Upgrading Our Knowledge Infrastructure (KI) for Economic Growth

by Bill Lauritzen

The *physical* infrastructure of our society includes its roads, water supply, sewers, electrical grids, telecommunications and more recently the Internet. However, there is another, *nonphysical* infrastructure that I think is equally important to our longterm survival and prosperity. This is the *knowledge infrastructure*. This KI carries the thinking and communication with which we build the roads, bridges, water supplies, electrical grids, etc.

It includes such things as the written symbols (alphabet or characters), the number system and its symbols, the languages and their spellings, the timekeeping system, the calendars, and the scientific measuring systems (such as Celsius or Fahrenheit for temperature). As with the physical infrastructure, *maintaining and upgrading the abstract knowledge infrastructure can be an economic multiplier,* potentially saving billions of person-hours each year.

Physical Infrastructure: the shared physical framework needed for a culture and economy to function.
Knowledge Infrastructure: the shared mental framework for a culture and economy to function.

Some historical examples of KI creation and maintenance include:

- The invention of symbols and writing which allowed the *offloading* of information from human memory to clay, stone, wood, papyrus, paper, digital storage, etc.
- The invention of primitive calendars (seasonal tracking systems): Stonehenge, Woodhenge, and other artifacts which are used as analog computational devices.
- The invention of primitive number symbols. Egypt (base 10), China (base 10), Babylonia (base 60), Mayan (base 20)
- Attic Numerals: ΔΔΔΔ + ΠΙΙΙΙ = ΔΔΔΔΠΙΙΙΙ (40 + 9 = 49)
- The invention of pictographs.
- Hieroglyphs in Egypt, Characters in China.
- Dividing the day into equal parts.
- Egypt dividing the day into two 12-hour parts.
- Babylonian use of highly composite numbers (such as 12, 60, and 360) for their number system, geometry, and time keeping.
- The invention of alphabets.
- Classic Greek numerals (which used the Greek alphabet) and Roman numerals.
- The invention of weighing scales in the Indus River Valley c. 2400–1800 BC.
- The invention and adoption of zero.
- The reform of the Roman calendar by Julius Caesar in 45 BC.
- The adoption of the Thai alphabet in 1283 by King Ramkhamhaeng. (example: **พ่อขุนรามคำแหงมหาราช**).

- The replacement of Roman numerals by Hindu-Arabic numerals in Europe in the 15th Century. (I, II, III > 1, 2, 3).
- The adoption of the Korean alphabet in the mid-15th century (thought to be a powerful reading aid) Example: ㄱ ㄲ ㄴ ... .
- The adoption in 1582 of the Gregorian Calendar.
- The adoption of the metric system by France in 1799, and subsequently by the most of the world.
- The publication of Noah Webster's first dictionary in 1807. Some of his spelling reforms were gradually adopted throughout the United States. (colour > color, centre > center, gaol > jail, mould > mold, honour > honor, etc.)
- Adoption of the centimeter–gram–second system (CGS) for distance, weight, and time about 1873. Gradually replaced by the MKS (meter–kilogram–second) system, which in turn developed into the modern SI (Système International) standard: second, meter, kilogram, ampere, kelvin, mole, candela for *time, length, mass, electric current, temperature, amount of substance, luminous intensity*.
- The use of the Latin alphabet (A, B, C, with some modifications) in place of Vietnamese characters, required for all public documents in 1910 by issue of a decree.
- The use of the Latin alphabet (A, B, C …) for Indonesian writing in the 20th century.
- The change from an Arabic to the Latin alphabet by Turkey in 1929.
- The simplification of Chinese characters in 1958 and 1964 to make writing easier.
- The use of the Latin alphabet for pronunciation of Chinese characters (called Pinyin) in 1982 for ease of learning pronunciation. (拼音 = *pīn yīn).*
- The adoption of the 24 hour clock by the British and US military, and most countries.
- The adoption of standard Time Zones in the US by the railways in 1883.
- Various Spelling Reforms in the US, Netherlands, Germany, Greece, Indonesia, Japan, Norway, Portugal, Russia, and other countries over the last 200 years.
- English Slang. (For example aircraft pilot slang in the 20th century: “klicks” for “kilometers,” “bandit” for “hostile aircraft,” “say again” for “could you repeat that,” etc.)

Although it is true that AI will continue to improve response time and productivity *as long as there is a human anywhere in the loop, even if it is only on the final receiving end of the loop, information must travel though this human/brain infrastructure and the speed of its travel will be a limiting factor in reaction time and productivity of the system.*

Also, just as physical infrastructures have to be constantly maintained, so too must knowledge infrastructures. As shown above, these knowledge infrastructures can sometimes be completely revised.

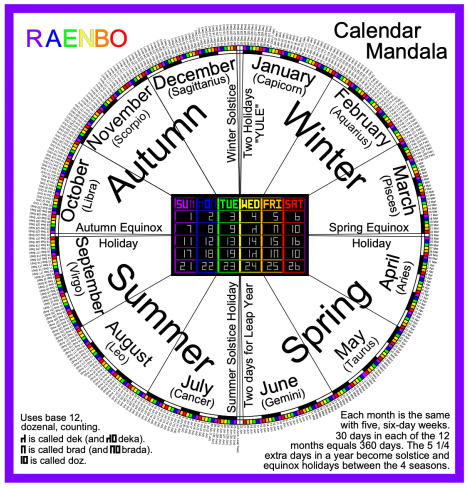
- *Good physical infrastructures enable the purchasing and delivery of goods and services with minimal human effort and time.*
- *Good knowledge infrastructures enables the learning and the communication of ideas and information with minimal human effort and time.*

Examples of Possible Upgrades:

I. Calendar Apps:

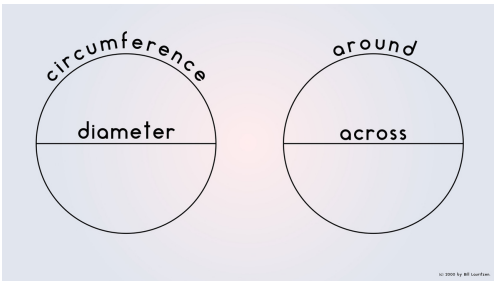
At present there is no completely scientific calendar in use. Instead of being based on a person's birth or another Earth-based event, I suggest year zero be based on the latest supernova nearest us. Wikipedia currently lists 86 different historical calendars, 8 different fictional or non-Earth calendars, and 12 calendars with alternative days of the week from the usual 7 days.

	January April July October					February May August November				March June September December				
S	1	8	15	22	29	5	12	19	26	3	10	17	24	
M	2	9	16	23	30	6	13	20	27	4	11	18	25	
T	3	10	17	24	31	7	14	21	28	5	12	19	26	
W	4	11	18	25	1	8	15	22	29	6	13	20	27	
T	5	12	19	26	2	9	16	23	30	7	14	21	28	
F	6	13	20	27	3	10	17	24	1	8	15	22	29	
S	7	14	21	28	4	11	18	25	2	9	16	23	30	
Worldsday follows December														W
Leapyear day follows June, but only in leap years														W



II. Mathematics Nomenclature

see white paper by author.



triangle	3-nik
rectangle	4-nik
pentagon	5-nik
hexagon	6-nik
decagon	10-nik
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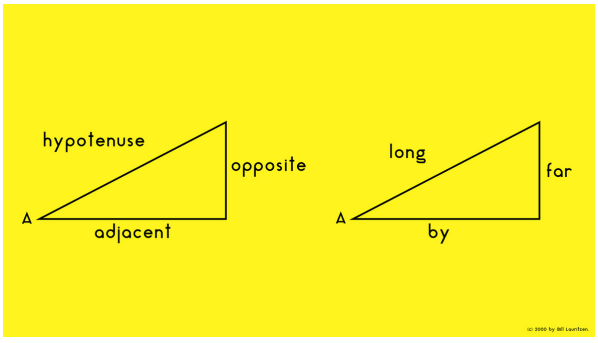
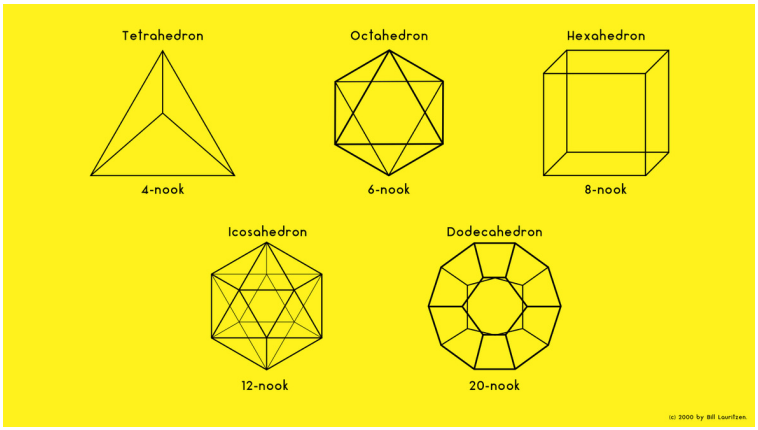
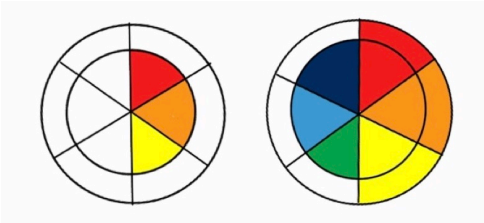
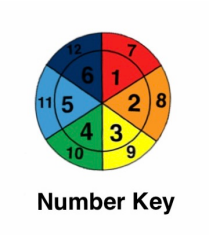




III. Numbers and Numerals
Past > Present > ? ? ?
I, II, III > 1, 2, 3 > ? ? ?

A Base-12, Digital, Spacial, Color-Coded Number System optimized for learning and usage. (concept and images by author):





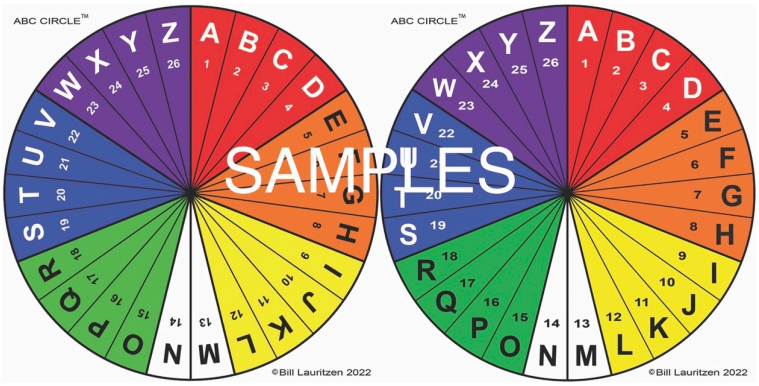
White paper 1
White paper 2

III. Time
One-Time-Zone for the entire world (Zulu Time.)

IV. English Spelling Reform
Every year change a dozen words to a more phonetic spelling as was done by Webster in 1807:
colour > color
centre > center
gaol > jail

mould > mold
honour > honor
etc.

V. Alphabet Interface
Alternative Alphabet Interface with Chunking and Color Wheel Coding optimized for learning:



VI. Scientific and Medical Nomenclature
Example: Chemical Nomenclature Reform (Using numbers rather than letters. Example by author.)

O_2	8_2
CO_2	68_2
H_2O	1_28
$C_{20}H_{30}O_2$	$6_{20}1_{30}8_2$
$C_{12}H_{10}$	$6_{12}1_{10}$
$(CH_3)_3N^+CH_2CH_2OCOCH_3$	$(6,1_3)_37^+61_261_2868613$
C_2H_2	6_21_2
C_6H_6	6_61_6
$(C_6H_{10}O_5)_x$	$(6_61_{10}8_5)_x$
$C_{16}H_{13}ClN_4O_5S$	$6_{16}1_{13}6l7_48_5(16)$
$C_{22}H_{30}N_6O_4S$	$6_{22}1_{30}7_68_4(16)$

Digital Implementation

With the appearance of digital 1) computers 2) the Internet, and 3) software applications, it is possible, for the first time, to develop, test, and deploy Alternative Knowledge Infrastructures (calendars, number systems, scientific nomenclature, etc.) quickly and cheaply. *It is also possible to translate from one KI to another with the click of a button (as is done already with Celsius to Fahrenheit).*

Possible Next Steps

- An alternative calendar app could compete against the traditional calendar, and also give people the ability to choose between one or the other depending on the circumstances.
- Numbers apps/games for children.
- Mobile games with science fiction backstories could be developed to teach new systems to children.
- A digital chemistry text could use numbers rather than the traditional letters (hover over the numbers to get the traditional letters.)
- Universities could test alternative nomenclature to see if they improve student learning time, retention and application.
- A website could allow alternative KIs to compete. Data and user feedback could be collected/ evaluated with A/B testing.