



# GROWING THE TREE OF KNOWLEDGE



## THE CASE FOR KNOWLEDGE SCIENCE

It's hard to miss the signs today, leading us to the promised land of computerized, automated, web-enabled [Knowledge Acquisition & Management](#). We absolutely need these systems and solutions to become the best in your industry and to stay competitive.

Yet - and with all these new systems around - how do we account for the ever growing information overload? How do we deal with the exponential growth rate (and corresponding underutilization or actual waste) of the new (and mostly static) knowledge all of us generate? Do we collect, process, store, and present the right data, information and knowledge in the right format, at the right time, to the right audience? Don't we just treat the symptoms and not the cause, by using the latest technology?

Our argument here is that acquiring, and managing your mostly static, paper-based knowledge is not enough anymore. To win this war, we must go back to the source. [We must capture dynamic information before it becomes static, and turn it into the right knowledge at the right time for the right audience.](#) God knows, we may even be able to manage the remaining static knowledge that we keep for documentation, educational, and training purposes, in an easy, effective way. . . .



## BACKGROUND

Since the start of World War II, human undertakings have become more, and more complex. The war was global in scope, and gave rise to economies, cultures, and logistics which span the globe. While the world has shrunk to a voyage of 19 minutes around it by the space shuttle, the cost, and time to achieve such feats have at least doubled every

decade. For example, the Manhattan Project was successfully completed in less than four years, at a cost of a few billion dollars. The Apollo Project, again successful by all measure, took eight years, and 24 billion dollars to land men on the Moon. Real numbers for the International Space Station, for its projected length of operation are now over 100 billion dollars, and climbing. [And here we are only talking about the largest scale, most visible government projects, not the millions of lesser known private, or public investments, which require us to create, process, manage, and reuse knowledge much more dynamically, and effectively than ever before.](#)

Fortunately, we now have the tools to build the dynamic knowledge systems we need, by utilizing the following technologies:

- Inexpensive 32 and 64 bit workstations, and networks
- Powerful DSP (digital signal processing) for real-time data and speech acquisition, and their translation from analog to digital formats
- High fidelity Pattern Recognition with neural network technology, which can translate this digital data into symbolic representations for real-time use.
- Multilayered symbolic information and knowledge processing systems, such as:
  - Object Data Base Management Systems (ODBMS)
  - Hypertext, as an instance of ODBMS
  - Rich or multimedia, as a more advanced instance of ODBMS
  - Object-oriented programming, and component based software engineering
  - Advisory, or expert rule based programs
- Fuzzy logic based process control to translate decisions from symbolic, digital format back to the analog format of the real world, taking into account uncertainties in it; and
- High speed (10 Megabit to Terabit speed) telecommunication services, connecting individuals and organizations into work groups, and supply chains over local and worldwide networks, a.k.a. the Internet

To deal with these issues, Applied Intelligence Laboratories (A.I. Labs) has been conducting basic research since 1988. This work, done in collaboration with Pace University of New York has produced a new discipline, under the subject domain of Knowledge Science.



## **WHAT IS KNOWLEDGE SCIENCE?**

We define Knowledge Science as follows:

[Knowledge Science is the theoretical framework of knowledge generation and use. It is the result of interdisciplinary studies in almost all fields of science. It works with proven, universal principles to show how to generate and manage knowledge, in order to create systems of all kinds and complexity.](#)

Our definition is generic by nature, as it must encompass all of our higher level mental, and social activities. We found, that to discover how knowledge is generated, and utilized in such diverse environments, we need to examine, and build upon all of the following areas:

1. Data-Information-Knowledge-Expertise
2. Rules-Laws-Models-Theorems
3. Structuring-Grammar-Language-Meaning
4. Reasoning-Thinking-Learning-Problem solving
5. Systems-Systems engineering
6. Entropy-Redundancy-Control-Communication
7. Complexity-Evolution
8. Culture-Economy-Society

Our research has focused on applying fundamental principles from these fields to triple the long term success rate of our product, process, or service creation, and utilization efforts. This 300% gain is not an arbitrary number. We compared our minds' capacity to learn, think, and develop new systems, be they products, processes, or services, with our historical long term success rate, as follows:

	Historic and current values	Achievable by matching our minds' capacity
Success rate:	<u>1 out of 100 projects</u>	<u>3 out of 100 projects</u>
Profitability/Service value:	5%	15%
Recyclability:	20%	80%

The reason we really have this opportunity is that these principles, embodied in Knowledge Science, enable us to:

- Measure individual and organizational data-information-knowledge-expertise generating and utilization capacity.
- Define meaning and how it relates to the "Law of survival".
- Understand the rule based process of system evolution.
- Quantify complexity and define complexity barriers.
- Consistently apply the "Law of minimum resource allocation" (the 80:20 rule).

Armed with this knowledge we can, for the first time, do a fitness analysis for any new project, or proposed change; see if they are feasible today; and what would actually make them successful now, or in the future.



## **HOW CAN YOU USE KNOWLEDGE SCIENCE?**

Our purpose here is to give today's knowledge workers a road map to tomorrow's knowledge based technologies. We collected, and organized everything we learned into a PC hypertext base, titled *Knowledge Science* as described next.

# KNOWLEDGE SCIENCE

This program works like a computerized encyclopedia, having been fully cross-referenced bibliographically, and by content. Each subject is either described in detail, or links to other information for more detail, allowing you to easily browse in both directions on any path of your choice. All information is linked together by meaning, and becomes immediately useful to you. This self-study approach has clear-cut benefits, by:

- A. Providing you with a road map to anticipate advances in your field.
- B. Making it easy to see the links within many different categories and subjects, such as creativity, bio and techno-evolution, etc.
- C. Fostering the development of your ideas and associations as you go along.
- D. Enabling you to study at your own pace.

[Knowledge Science Vers. 1.2 is available](#) on NewMedia Publishing's web site, both as a download and on CD-ROM, at: [www.newmediapublishing.com](http://www.newmediapublishing.com) In addition to the manual, it contains a paper delivered at the Conference on Systems, Man and Cybernetics Proceedings, University of Virginia at Charlottesville.



## WHAT'S NEXT?

In addition to the ongoing research, planning for the next software version in XML/Java is also under way. We encourage you, and everybody else involved in knowledge acquisition and management, to work with us in any way you see fit, for all of our benefit.

Sincerely,

*Steven Kingsley*

Author