved by th
Secular monarchs granted the universities charters defi
rights, freedoms and obligations to the Crown (similar
guilds) and then cultivated and supported them not just fo
of knowledge but as a source of talent to balance the influe
Church.

2

The medieval university was typically organized i
primary domains of philosophy (literally 'the love of kn
natural, moral and metaphysical. To these, the practice
knowledge) or self-regulating professions of law and medi
added as distinct, quasi-independent branches of
Excepting the practices, the university taught the 'Liberal
knowledge suitable for the edification of gentlemen an
This included music, the only Art originally admitte
university and which acquired its own home in acad
Conservatory.

Specialized university departments and facult paralleled, in the 'real' world', by a spectrum of guilds prac 'mysteries' (Houghton 1941) of the Mechanical Arts. To the mind and the word was noble; to work with the hand Arguably, this bifurcation of 'knowledge-for-knowledge's- 'knowledge-for-practice' is evidenced, for exan contemporary distinctions between science and techno between management and labour.

With respect to modern disciplines, natural philoso out into the natural & engineering sciences while moral p split into the humanities & social sciences. Noneth organizational structure and rituals of the medieval continue to this day. Anachronisms include: the Bachelor of Arts and Doctor of Philosophy degrees; the robes; and, such as chancellor, dean, provost, *etc.* The word 'ana highlights a salient characteristic of knowledge, *i.e.*, it "overlapping temporal gestalten" (Emery & Trist 1972, 24 a graduating PhD on stage receiving a diploma in 21s genomics wearing robes designed in the 12th or 13th cen a mortar board, square or trencher cap from 17th centu and Cambridge (Australian University Women, *Academic* *Service*, 2004). The knowledge in the ritual and that em the diploma are from vastly different time periods overl the graduate's present - a re-linking with the past, a *relig* the natural & engineering science where new knowledge old, in other domains old knowledge often continues to be *e.g.*, while ancient Greek physics is not taught in the university, ancient Greek philosophy continues as pa curriculum and the works of King Tut, Bach and Sh continue to 'speak' to audiences.

What differentiates modern disciplines from medi however, is emphasis on *additions to* rather than *interpr* existing knowledge. This change became embodied in the university' which appeared first at the University of Berli and then spread to the United States and beyond. Em 'new' knowledge led to a progressive fissioning of the na engineering sciences into an ever increasing array of sub-c and specialties (Kuhn 1996). Each has its own differentiat

language, practices, instruments, research agenda and tal
tends to bifurcate into theoretical and practical bran
economic theory vs. economic policy. Furthermore, the t
structure of many disciplines in the humanities and socia
is culturally determined,

e.g., the French university syllabus in Sociology is differen
British and the British from the American.

This process of the splitting off (the Latin m
'science') is an example of the division and speciali
knowledge in action. It has the benefit of ever more
examination of a phenomenon but at the cost of i
incommensurability, *i.e.*, the inability to communicate k
to the uninitiated. It also has the associated costs of res
heterodox approaches and external audit, *e.g.*, inter-di
studies. In a manner of speaking, what is gained in depth
is lost in breadth of vision.

Induction

In logic, induction refers to reasoning from the spec
general in contrast to deduction which refers to reasoning
general to the specific. The word 'induction' derives
French meaning, among other things, "the action of intro
or initiating in, the knowledge of something" (OED, *induc*
is in this sense that trans-disciplinary induction
introducing, in my case, economics, to arguments and
developed in other disciplines of thought.

If induction carries the sense of increase, then
carries the sense of decrease. In fact, the word 'deductio
from the French meaning "the action of deductin
deduction, 1a). Put another way, deduction involves sim
of the complex; induction involves the complication of th
in this case, of the word 'knowledge'. Deduction serves as
of reductionism in the natural and engineering sciences as
the social sciences practicing 'calculatory rationalism'.

Trans-disciplinary induction can be expressed
complimentary ways. First, as in semiotics and analytic ps

knowledge about a given phenomenon - in this ca knowledge – can be seen symbolically. In effect, trans-di induction involves a circumambulation around the questi at it from as many different perspectives as poss interpreting specific disciplinary findings as symbolic c more numinous meaning (Neumann 1954, 7).

Second, a discipline can be likened to a blacl complexity into which relevant evidence and argument flo event horizon. Using this metaphor, trans-disciplinary tries to capture, cream off, harvest or otherwise pick off 'k about knowledge' from the event horizon before it is sucke black hole where it becomes enmeshed in often he complex internalist debate specific to a discipline economics of Keynes *vs.* Keynesian Economics. To a de skimming is only now becoming possible because of w research libraries such as JSTOR at the University of Chica

For my purposes, and excluding etymology (the o meaning of words which is used throughout), the event h five disciplines including economics, philosophy, sociolog

'interdisciplinary' fields of study - science and technolo surveyed (Exhibit 1: Trans-disciplinary Event Horizon sixteen of their sub-disciplines evidence and argur harvested.

Weaknesses, Strengths & Application

Like any methodology, TDI has weaknesses as strengths. Its strengths lay in the breadth of vision it contri weaknesses, however, are many. First, it relies on langua can articulate some but not all forms of knowledge, *e.g.*, 'tacit' knowledge that by definition is not, or cannot be, co Polanyi 1962a). In this way TDI is like all linguis methodologies and has similar difficulties in treating phe such as the aesthetic experience, "works of tecl intelligence" (Aldrich 1969, 381), 'instrumental realism' (I and 'instrumental epistemology' (Baird 2004).

Second, TDI is akin to sophistry: one builds the stro

from supporting evidence and argument, ignoring, defle
seldom refuting contrary evidence. TDI is therefore i
subjective and dependent on the experience, skill and et
practionner.

Third, TDI, like medieval scholasticism, relies on While evidence is gathered from experts, their contribu generally subject to dispute and debate internal to t respective disciplines. Furthermore, one must gather thei using one's own 'external' reading (Loasby 1967, 172-173)

Fourth, each TDI researcher will be strong in so while weak in others. True polymaths are probably Experimenter expectation or bias can also be expected. Bu suggests, even the choice of which normal science puzzle influenced by a natural scientist's culture, experience and (Kuhn 1996, 128). To this degree, even the natural & en sciences are value-laden.

For all its weaknesses, TDI is, to paraphrase Boulding: "better than nothing" (Boulding 1966, 3). Furth does offer a breadth of vision compensating for the narr disciplinary focus. In this regard, TDI fosters formation – of a design, metaphor, pattern or theme that may symbol up the phenomenon.

I will now report results of TDI applied to the quest competitiveness of nations in a global knowledge-based 'Knowledge about knowledge' is presented as: a Platonic M

indivisible unity; a Dyad consisting of Science & Des distinct yet related Triads expressing knowledge as form, output; and, six Qubits or four-fold measures of knowled from etymology, psychology, epistemology, pedagogy, economics. Finally, I will use this paradigm (MDTQ) to e competitiveness of nations in a global knowledge-based (Exhibit 2: Competitiveness Paradigm). I advise the read purposes of this paper more detail is offered concerning k as a Monad and Dyad with progressively less detail pre Triads and Qubits. I also de-emphasize the economics. inverse of my dissertation.

As Monad

'Knowledge about knowledge' can be viewed as a Platonic
an indivisible unit of being like the atom of the ancient Gre
could not be split. Of course, knowledge comes in many
forms; it is acquired in various ways; and, it has many
sources. Nonetheless, considered as a Monad, it exh
irreducible characteristics: it is a biological imperative or
food and shelter; it is immeasurable; it is incommensurab
is generally communicated through a human language, all
including mathematics (Boulding 1955), is subject to inh
inevitable limitation.

Biological Need

Knowledge literally begins with the dawn o
consciousness. It arrived in a phylogenetic instant of self-a
with the appearance of our species *homo sapiens* (literally
that knows') some 300,000 years ago and of our sub-spe
sapiens sapiens (the man that knows that he knows) ab
30,000 years ago. Subsequently each of us experi
individual ontogenetic instant, repeated generation after g
when we emerge out of infancy into self-reflective consc
'To know' is *the* defining characteristic of our s
characteristic rooted in our subjective, individual, biologi
then shaped and directed according to the institutional, r
social norms of a specific human society. And, as will be
need to know invokes many different faculties, not just r
logic and functions in many domains.

The biological imperative 'to know' is apparent in at
ways:

first, ultimately only the individual human being can 'kn
Books and computers do not know that they know, nor
other species, at least on this planet. Companies, corpo
and governments or, in Common Law, 'legal persons', c
know. Only the solitary flesh and blood 'natural person'
know;

second, being organic, knowledge mutates, flows back a
selectively feeding on itself, growing and developing. Th

Exhibit 2: Competitiveness Paradigm

two different streams of knowledge meet in a single indi
they tend to interact mutating into new knowledge or connexions;

third, osmotic pressure forces high concentrations of kn
from one domain across semi-permeable social and ins
membranes into other domains. Two examples demon
monitor scientific experiments German physicist Ferdin
Braun developed the first cathode-ray oscilloscope in 18
Industry quickly adopted it to monitor production activ
turn, industry converted it into the ubiquitous television
occupies our living room and connects us to the wider w
second example is from theology. After the fall of Rome
Christian Church invested heavily in theology. This new
knowledge spread into every corner of Christian life fost
some activities, (*e.g.*, religious painting and cathedral construction) while inhibiting others (*e.g.*, a banking sys
charging interest); and,

fourth, given the biological imperative one faces a wicke
complex set of questions. How do we know in terms of
bundles and pathways? Who, in a psychiatric sense, kn
ego consciousness does not? What is the difference betw
knowing in the subjective sense of aesthetic, moral and values and in the objective sense of the angular spin of e
or the genetic alphabet of life? Where in the modularize
do we know, *e.g.*, in a specific part of the brain stem or transcendent to its component parts?

The questions continue. What is the relationship
knowing and memory? Where does knowledge go wh
thought? Does what we know correspond to an externa
truth or reality? Or is what we know relative and subje
contextual to time, place, culture and person? How
knowledge of the individual coalesce into human culture?

Immeasurability

The immeasurability of knowledge can be demon the distinction between information and knowledge ma (Bouthillier & Shearer 2002) or between 'bits' and 'wits' 1966). Information theory involves storage and transn human knowledge in electronic rather than hardcopy or format. These remain the domain of library science and t Decimal System. Storage involves audio-video disc databases, hard drives, e-books, *etc.* Transmission and requires hardware such as computers, radios, television se Internet. 'Analogue' content is digitized for stor transmission then reconverted into human-readable format, *e.g.*, sounds, pictures and words. The unit of digi the binary on/off 'bit': 0, 1.

The 'bit', however, abstracts from the content of transmitted information. The same number of bits coul from a telephone conversation between two teen-age Saskatoon or between the Presidents of the United State Russian Federation. Bits don't discriminate. Develope world of telecommunications and computers, the bit lenc quantitative analysis. It does not, however, provide a hor unit of knowledge, or what Kenneth

Boulding calls 'the wit' (Boulding 1966, 2). The bit also allowance for ignorance, *i.e.*, the absence of knowledge. wit, we are restricted to qualitative or descriptive Accordingly, in what follows no attempt is made to qua 'test'. The argument stands or falls on logic and beli However, to paraphrase Kenneth Boulding, "this is be nothing" (Boulding 1966, 3).

Immeasurability, however, has not stopped ec among others. The 'utile' – Jeremy Bentham's unit m pleasure and pain – is the foundation stone of modern analysis. We cannot, however, measure the pleasure and individual, nor can we add it up across individuals using *calculus.* The measurement problem, *e.g.*, the greatest go greatest number, is finessed through *reification by proxy* let us assume the utile can be reified, *i.e.*, made con calculable, specifically as money. In this philosophy, c (suffering disutility) to earn income to buy goods and s consume them, *i.e.*, extract utility. The money price one p market theoretically reflects the utility that can be approp the consumer. Some day the 'wit' too may be reified l moment, there is no obvious proxy on the analytic horizon

Incommensurability

Beyond immeasurability, there is the incommensu knowledge. Incommensurable is an adjective meaning " … common measure except unity" (OED *incommensurab* Thus while we have knowledge about the arts, sciences ar there is no common measure other than the word 'kr itself. The incommensurability of knowledge has been id explicitly and implicitly - by scholars in a wide range of c including: Daniel Bell (sociology); Naom Chomsky (linguis Jung (psychology); Thomas Kuhn (history, philosophy, so science); Walter Lippman (journalism); Magorah M (psychology); Michael Polanyi (history, philosophy, soc science); and, Adam Smith (economics).

Incommensurability is emotionally most evident in where the *Art-for-Art's-Sake Movement*, a child of the Revolution (Henderson 1984) is continuing to generate moving, shifting and changing *avant garde* (Bell 197 spinning out increasingly esoteric aesthetic messages int ever smaller audiences, *e.g.*, atonal music and what Tom W "The Painted Word", *i.e.*, when a painting is smaller exhibition label (Wolfe 1975) to 'egalitarian realism' and ' in-the-eye' school of art (Chartrand Summer 199 incommensurability of artistic knowledge can be summed aphorism: "I know what Art is when I see it and that's not A

Noam Chomsky introduced to linguistics the a language as a genetic but abstract organ. Like the physical the body, the language organ develops through the life sta individual. Its capacity can be increased through exercis muscles of an athlete but genetic endowment and dispo be taken only so far. Chomsky uses post-Schonbergian m limiting case: "Modern music is accessible to professional be to people with a special bent but it's not accessib ordinary person who doesn't have a particular quirk of enables him to grasp modern music let alone make him wa with it" (Chomsky 1983, 172). This inaccessibility re incommensurability of knowledge.

Carl Gustav Jung, in analytic psychology, explicitly word 'incommensurability' to define the rupture betwe and faith. While both concern the same empirical wo incommensurability represents "a symptom of *consciousness* which is so characteristic of the mental d our day" and of modern society as a whole (Jung [1956] 19

In his seminal work, *The Structure of Scientific Re* Thomas Kuhn observed that specialization and puzz within the paradigm of normal science generates knowle 'incommensurable' (Kuhn, 1996, 103, 112, 148, 150 neighbouring specialties and, by extension to other k domains, disciplines and society as a whole. Semi-p barriers or paradigms separate specialties fostering spe has generated dramatic growth in our knowledge and con physical world. The very success of the natural sciences, i argued, rests on the axiom: "good paradigms ma neighbours" (Fuller 2000, 7). This specialization by para Price to coin the phrase 'invisible colleges' to describe th fifty people in the entire world who can understand wha said or written in any given specialty of the natural and en sciences (Price 1963).

If the invisible college symbolizes the incommensu specialized knowledge, then public opinion represe insertion between man and his environment of a environment" (Lippman 1922, 15). Knowledge of this environment is incommensurable with immediate experience. In a complex society, one's immediate sur are part of a much larger environment about which one only indirect knowledge or experience. Knowledge of t

world is derived not through the senses but through wh
Lippman called *Public Opinion* in his study of propagand
mass media during the First World War (Lippman 1922
introduction entitled "The World Outside and the Pictur
Heads', Lippman uses the poignant example of a few
French and German nationals living on an isolated islan
where "for six strange weeks they had acted as if they wer
when in fact they were enemies" (Lippman 1922, 3).

Psychiatrist Magorah Maruyama whose work incluc
of human space settlements coined the term 'paradig
capturing the incommensurability of knowledge betweer
professional practices confronting the same objective phe
(Maruyama 1974). Consider a social worker consulting
family made up of an alcoholic father, a promiscuous m
delinquent children. This is an objective reality that can
using a language that permits communication betw
professional and the client. The social

worker returns to an office where this 'objective reality' is
using another language with colleagues. In turn, the ca
reports to an administrative supervisor (in yet another
who, in turn, reports to a 'political master' using ye
language. It is the same objective reality yet different p
come into play. And these paradigms exhibit varying c
incommensurability.

Michael Polanyi writes explicitly of incommer
between what subsequently become known as codified
knowledge in technical performance (1962a, 174). Else
implies that: (i) knowledge obtained through belief d
articles of faith and that derived through sci
incommensurate; (M.Polanyi 1952, 217) and, (ii) scien
technological knowledge are incommensurate reflec
profound distinction between science and technology [wh
an instance of the difference between the study of nature c
hand and the study of human activities and the products
activities, on the other (M.Polanyi 1960-61, 406).

Incommensurability is also implicit in Adam

argument that public education is necessary to mi
damaging, or what Marx would later call, the 'alienating'
the division and specialization of labour on workers' min
worker, Smith wrote: "his dexterity at his own partic
seems, in this manner, to be acquired at the expen
intellectual, social, and martial virtues" (Smith 1776). T
shadow-side of the contemporary division and special
knowledge, a wraith that Adam Smith foresaw.

Language

Trans-disciplinary induction can arguably accomm
biological imperative to know as well as the immeasura
incommensurability of knowledge. It cannot, however, e
meta-methodological dilemma of language. Excepting
tooled knowledge, knowledge finds expression through
language, each of which, including mathematics (Boulding
subject to inherent conceptual and other limitations.
certainly the case with English, the language of this article.
knowledge in English, one begins with the word - its c
meaning, *i.e.*, its etymology. A word, of course, is part of a
that in turn is the foundation of the traditional 'nation' o
e.g., the Chinese, English, French, German or Japanese
nation and/or people. In addition to words or voc
languages differ in their grammar including their synta
ordering of words, and, when reduced to writing, they
alphabet (phonetic) and/or script (ideographic), *e.g.*, Cyri
Mandarin, Roman, *etc.*, and, arguably, mathematics.

Spoken and written language is a defining featu
species. It is the primary but not exclusive means by whi
knowledge is expressed and exchanged between indivi
across generations. Sometimes, however, as with th
Positivists, language is treated as synonymous with k
which leads to other forms being ignored. This has be
"semantic ascent" (Baird 2004, 8). Nonetheless, "if langua
is this all-embracing sort of activity,

stylizing most of our other activities as human beings, th
best defined, not simply as a rational animal but

symbolicum - the language-using animal" (Aldrich 1969, 38

To cite an example: Kawasaki in his analysis o education notes that in Japanese there are no proper nou Platonic sense of 'idealized forms' (Kawasaki 2002). Henc concepts such as 'the computer' or 'acceleration' have m Japanese only as specific experiential cases, not as abstract forms. He suggests this may explain why the Japanese hav in technological innovation but lagged in the pure scie contrast, the presence of abstract idealized nouns in En explain why there appears, in my survey of sixteen sub-d no etymology of the word 'knowledge'. In effect, it is tr universal, as a monad, not as a particular. But the word 'k is, as will be demonstrated, particular to the English langua

From the OED, I can report four findings. First, ther primary meanings for 'to know' by: (i) the senses; (ii) the doing; and, (iv) experience. All four are reconciled in the human being and organically interact therein, *e.g.*, son read best (know by the mind) when they can physically ha (know by the senses) rather than simply see it on a screen.

Second, as a verb 'to know' has absorbed many me the archaic verb 'to wit'. Thereby, 'to know by the se become conflated with 'to know by the mind', *i.e.*, to wit. however, 'wit' survives defining the seat of conscious natural person. This distinction - knowing through the the mind – arguably plays an important role in c distinctions between the Liberal and the Mechanical Arts Science and Technology and between Management and La

In addition to absorbing 'to wit', 'to know' has also the meaning of 'can' as in 'know how' or 'can do'. In fact, and 'can' share the root in Old English – *cnaw*. Both also root meaning of to know by acquaintance, *i.e.*, by experien in English one verb carries at least four distinct meanings by the senses, the mind, the doing and experience. In Ge contrast, there are separate verbs for each meaning.

Third, if closely related languages such as French and Scandinavian use different verbs for different sen know', then one can reasonably conclude they possess ma of subtle meaning not available in English. These mean become lumped together in English into a single word 'k that has become numinous with purpose but confusing multiple meanings.

If one extends this English etymological economy distant languages using scripts other than the Roman alph the distinct and subtle differentiations of 'knowledg Cantonese, Hindi, Mandarin, Russian, Thai, *etc.*, may sim capable of translation. It becomes 'local' knowledge sp nation and a people. Given the rate at which human lan becoming extinct,

however, many subtle meanings of 'knowledge' are lost e perhaps forever. (Sampat 2001)

<u>Fourth</u>, there is the relationship between 'k 'ignorance', 'belief' and 'opinion'. Ignorance is quite si want of knowledge" (OED, *ignorance*, 1a). And if 'k derives from reason then 'belief' derives from some other is held with emotional certainty (OED *know*, v., 10a). while opinion may derive from reason or other faculties it a probability, not a certainty (OED *opinion*, n., 1a).

All four meanings co-exist in each individual hum Each, however, generates distinct and sometimes conflict needs or desires to know. Collectively, the balance or blen ways of knowing constitutes an English-language knowle the *WIT*. It is a qubitic or four-fold measure of ways of k the English language, *i.e.*, by the Senses, Mind, D Experience. I will more fully define the qubit below.

Given the importance of language in theories of k *e.g.*, Logical Positivism, the *WIT* is, by definition, a limit language construct. In other languages there are probabl 'to know' expressed in English only with great difficulty, if Logical Positivists attempted to overcome this pr restricting themselves to the language of mat Mathematics, however, is a subset of language, not the around.

As Dyad

Having scanned, collected, sorted, compiled and c
argument and evidence of 'knowledge about knowledge'
event horizons of sixteen sub-disciplines, a common
pattern was induced: *Science by Design*. Since the beg
Western civilization, reason, or the Greek *logos* (from w
word 'logic' emerged), has been accepted as the preferre
knowledge (Dorter 1990, 37). It distances us from our p
frees us from the distracting world of sensation and emoti
hands of the Romans *logos* became 'reason' derived from
'ratio' as in calculate (OED, *reason*, n 1). And from the R
also derive 'Science' from the Latin *scire* "to know" whicl
derives from the Latin *scindere* "to split" (MWO).

Science

Science today is accepted as the epitome of reason
knowledge by splitting or reducing a question into sm
smaller parts or elements and, at the extreme, instr
controlling them to generate specific phenomenon (Ba
This pattern of behaviour is 'objective' in that it is ideally c
"without being influenced by personal feelings or opinior
objectivity, n). This form of objectivity attains its apothe
scientific instrument generating knowledge about the
world without the intermediation of a human subject (Ba
Idhe 1991; Mitcham 1994).

The reductionism of Science extends beyond metho
epistemology, *i.e.*, the theory of knowledge. Knowledge
been split into domains, disciplines, faculties and form
adoption of the 'experimental method' in the 17th
reductive experimental instrumental science has yielded
material and intellectual benefits to humankind. It st
secondary phenomena distinguishing cause from effect re
the natural sciences the underlying 'laws of nature' (Ta
1930; Zilsel 1942), or what alternatively might be called t
or pattern of nature.

Design

Ignoring for the moment the question of consc
unconscious 'knowing' explored by analytic psycholo
[1918] 1970), "the tradition that there is a non-rationa
knowing that rivals or even surpasses rational knowledge i
philosophy itself" (Dorter 1990, 37). These two realms – th
and the non-rational – have been at odds from the beg
Western thought. And while the rational has become em
our contemporary concept of Science, the non-rati
remained a wraith taking many forms, assuming many n
evading systemic identification. To Plato it was Art; to th
Fathers it was Revelation; to the Scholastics it was analogy
Smith, it was moral sentiments; to Thomas Kuhn, it was
(1996, 155) or gestalt switching (1996, 111-14) or, in desc
root of scientific revolutions, intuition characterized b
falling from the eyes", "lightning flash" and "illuminatio
123).

Whether it is called aesthetics, art, custom, design,
gestalt, institution, intuition, paradigm, pattern constru
recognition, revelation, symbolism or technological k
there lurks behind the bright light of Science an amorph
rational way of knowing. Accordingly, the portmant
'Design' is chosen because the notion is abstract
unequivocal, clear-cut definition can be offered. In a
activity - be it art, science, politics or religion – both
knowing are at play. Differences are in balance, conc
priority and focus.

The dark realm mints a coin with two sides
construction and recognition. Both involve diverse
knowledge fitted together into a coherent whole. When thi
work of aesthetic or technological intelligence 'works', *i.e.*
awareness occurs or a physical device functions. One c
between works of aesthetic and technological intelligen
Pythagorean cognate relationship or pattern between nu
matter reflected in music and the geometry of perspective
is the ancient Greek word *techne* meaning both the 'useful
technology and the 'fine arts'.

But how can this duality be reconciled, or, in ter

Ancients, how can we achieve *enantiodromia* – a reso
opposites? One way is to simply accept their oppositio
each as appropriate. This is the solution in physics with
the particle/wave paradox of light. Alternatively, one
considered a

special case of, or descendent from, the other, *e.g.*, Sci
special case of Design, or *vice versa*.

If Design is a special case of Science then resolution
material world of DNA, neurons and brain lobes. This
however, to circular causality in neurophysiology and els
nature (Freeman 1999). Thus while higher order s
consciousness may arise from matter, the mechanisms
they arise, and how once established they sustain the
problematic at best. And a meta-methodological dilemm
know that I know and it is with this reality that I must deal
the epiphenomenal nature of my consciousness.

If, on the other hand, Science is a special case of De
we should be able to identify not just differences
commonalities. In many ways Science, especially exp
instrumental science, is an organized and collective
human behaviour, *i.e.*, a recognizable institution sometin
'The Republic of Science' (M.Polany 1962b). This is a be
pattern that, in evolutionary terms, has been laid d
recently, and remains very fragile: it is only about four
years old (Kuhn 1996, 167-168). It is so recent, in fact, th
Henderson in his analysis of psycho-cultural attitudes
religious, aesthetic and philosophic – concludes: "we can
for science… the same epistemological authenticity tha
demonstrate in the four basic cultural attitudes" (Hender
77). Henderson suggests, however, that a 'scientific atti
emerge as a hybrid of the philosophical attitude "to lin
subjectivity to a minimum in observing the nature of ma
and aesthetic objectivity in "observing nature and ma
significant distance" (Henderson 1984, 77). This aestheti
in the hands of the German poet Goethe, in fact gen
alternative 'science'. Known as 'Goethean Science', it is ex
in his *Theory of Colours* (Goethe 1810) written to refute

materialistic analysis. The power and intensity of
observation is succinctly demonstrated therein.

Another facet of being a special case of a highe
evidence of that higher order operating within the spe
Sparkes thus concludes: "pattern recognition is undo
deeply ingrained human capability, and that it should b
the kind of information processing which goes on in scie
beyond reasonable doubt" (Sparkes 1972, 41). The repea
the terms aesthetics, design, gestalt and intuition by Tho
in explaining *The Structure of Scientific Revolutions* is also
of the operation of Design within Science itself.

Even the media used by Reason and Science – lan
mathematics – can themselves be considered examples
It has thus been argued that the nature of the Greek alph
facilitated development of Western thought. Marshall
following the lead of his mentor, Harold Innis (1950, 19
that we recognize the fundamental differences bet
perception of literate and preliterate peoples but w
appreciate the impact of different alphabets. McLuhan a
only phonetically literate man lives in a 'rational' or
space. The discovery or invention of such a cognitive spac

that is uniform, continuous and connected was an envi
effect of the phonetic alphabet in the sensory life of ancie
This form of rational or pictorial space is an environ
results from no other form of writing, Hebrew, Arabic, c
(McLuhan and Logan 1977).

And if a phonetic alphabet creates a rational space in
then mathematics surely creates a 'surpra-rational' one
extreme space only the most rational of hypothese
formulated if they are to be proved. Arguably it was this p
first recognized by Pythagoras as the cognate relationship
matter and number that led the Logical Positivists t
knowledge to purely propositional terms best express
language of mathematics. From this perspective lang
mathematics are advanced forms of Design with lite
numeracy sophisticated forms of pattern recognition.

The distinction is between Science which relies on v

numbers, *i.e.*, semiotic ciphers perceived mainly by s
Design which calls on a wider range of elements of Mind a
acquired through all the senses - sight, sound, smell, t
taste. In turn, if Science is but a special case of Design
question arises as to the origins of Design itself. Our firs
homo habilis or the 'handy man' (two to three million ye
most noted for tool making. Patterning or tooling physic
(using the opposable thumb) thus precedes the symbolic p
of words and numbers by millions of years. In this regar
notes that:

> It is with our hands that, fundamentally, we perfo
> as artists in the technological operation. As such,
> soul is in our hands. *The eye may guide the hand*
> *in this case, the seeing is for the sake of the handli*
> Technological intelligence does not come to rest in
> eye or the ear. Its consummation is in the ha
> (Aldrich 1969, 382)

Even as Science explores deeper into matter and fa
into space, it too uncovers patterns or Design. The so-call
nature are in this sense examples of Design. The human
to make and see Design everywhere finds ultimate ex
rightly or wrongly, in 'The Argument from Design', a
argument for the existence of God:

> In its most fresh and innocent form, it went someth
> like this: you can tell by observing the order in
> universe that the universe has been designed. T
> implies the existence of the Designer, whom,
> Aquinas said, men call God. According to
> wonderful story that this suggested, in the Beginn
> was the Designer with his Design or Purpose. (Ald
> 1969, 379)

This is, of course, the foundation of what is k
theological circles as 'intelligent design'. On the more pr
of the competition of nations in a global knowledge-based
Alfred Lord Marshall noted long ago that: "it is every day
that it is *the pattern* which sells the things" (*emphas*
Marshall 1920, 178).

As Triad

Having split the Monad into a Dyad (Science and D are still left with abstractions that to find expression must form, *i.e.*, must be reified. Form, according to Francis Bac real or objective conditions on which a sensible quality depends for its existence" (OED, *form*, n, 4 c). Using T induced that knowledge takes three distinct forms, each of turn, can be expressed as a Triad.

Form

The primary Triad of form includes personal & taci and tooled knowledge. Personal & tacit knowledge is soma is embodied in a natural person. Codified and tooled know extra-somatic (Sagan 1977), *i.e.*, fixed in an external mater such as a book or machine. Extra-somatic knowledge meaningless artifact, however, until someone reads it or work by pushing the right buttons. This requires, o personal & tacit knowledge that comes with prac experience. Thus all knowledge is ultimately personal and

Personal & tacit knowledge is fixed in a person as bundles of memories and as the trained reflexes of ne muscles. I have developed the term from Michael seminal work *Personal Knowledge: Towards a Po Philosophy* first published in 1958 (M. Polanyi 1962 knowledge, which is strictly personal, is the experiential k of performance embodied in the trained reflexes of n muscle. Personal knowledge embodied in memory can u codified while tacit knowledge cannot.

Codified knowledge is fixed in a medium of comm that allows knowledge to cross time and space until anoth reads or decodes it. By doing so the receiver adds it to personal & tacit knowledge. This excludes machine-cod computer and genomic languages intended to be read by a or matter, not by a human mind. Codified knowledge works of aesthetic intelligence, *i.e.*, works of Art that carry meaning rather than physical function.

Works of technological intelligence embody knowledge, *i.e.*, different forms and types of knowledge designed into a functioning physical matrix as an instrun as sensors to measure the material world, tools to manipu toys to take pleasure from it. Instrument existentially e senses and grasp beyond genetic endowment. In the pro become part of ourselves; they cease to be 'other' or 'ou alien. Michael Polanyi in the philosophy of science a Heidegger in the philosophy of technology both use the h an example (Polanyi 1962a, 174-75; Idhe 1991). That k can be tooled or fixed into works of technological inte demonstrated by the common practice of reverse e (Samuelson & Scotchmer 2002). Standards and techniqu as machine-readable codes associated with the operatio of technological intelligence are treated as forms of 's knowledge.

Inputs

The secondary Triad involves knowledge as inpu economic process – capital, labour and natural resources. and tooled knowledge is fixed or frozen in an extra-somati matrix becoming marketable as 'codified & tooled' capital. & tacit knowledge is fixed in the natural person who marketable as 'personal & tacit' labour. At first glanc resources appear to have no relationship to knowle definition, they exist in "the State that Nature hath (quoting Locke, Dooley 2002, 4). They are just pa environment until the knowing mind recognizes them Thus oil lay in the ground virtually untapped until invent internal combustion engine. Just as Polanyi (1962a, 56 recognize a tool by its purpose, we similarly identi resources by the human ends we attribute to them. At a g in time a naturally occurring substance is seen as nothing of the environment, *e.g.*, bauxite ore. Take a pathway th jungle one day and you see a large rock outcrop. The next new knowledge, the same path leads not to a featu environment but to a bauxite deposit that can be conv aluminum. It has now become a 'toolable' natural resou has not changed, one day to the next, rather new knowle us to see it in a very different light.

Outputs

The tertiary knowledge Triad involves knowledge as outputs of a knowledge-based economy – the Person, the the Work. Inputs are used to fix or tool knowledge, mainstream economists believe producers fix utility, goods and services valued in-and-of-themselves (or what I because there is no other word in English describing a thi in-and-of-itself)) rather than as a means to an end. In t inputs are utilitarian and outputs are non-utilitarian. It is to note the distinction in the use of the word 'utility'. usage it means, in effect, useful for a purpose. In Ec however, it means the number of units of pleasure/pain contained in a good or service and which can be extract consumer.

Knowledge outputs are, however, ambiguous in na example, the Person can be considered a Work produce education, experience and training. A work of aesthetic in can be considered Code in that it carries semiotic meaning of technological intelligence can be considered the ex extension of the senses and grasp of the Person.

For purposes of clarity, I restrict the meaning of Per natural person as carrier of personal & tacit knowledge. Code to extra-somatic material matrices carrying semiotic and restrict Works to extra-somatic material matrices physical function, *i.e.*, the ability to measure and/or mani physical world rather than the human mind. This inclu tooled' knowledge such as standards and techniques a machine-readable instructions such as

computer and genomic code. Ultimately, however, a Co Work have meaning or function only through the age Person.

As Qubits

Two sub-disciplines of the natural sciences (su physics and genomics) suggest a common denominato

organization of information in nature – the qubit or four
The traditional binary bit of information theory (0, 1), or '
extended by these sub-disciplines to the qubit w
alternatively be expressed as (0, 1, 2, 3) or (1, 2, 3, 4).
pattern has been revealed in analytic psychology.

First, in sub-atomic physics the quark is the smalle
structure of physical nature. Quarks combine to produ
effect called hadrons, *e.g.*, protons and neutrons. Quarks
flavours and three colours – charmed, up, down, strange
bottom, red, green and blue (Nielson 2002). Weizsacker's
theory of Ur-objects argues that the foundation of physica
the quark – can be operationally described as a '
information (Lyre 1995; Card 1996). That Weizsaker's qu
just 'theory' is demonstrated by ongoing efforts to de
quantum computer based upon an implication of this
entanglement (*Economist* June 6, 2002).

Second, in genomics the informatics of DNA is
combinations of four nucleotides or a qubit made up of ad
thymine (T), guanine (G) and cytosine (C). These are alwa
A-T or C-G. A sequence of three pairs is called a codon en
amino acid. Amino acids, in turn, combine to form pro
molecular machines of life" (Hood 2002). The informatio
and processing capacity of DNA exceeds all other forms b
an order of magnitude, *e.g.*, computers.

Third, in his analytic study of the human psyche – i
as well as in the myths, fairy tales and 'black arts' of huma
throughout history – Jung uncovered that four is "the
number by which order can be created" (Jung [1954] 196
called this 'the quaternary' or 'union' in contrast to the tri
which is, in psychic terms, masculine, and the dyad (two
feminine. He also identified four basic ways of knowing
consisting of thinking, intuition, feeling and sensation – t
of which combine or entangle to generate knowledge a
consciousness. That these four ways of knowing are not ju
is demonstrated by the fact that they have spawned one o
widely used psychological testing instruments in the w
Myers-Briggs Type Indicator®.

Qubits were used to model different facets of knowl

example, there are four different etymological ways 'to k
by the senses, (2) mind, (3) doing, and, (4) experience. T
will be called a '*WIT*'. There are five 'pure' cases in which
or all four ways of knowing are engaged - (1, 0, 0, 0), (0, 2, 0
3, 0), (0, 0, 0, 4) & (1, 2, 3, 4). In most cases, however,
more than one but

less than four will be engaged, *e.g.*, (0, 2, 0, 4) or, to kn
mind and experience as in the re-processing and re-o
memories.

While absence (0) is clear, presence is not straight
Rather presence varies in intensity. For example, phy
(knowing by sensation) felt during a marathon (knowing
may be so severe as to force one to leave the race, or mild
be overcome by will power (knowing by the mind).
quarks, different components of a quibit are entangled.
this means, among other things, that having been in
contact at one point in time they remain connected or
when separated in space and time. It is this phenom
entanglement that provides the foundation for
computing. Six qubits have been identified so far. I will
from a disciplinary perspective: etymology, ps
epistemology (inclusive of pedagogy), law and economics.

Etymological *WIT*

The *WIT* is a qubitic or four-fold measure of ways o
in the English language. There are four meanings of 'to k
the Senses, Mind, Doing, and/or Experience. Three
meanings have accrued to the Old English verb 'to know',
its original meaning of to know by the senses. From the ve
has come to know by the mind, and from the verb 'can' ha
know by doing. In addition, the meaning of 'to wit' as me
of 'can do' as reflex captures the meaning of to know by e
i.e., by memory (mind) and reflex (body).

The *WIT* is, therefore, by definition, an English
construct. In other languages there may, and probably a
of 'to know' that can be expressed in English only v

difficulty, if at all. The Logical Positivists attempted to
this problem by restricting themselves to the lan
mathematics. Mathematics, however, is a subset of lang
the other way around. Similarly, English, and other
European languages use Platonic idealized nouns not fo
major languages, *e.g.,* Japanese ([Kawasaki 2002](#)).
etymological differences appear to have compe
implications.

Psychological *PSI*

The *PSI* is a qubitic measure of psychological ways o
including Reason, Revelation, Sentiment and Sensation.
individual, all four function. Like quarks, they do not ex
There are no free faculties. They exist together uniquely
as the 'self-awareness', 'consciousness', 'knowing', 'mind'
the individual human being. This uniqueness colours th
interaction of all faculties.

Epistemologic *IMP*

The *IMP* is a qubitic measure of epistemologica
knowing. These include the Natural & Engineering Scien
the Humanities & Social Sciences (HSS), the Arts (literary,

performing and visual), and the Practices or self-
professions. In brief, the NES generate knowledge
physical world. In application, they produce physical tech
manipulate matter and energy to satisfy human want,
desires. The HSS generate knowledge about being
individually and collectively in families, communities,
nation-states. When applied, they produce orga
technology, *i.e.*, the ability to shape and mold human in
and societies. The Arts generate knowledge about the hu
and emotion. In application, they produce aesthetic
technology, *i.e.*, the ability to manipulate emotion pr
'technology of the heart'. The Practices apply knowledge
practical and pressing problems of daily human life, *e.g.*,
taxes.

Pedagogic *PED*

While the *IMP* provides a qubitic measure of episte
knowledge, another can be identified at the pedago
Knowledge can thus be classified according to its domai
(d/p), discipline (d), sub-discipline (sd) and specialty
quartet constitutes the qubit *PED*. In effect, a National I
System (OECD 1997) is constructed by selecting specific k
domains and practices (*IMP*) to be preferentially encou
national governments at specific levels of concentr
domain/practice, discipline, sub-discipline and specialty (

Legal *IPR*

The *IPR* is a qubitic measure of the privatization of k
as legal property. Intellectual property rights are grant
knowledge fixed in a material matrix for a limited time.
granted to natural and legal persons. Certain rights unde
Code, but not under Anglo-American Common
"inalienable, unattachable, imprescriptible and unrenoun
the natural person (Article 11, Decision 351, Andean Co
1993). Such rights echo back to ancient animism and a
self-evident under 'natural law' (Taylor 1929, 1930), the
root of the Civil Code.

The matrix in which new knowledge is legally fixe
utilitarian as with patents & designs; non-utilitarian
copyrights & trademarks; or a person – natural or legal
trade secrets and know-how. All other knowledge (new
falls into the fourth qubitic slot, the public domain or 'k
commons'. The public domain, however, unlike
commons such as the oceans, seas and atmosphere, g
expands with exploitation. It is also historically and const
related to freedom of the press and freedom of expressio
– two foundations of popular democracy (Alstyne 2003).

Sui generis or 'one-off' rights may be fixed in any n
are usually created by selecting from and mixing the
rights collectively constituting traditional IPRs. In reality,
each national intellectual property regime is *sui generis* i
the unique cultural product of the distinctive legal hi
nation-state. This is

one reason why intellectual property rights are subjec 'national treatment' rather than harmonization under t Agreement of the WTO. Such differences serve no distinguish one nation-state from another but also pı opportunity for competitive advantage in a global knowle economy (Paquet 1990).

Economic *FLX*

The *FLX* (pronounced 'flex') is a qubitic measure of knowing, specifically of technological change. In the Model, technological change refers to the impact of new k on the production function of a firm or nation. S knowledge may be: *disembodied* or systemic to the econ as general improvements in communications or trans *embodied* in a specific piece of equipment such as the tran transistor radio; *endogenous i.e.,* developed internally to nation; and/or, *exogenous, i.e.*, developed externally to th nation.

However, the *FLX* can be lumpy and uneven. It ca negative in that 'de-industrialization' can occur whereby k moves 'off-shore' and is lost to a nation or firm or thr skilling' whereby traditional praxis is embodied in a new in and similarly lost but this time to a machine. Such knowledge is somewhat analogous to the 'Kuhn experienced in scientific revolutions in the shift from one to another (Fuller 2000). On the one hand, output may be or costs reduced; on the other hand, there is a loss of kno domestic production is replaced by foreign or advanced production. This is one reason for not using the conventi 'flow' which conveys a sense of constancy. Exogenous ch innovation of a new general purpose engines may tran entire economy (David 1990, 335). On the other hand, en tinkering on the shop floor, the 'D' or development in 'R contribute only to the specific firm. A *FLX* is a measure types of technological change or 'new knowledge' as it a production function of a nation or a firm. Such new know emerge from the NES as physical technological change,

HSS as organizational change, from the Arts as design
some combination thereof. It may also enter the p
function in the form of any or all of personal & tacit labou
& tooled capital and/or toolable natural resources.

Quintessence

TDI yielded a four-fold model of knowledge as Mon
Triad and Qubit (MDTQ). As a monad, knowledge
differentiated biological need to know. It is also imm
incommensurable and its expression, through human
including mathematics, is inherently limited and biased.
knowledge is acquired in two radically different yet relate
Science or reduction and by Design or construction. A
knowledge takes the form of personal & tacit, codified a
knowledge fixed in a person or an extra-somatic ma
marketable as an input to, or intermediate good in, the p
process as codified & tooled capital,

personal & tacit labour and toolable natural resources. K
is also marketable as a final output as a Person, Code a
The Person, however, is the ultimate input and ou
knowledge-based economy because a Code or Work has m
function only through the agency of a Person. As
knowledge from six disciplines was characterized by four
knowledge bits: the etymological *WIT*, the psychologic
epistemological *IMP*, pedagogic *PED*, legal *IPR* and econo

The resulting Competitiveness Paradigm (Exhibit 2)
a structural representation of a knowledge-based eco
worst, it is a simple taxonomical one. The question arises,
as to what links and lubricates the elements of, and fuels
as a whole? The fuel is simply the biological human need
The linkage or lubricant would constitute a quintessen
from the MDTQ model. 'Quintessence' means "the 'fifth e
ancient and mediæval philosophy, supposed to be the su
which the heavenly bodies were composed, and to be actu
in all things, the extraction of it by distillation or other
being one of the great objects of alchemy" (OED, *quintesse*
While four is the minimum number to bring order out

(Jung [1954] 1966, 46), five is the number of ch
transformation and of magic, *e.g.*, the pentangle or star of
on military aircraft of many nations.

Arguably, the quintessence of a knowledge-based ec
government. In the Standard Model of economics th
government. Under conditions of perfect competition al
internalized by producers in the market price. Ther
uncosted externalities like pollution. In turn, the consum
the market price internalizes all benefits including kn
There are no external benefits as with a public good. Th
fact, no costs or benefits external to the market transacti
is, therefore, no need for government in the economy.
the Standard Model shares this conclusion with Marxism
conditions of perfect communism there will be a 'witherin
the State'. In Leninist terms, there will be no role for the
revolutionary vanguard because the revolution wo
happened.

In a knowledge-based economy, however, governme
necessary evil that will eventually disappear. Rather it is
necessity for such an economy to exist. This is most evi
respect to the privatization of new knowledge through
intellectual property rights – copyrights & trademarks,
design & patents and know-how & trade secrets. Gov
however, plays, at one and the same time, five diffe
including that of: Custodian, Facilitator, Patron, Arch
Engineer of the national knowledge-base including rights
knowledge and that in the public domain.

The Custodial State is directly responsible for acce
conservation of the national knowledge-base through
archives, museums, libraries and arts centres. This ro
evidenced by cultural patrimony legislation controlling the
'national

treasures' and by departments of government mandated t
preserve and promote national culture.

The Facilitator State supports production and conse
knowledge through 'tax expenditures', *i.e.* taxes for

forgiven. Government can choose not to tax certain types
and/or expenditures made by citizens because relevant ac
considered merit goods. A merit good is a good or serv
consumption or production is encouraged on the basi
market value judgments.

The Patron State funds the production and conse
knowledge through arm's length councils in all knowledge
and some practices. The government determines how n
support to provide, but not which organizations or c
receive that support. A council is usually composed of a
trustees appointed by the government. Having been a
however, trustees fulfill their grant-giving duties independ
day-to-day interests of the party in power, much like the t
blind trust. Granting decisions are generally made through
of peer evaluation.

The Architect State funds knowledge produc
conservation through ministries, departments and s
agencies. Bureaucrats, in effect, make grants. The
supports knowledge as part of general social welfare
based on the historic traditions of western European cul
the fall of Rome by both Church and State.

The Engineer State owns selected, critical and con
means of knowledge production, distribution, consum
conservation. This includes regulation and licensin
electromagnetic spectrum for broadcasting and the intern
the cultural filtering provisions of the General Agreement
and Trade (GATT) including the 'morals clause', cont
national intellectual property rights regime subject to
treatment rather than harmonization under the WTO; c
and operation of national knowledge generating in
including laboratories, libraries and statistical agenc
application of the national security provisions of the WTO.

In playing these five roles, government construct
known as the 'national innovation system' (OECD 1997).
such a system involves the conscious institutionalized
knowledge generating institutions such as universities a
sector laboratories to the private sector through the active
of government. With respect to universities this new in

matrix arguably constitutes the greatest change in the m
the university since creation of the first research universit
in 1809. At that time the change was from interpretatio
the generation of new knowledge. Arguably, today, the
from generation to commercialization of new knowledge.

Within the MDTQ model, the competitiveness of n
global knowledge-based economy can be assessed relati
comparative advantage at each level of the model. Do
nation-

state place certain types of knowledge out of bounds to be
a monad? Does it enjoy a dyadic advantage in either S
Design? Is it better at developing personal & tacit labour,
tooled capital or toolable natural resources? Is it com
better at producing Persons, Codes or Works relative t
rivals? Similarly, comparative advantage can be identif
qubitic level. At all levels of the model the policy ques
identifying comparative advantage, become whether to
current balance and blend or change it and if so, how?.

Beyond limitations and weaknesses inherent
Competitiveness Paradigm, there remains the fact that
horizons of many more disciplines remain to be sur
'knowledge about knowledge'. And, of equal importa
remains many significant non-English expressions of 'k
about knowledge' to be collected. Accordingly, not o
article and its parent dissertation limited by the disciplina
surveyed, it is also handicapped by being rooted in th
language with its inherent limitations and weaknesses tha
have at least partially revealed. These weaknesses will
plague any other researcher who may choose to apply
variation on the theme to another meta-methodological di

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