
Into the Future

A Vision Paper



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for

American Society for Training & Development (ASTD)

and

National Governors' Association (NGA)

Commission on Technology & Adult Learning

February, 2000

Acknowledgements:

The creation of this vision paper has been one of those rare and fascinating experiences in which what was being written about and the work to be done were exactly the same. This paper is about technology, adults, and learning, all combining to produce quality results and new knowledge. The creation of this paper involved exactly these elements. It required a team of adults, who used the technology available to convert tacit knowledge about the subject into explicit information, so that it could be captured, organized, and readily transferred to the members of the ASTD and NGA Commission on Technology and Adult Learning. Reiterating this process at a new level, the Commission members will assimilate this information, discuss and analyze it, create new knowledge as they do so, work to make this explicit, and transfer it to others to develop policies and practices to effect the Commission's recommended changes. A perfect model of the future vision described herein.

Creating this vision paper has been a classic example of a project team working and learning. As with any project of this magnitude, this paper was a highly collaborative effort. While those who provided various forms of input and ideas shaping this work are far too numerous to mention, the following three people played critical roles and without their assistance this paper could not have been completed:

Jay Cross:

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Joining the project soon after it started, Jay collaborated on the early ideas on how to approach the broad and deep topics to be covered by the eclectic mix of extremely talented Commission members. Jay continued to play a pivotal role throughout the project in a variety of capacities, including contributing his own diverse knowledge of learning and technology, being a sounding board for new ideas, and capturing wide-ranging discussions of the paper's subjects in a range of formats from written drafts to graphics, illustrations, and white-board meetings. Jay was also extremely valuable in his ability to edit from his perspective of being inside the project, while maintaining an external perspective and looking out for the needs of the Commission. Showing the breadth of his skills and knowledge, Jay also researched many of the issues and references and created many of the graphics and illustrations used within the document.

Marsha Calhoun:

Editor and writer extraordinaire, who lives in Petaluma CA and at likeswords@aol.com

Marsha bore the brunt of the real work on this project, serving as everything from project manager to writer to editor. Originally expecting just to look after the editing, Marsha exhibited exemplary capabilities to be an adaptive and dynamic problem solver. Never was there a task she wouldn't take on, never did a task require too many hours, never was it too late or too early to work. Marsha's tenacity for getting it right resulted in the quality of writing and editing displayed within.

Grace Gallego:

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Grace and her team created the entire design of templates, moved all the scattered project content into the format, and turned the whole thing around in days.

In addition, the following people gave extremely generously of their time, often on short notice, to do many reviews throughout the process:

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From NGA, Evelyn Ganzglass and Chris Thompson provided the much-needed additional perspective of those whom they represent, and they too worked to meet some very short deadlines for review.

Providing the invaluable perspective of those outside the project for in-depth review of the content and organization of this vision paper, were Jimm Meloy of Autodesk, Don Johnson Office of the Secretary of Defense, and Marcia Conner of PeopleSoft.



Wayne Hodgins,
Director of Worldwide Learning Strategies, Autodesk Inc.,
President and co-founder of the Learnativity Alliance

February, 2000

The Commission on Technology and Adult Learning: A Joint Project of the American Society for Training & Development (ASTD) and the National Governors' Association (NGA)

The Commission

The American Society for Training & Development (ASTD) and the National Governors' Association Center for Best Practices (NGA) will convene a *Commission on Technology and Adult Learning* that will bring together Governors and CEOs from business and post-secondary education to clarify and examine the most critical issues for public policy and practice raised by the changes in the economy and increasing use of information technology for adult learning. Supported by a Task Force of experts in learning and technology, corporate human resource development executives, and public policy representatives from federal and state agencies, the Commission will bring together information and expert testimony and identify best practices, in order to make recommendations for public policy and private sector action.

The New Context for Learning

The "New Economy" - whether described as the information economy, digital economy, or knowledge economy - is characterized by structural changes that have profound implications for the public policies that frame lifelong learning. These changes include industrial and occupational change, globalization, the changing nature of competition and the progress of the information technology revolution. They place a premium on knowledge, skills, and training. In order to develop the new systems for adult education and training that will support the skills needed in the 21st century, we must understand the implications for radical change in the nation's traditional context for learning, that are being driven by information technology.

Information technology is changing the access to knowledge, the process of learning, and the delivery of education and training. Teaching and learning can now take place outside the traditional institutional and workplace-based venues for education and training that are anchored in accreditation and certification and tied to defined skills, jobs and career paths. Within this new context, the adult who has been an occasional "student" becomes a continuous "consumer" of knowledge available worldwide, anytime and anywhere. As employees increasingly gain control over their own learning and career development, employers face difficult challenges in training and retaining a workforce with consistent levels of skill.

The relentless demand for new skills created by the use of information technology in work has reinforced the demand for effective and measurable - in terms of performance improvement and return-on-investment - education and training. In response, a dynamic market, of for-profit providers is developing parallel to the existing public education and private sector training systems.

Introduction to the paper, “Into the Future”:

The purpose of the following Vision Paper “Into the Future” is to provide a common platform from which to begin our discussion on February 10-11. Each member of this commission is an experienced and thoughtful leader in the area of learning and technology; yet there is also a range of specialization and focus. The vision paper can serve as either introduction or reminder of the potential of the new world of learning “anytime anywhere”, and of the education and training systems and practices now in place.

We have developed an agenda to allow time for discussion of both the potential impacts of technology on adult learning, and also of the challenges these pose for governments, organizations and individuals. Please let us know if you have any questions prior to the meeting.

We invited Wayne Hodgins, Director of Worldwide Learning Strategies at Autodesk and a leading participant in many of the discussions taking place world wide around the future of technology and learning, to draw on current work and developing trends, in order to create a paper of what the future could look like in terms of the use and impact of technology in adult learning.

His paper is a demonstration not only of the new approaches to learning, but also of the new vocabulary, text formats and ways of thinking that are part of that future. We know that technology’s intersection with learning is not a simple trend of old approaches being replaced by new, but that new hybrid forms of learning and delivering content are emerging – with many combinations of traditional classes and teaching combined with technology-based methods for finding content and learning. In fact, a powerful argument has been made that the most effective technology-based delivery model is one that incorporates a heavy human component – professors, experts, tutors, mentors and colleagues. We ask you to keep in mind that the purpose of creating this vision, of trying to imagine this future, is to paint a picture that will offer a focal point for actionable plans and policies.

Where We Are Now:

The paper assumes awareness of:

- Technology is already widely used in adult learning. It is growing relatively “free form” and outside of the traditional social policy arena.
- There is a shift from “education and training” to “knowledge management”
- There have been leaps forward in the methods available to sort, retrieve, and re-use data and information through the application of “object-oriented” methods.
- The Internet and multimedia data and methods have already become a big part of adult learning.
- Separate technologies and organizations are merging to create multi-faceted and multimedia delivery channels for content that enables learning.
- The wireless age and use of broadband cable are here so that both individuals and institutions will have greatly expanded access to information at home, at work, at school – anywhere.
- Many teachers and technology experts are working together to launch a set of methods and standards that will enable easy re-use, recombination and transfer of content between individuals, institutions and countries.

Issues for Public Policy and Private Practice:

We have identified the following eight areas within public policy and private practice that are clearly affected by the possibilities of learning in the context of technology. These categories were included in the original proposal for this Commission. During the meeting, you will have an opportunity to discuss these, add to or subtract from them, and determine which are the areas most critical for the work of the Commission.

1. Equitable Access: Aspects of this issue include: a) ensuring access to computers and the internet for all socio-economic groups (often described as the "digital divide"); b) overcoming barriers to learning using technology (including learning styles, basic skills); and c) developing and implementing common standards in the use of technology -- such as interfaces, objects, platforms -- that will enable reuse, communication, and the overall capability to access and use existing on-line or technology-based education and training resources.

2. Accreditation and Licensure: Issues here concern the need to revise existing systems for ensuring quality and excellence of curricula, developers, trainers, and educators. Existing systems are not easily applied to the methods, content and flexibility of online learning.

3. Assessment, Certification & Acquiring Credentials: The need is to define and establish appropriate systems and processes for assessing competency and knowledge and for formal assurance of the acquisition of knowledge that takes place outside of a traditional institutional structure or curriculum format. Individuals must be able to rely on credentials, which are portable and recognized in relevant professional or academic environments.

4. Lifelong Learning: There is growing realization that we can no longer define education and training in terms of traditional "blocks" and "silos". We need to move instead to a lifelong learning "pipeline", and to consider the role that on-line and other technology-based learning can play in an interdependent system beginning with pre-school and carrying on through ongoing workforce development and adult learning

5. Funding Sources & Funding Models: Funding for adult education and training has been related primarily to institutions— post-secondary education institutions, private providers of training, formal training inside organizations, and others. Individual student aid is frequently restricted to particular hours or number of courses. We need to examine the processes and structures for funding, in order that they encompass the new realm of on-line education and training.

6. State Investments for Economic Development: The practical appeal of on-line learning has implications for state policies governing investments in education and training infrastructure to attract business and create jobs. The increasing importance of a workforce for the information technology and engineering sectors, as well as the necessity for all workers to use technology, requires the availability of online resources for skill development and re-training.

7. Intellectual Property: "Ownership" of content becomes more complex as open access to information expands. Traditional processes of copyright and "fair use" do not address on-line "learning objects" or the new ways content will be recombined and reused by teachers, trainers and learners. As organizations develop new business models to support learning "anytime, anywhere," we need to take a new look at "rights management" for creators, authors and publishers.

8. Tax and Regulatory Policies: Tax and regulatory policies governing not-for-profit and for-profit education and training providers may no longer be appropriate or optimal, as the process of learning "anytime, anywhere" blurs state and national boundaries with respect to location of providers and adult learners.

Expected Outcomes of the Commission

Over the next eighteen months, the Commission will:

- Frame the questions and implications for the public and private sectors as adult learning develops through information technology;
- Identify best practices in the public and private sectors for promoting access to, and the effective use of, information technology for adult learning;
- Describe the appropriate public and private sector roles and responsibilities that will facilitate the use of information technology for lifelong learning;
- Connect this work to similar activity focused on K-12 education; and
- Make recommendations for state and national public policy to facilitate the nation's transition to an information economy.

Impact and Dissemination Activities

- ASTD and the NGA will publish an interactive, electronic report, to be released early in 2001.
- High visibility public meetings to discuss the report's findings and recommendations will be held in Washington, D.C. and in other locations, hosted by Commission members.
- A Web Site, established at the inception of the project, will incorporate the ongoing dissemination activities and discussion of the findings, and highlight opportunities to get involved in priority issues.
- ASTD and NGA will create opportunities for business, government, education, and labor to come together on national, state, and local levels to develop and create useful initiatives that use technology to enhance life long learning.

Commission on Technology and Adult Learning

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Inaugural Meeting

Feb. 10 & 11, 2000

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Notes:

INTO the FUTURE

"We can let the future happen or take the trouble to imagine it. We can imagine it dark or bright – and in the long run, that's how it will be."

David Gelertner, 2000

Imagine.....

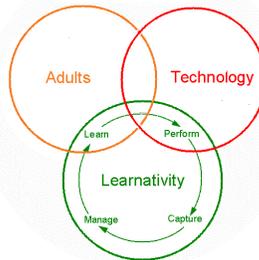
- ▶ What we could do if we all shared a common vision of technology and adult learning.
- ▶ If our actions and decisions resulted in the reinvention of learning through the more effective application of available technology.
- ▶ What the future will be like if we choose to cultivate people with the skills needed to lead the technology that assists them in innovative problem solving.
- ▶ Reading in 2010 how this Commission was identified as one of the milestone catalysts at the takeoff point of the new learning economy.

Welcome to the future! In the space between this page and the last, time will be shifted forward five to ten years. Join us on a high-level flight over the new world of technology and adult learning that orbits around the unique learner in a knowledge-based universe. The rules of Newtonian physics have been superceded by those of Learnativity, where the gravitational pull of creating new knowledge determines and shapes the actions of everything within. So suspend disbelief for the next little while, fasten your seat belts low and tight, make sure your tray table is in the locked and upright position, be open to the new world that is created by this shift, and remember that Einstein once said, "A change in perspective is worth at least f50 IQ points. Ready? Three . . . two . . . one . . .

Vision Paper Scope

This paper aims to help you envision the contributions of technology, adults, and learning to a bright and successful future society in which we would all want to live. We will address these three areas:

- **Adults**, defined as individuals who are currently in or about to enter the work force
- **Learning**, as it relates to workforce development in a knowledge-based economy
- **Technology**, as it empowers and enables learning and the realization of the future.



Vision Paper Goals

- ▶ Create a **shared vision** of a bright and achievable future for all working and learning adults
- ▶ Identify the **common themes and forces** that shape the technology and adult learning environment of the future
- ▶ Provide **new perspectives** and new ways of thinking about adults, learning and technology
- ▶ Foster **creative thinking and imaginative solutions**.

It is in the overlap of these areas that we find the questions and possibilities that need to be explored and addressed. We take a positive view of the future in this paper, but whether or not this future becomes reality will depend in large measure on the policies and practices that we and others begin to determine and put into place.

Vision Paper Premise and Approach

The future isn't just happening to us any more; we make decisions every day that determine what decisions we will be able to make tomorrow. As we stand at the inflection point of a new learning economy, we realize that it will be shaped as we choose to shape it; it will be as rewarding and humane as we make it; the decisions we reach will determine what the world will be like for all of us.

The world of learning described in this paper does not rest easily within the public system of education and training that exists in this country today. Much of this system was put into place as a result of demand, and many of these demands of the time have changed dramatically or disappeared. The requirements for accreditation and assessment, the insistence on certification by accredited institutions, the establishment of public funding following the institution, the economic development policies of states in terms of funding educational establishments, the role of the public sector as a guarantor of access—these tenets of the system were put into place to insure quality, value, marketability, equality of opportunity, and other goals of this society.

Into the Future

How must our public and private-sector policies and practices change as we move into the new world of learning “anytime, anywhere”? Are these changes merely minor modifications of existing approaches to address new circumstances, or are more fundamental changes needed in the principles, premises, and standards underlying our system? Will markets assure access and quality in the new environment? As we realize that the individual is the new focus, locus, and customer, how do we protect and ensure the rights of the individual without creating barriers and intrusive authority?

The Commission on Technology and Adult Learning is being convened to look at the future of work and learning made possible through technology and identify policies and practices that make this future secure and available to all. In developing its policy recommendations, the Commission will be challenged to strike a balance between the new and the old, between the need to achieve results and the need to make sure that those results are achieved in a way that respects individual rights.

The power of a shared vision

We can only create what we can imagine. As Michelangelo reportedly remarked, sculpting a statue is easy--it's a matter of looking at a block of marble and taking away everything that doesn't belong there. More importantly, and what is often missed by many, is that Michelangelo worked with a group of 16 to paint the ceiling of the Sistine Chapel. Thus it was not the work of a single individual, however gifted, but the creation of a project team working with a shared vision.

Great groups

"As they say, 'None of us is as smart as all of us.' That's good, because the problems we face are too complex to be solved by any one person or any one discipline. Our only chance is to bring people together from a variety of backgrounds and disciplines who can refract a problem through the prism of complementary minds allied in common purpose. I call such collections of talent Great Groups. The genius of Great Groups is that they get remarkable people -- strong individual achievers -- to work together to get results. But these groups serve a second and equally important function: they provide psychic support and personal fellowship. They help generate courage. Without a sounding board for outrageous ideas, without personal encouragement and perspective when we hit a roadblock, we'd all lose our way" (Warren Bennis, 1997).

We see this Commission on Technology and Adult Learning as a "Great Group," and this paper aspires to provide some clarity for a shared vision and hope that the future it describes is an achievable dream. Specifically, this Commission on Technology and Adult Learning will use the vision presented here to identify public policies and private sector practices that make this future secure and available to all. Creating the future dictates that, like Michelangelo, we have a vision of what we want things to be like, not in every particular, but sufficient to ensure that our multiple efforts have a unity of purpose and direction.

Future first: Plan back

Alan Kay said, “The best way to predict the future is to invent it.” This vision paper is based on the concept of inventing the future first and planning backwards from there to today. The first step is to think about what this future will look like.

"Thus, the task is not so much to see what no one yet has seen, but to think what nobody yet has thought about that which everybody sees."

Arthur Schopenhauer
(1788-1860), 1973

The future is about acquiring and acting on knowledge.

"There can be no innovation in the creation of strategy without a change in perspective."

Gary Hamel, 1996

The future is a knowledge-based economy

The term “new economy” refers to a set of qualitative and quantitative changes that, in the last 15 years, have transformed the structure, functioning, and rules of the world. Ideas and knowledge, rather than material resources, drive the new economy, and the keys to job creation and higher standards of living are innovation and technology embedded in services and manufactured products. In this economy, risk, uncertainty, and constant change are the rule, rather than the exception.

There is an infinite supply of knowledge, which means that knowledge-based economics are fundamentally different and poorly understood. Fundamental principles and laws that governed previous economics, such as the law of diminishing returns, are being flipped inside out. In this new knowledge based economy is a seemingly impossible reversal to the law of increasing returns. (see right) However, understanding this new reality is central to constructing a vision of tomorrow.

Putting knowledge in context: As action

The future is about acquiring and acting on knowledge. Knowledge is not simply understanding and information; these are the raw resources of the new economy. Knowledge is the high value gained while providing services and creating products. When converged, learning, technology, and knowledge enable and empower individuals and teams to produce value for customers and competitive advantage for the team or organization.

The keys to success in the new economy are improving both individual performance and the productivity of teams and organizations. Both depend on understanding what knowledge is and how it directly affects performance. Improvements in creating, managing, and transferring knowledge can lead to increased creativity, efficiency, productivity, and competitiveness for an individual, a team, an organization, a country. This vision paper will illuminate this process as it is influenced by new technologies.

Putting learning in context: Learnativity

Just as creating knowledge is the keystone of a knowledge-based economy, learning is an integral component of “learnativity.” This is much more than just a word or a term. This is literally a new existence, a new way of living, a new way of being who we are. This is the state of the future.

As will be shown in more detail later, the learnativity model for creating knowledge is a continuous, spiraling conversion of tacit knowledge (such as know-how and experience) into explicit knowledge, which can be captured and turned into new tacit knowledge gained from learning by doing. In this context and in the knowledge-based economy, learning can be seen anew as an integral part of a knowledge creation spiral that involves

- ▶ **Performing**
- ▶ **Capturing**
- ▶ **Managing**
- ▶ **Learning**



“The prime law of networking is known as the law of increasing returns. Value explodes with membership, and the value explosion sucks in more members, compounding the result. Industrial economies of scale stem from the Herculean efforts of a single organization. Networked increasing returns are created and shared by the entire network.”

Kevin Kelly, 1997

A bright future depends on bright people

As we examine adults, technology, and learning, they all appear to be shaped by massive convergence, imploding to form a new common center of uniqueness. Roles and responsibilities that used to be divided nicely among different adults are now converged upon every individual. Technologies such as computers and telecommunications are converging, and learning is converging with performing, managing, and creating knowledge.

According to Webster's New World Dictionary of the American Language, College Edition, quaquaversal is defined as "directed from a common center toward all points of the compass; turning or dipping in all directions." We are entering upon a convergence of the inversed quaquaverse.

While this center of uniqueness is the inverse of what we have known, turning most of our perspectives and models inside out, it can also be seen as the nuclear center of quaquaversal motion – radiating out in every direction from the center – that is the nature of a bright new world and economy envisioned as the future of technology and adult learning.

The future will depend upon bright people using technology to cultivate their uniquely human skills. There is a significant difference, often overlooked, between machines that are able to perform so many functions that they usurp the roles of the people who use them, and truly intelligent tools and technology. For example, self-serve gas station pumps and automated scanning devices at checkout counters have automated front-end sales so as to virtually eliminate the need for skilled labor, or for any person at all. This is in stark contrast to something such as 3D design technologies, which support their respective users but require higher-order thinking skills from the person using them.

When we automate an existing process we increase its efficiency, which increases the mechanical nature of the work that is required. However, intelligent tools and technology cause the opposite: an increase in effectiveness rather than efficiency, with more new and more skilled roles that also tend to pay higher salaries.

Higher-order cognitive skills are the key to ever more intelligent technology to extract and create the knowledge these technologies make available. The need for these skills is permeating literally all jobs, requiring everyone in the workforce to be bright, to be a knowledge-based worker and feed into the knowledge-based economy that increasingly predominates.

The choice is ours to make: We can choose to foster a workforce whose main function is to supplement the machines that do the work, or we can cultivate people so that they can acquire the skills necessary to lead the technology that assists them in innovative problem solving. In this vision paper, we choose the latter and offer you the option of the bright, personalized, knowledge-based future.

Revolution or Evolution?

An economic revolution changes how everyone does business, not just how a specific product is made. So the invention and production of the automobile, for example, is not a revolution. There were 200 or so auto manufacturers in the

1920s, and they eventually became just three, but business was conducted the same way.

The steam engine, however, revolutionized how all work was done.

Similarly, industrialization revolutionized where and how all work was done.

*And in our time, computers, networking, and the Internet are changing how all work is done. **We're truly in a revolution.***

Dr. Lester Thurow, 1999

The choice is ours to make: We can choose to foster a workforce whose main function is to supplement the machines that do the work, or we can cultivate people with the skills necessary to lead technology that assists them in innovative problem solving.

Technology

We finally have things in the right order, the horse before the cart. Technology is human-centric, designed to be intuitive and transparent. Just like oxygen, light, food, clothing, and shelter, we depend upon it to just be there. We expect it to actively and adaptively support our performance and productivity. Virtual and augmented reality, simulations, digital paper and ink, voice recognition and control, and biometric feedback are a few of the technologies that provide truly dynamic and adaptive support for learning and performing. Technology is so natural to use and so supportive of completing the right tasks well the first time, that the users are unconscious of the technology itself and focused instead on success.

Intelligent technology aids and abets our learning because of its own ability to learn through memory and pattern recognition. It learns about us as we use it, observes the surrounding conditions, notices the consequences and results, and is able to analyze what it learns to anticipate our future needs. We finally have truly just-in-time learning and performance support for achieving personal and group peak performance.

Today	→ Tomorrow
Technology in the Foreground	Transparent, Embedded, Background
Smart	Intelligent (Learns in Use)
Virtual	Augmented
Artificial Intelligence	Augmented Intelligence
Generic	Task Specific
Good Guessing	Precision Predictability
Pre-programmed	Adaptive to User and Situation
Proprietary	Open Standards

Imagine.....

- Technology adapts itself to you and your environment, not vice versa.
- There is a pervasive, ubiquitous, and transparent technical infrastructure supporting all your learning and performance needs.
- Technology looks after all the details so you can stay focused on solving the real problems.
- You are part of the “infrastructure,” a “node” connected to the system that is aware of who and where you are.

AT A GLANCE

- ▶ Technology is disappearing much as electric motors did, embedded and invisibly working within virtually all appliances, clothing, even the soil and the air.
- ▶ Our own limitations for innovative thinking and application are the limits on the potential of technology.
- ▶ The most valued technology is not that which replaces reality or intelligence with artificial forms, but that which **augments** our own.
- ▶ Performance support and augmented intelligence technologies replace the need for *technology operators* and increase the demand for higher-order thinking skills of the know-why variety that are highly transferable.
- ▶ Technology will largely obviate the need for formal, classroom type, event based learning to produce know-what and know-how.

TECHNOLOGY

The Vision

Clothes or Fire?

Information technologies are more like clothes than like fire. Fire is a wonderful technology because, without knowing anything about how it operates, you can get warm just standing close by. People sometimes find computers, televisions, and telecommunications frustrating because they expect these devices to radiate knowledge. But all information technologies are more like clothes; to get a benefit, you must make them a part of your personal space, tailored to your needs. New media complement existing approaches to widen our repertoire of communication; properly designed, they do not eliminate choices or force us into high tech, low touch situations.

Chris Dede, 1995

It's about time

Human attention is our most valuable and scarce commodity. When our time is what we have to offer the world, we look at technology differently. We aren't distracted by the sheer novelty of what it can do. We want to know how quickly it can help us get where we want to go, do what we need to do. We want it to stay in the background of our conscious awareness and environment while it assists us to perform the uniquely human tasks of exploring, evaluating, creating, innovating, and communicating.

General to specific

Technology moves from being very generic and centered on process automation to being very application-specific, matching the specific needs and knowledge of what it is being used for. It moves from word processor to guided resume creation, from spreadsheet to financial "agent," from computer-based training to ever-present and available personal learning mentors and performance coaches.

Smaller, faster, cheaper

Following the apparently infinite advance of Moore's Law (which states that computing power doubles every 18 months), the similar microtization of the size, cost, and power consumption of technology provides ever-smaller and more powerful technology at ever-lower prices. Tiny computers are increasingly embedded in our clothing, our homes, and our workplaces. They are ploughed into the soil, floated in the air, embedded in every bottle, box, and container, and are part of every machine, vehicle, window, and door. Wireless virtual networks power our "smart houses" as computers literally fade into the woodwork. Eventually, they disappear from conscious awareness, just as the miracle of electricity and all the thousands of motors in our appliances have done. Our focus is shifting from how "cool" technology is, to the amazing results it enables us to achieve. We are limited only by our imagination and capacity for innovation in reaching this bright future.

Just like me: It's only natural

Technology that can learn about us can serve us better. When we're word processing, we don't want to do a "spell check"—of course it has to be spelled correctly, and the language has to be localized to include the appropriate use of colloquialisms, professional jargon, acronyms, etc. We expect it to ask when it doesn't know, and to remember what we tell it.

We feel the same about voice recognition. We want it to recognize not only our speech, but who is speaking. We want it to learn our way of speaking, read representative samples of our previous work, have a knowledge base of best practices for this type of communication, and coach us on ways to improve if we can, as well as transcribe what we say if needed and on demand. When we have a question, we want to ask it—out loud. Natural language processing takes the question, combines it with what it knows about us and our current situation, and provides a response accordingly. Rather than adapting ourselves to accommodate the requirements of technology, the technology accommodates and serves us.

The Vision

Migrating from smart to intelligent

Adaptive technology adjusts dynamically to the person, the situation, and the objectives desired. It gets better as you use it, learning and remembering what it did before and using this information to predict what you might need next. When smart technology is supplanted by intelligent technology, we no longer strive to do old jobs better, but look toward innovating and creating new possibilities.

Augmented Reality

One such technology is augmented reality (AR). In contrast to virtual reality (VR), which normally shuts out all of the input of actual reality with headphones, goggles, body suits, and sealed chambers, AR users might wear a pair of clear glasses or a head-mounted system that projects an image in front of them. AR leaves all the real information in place and additional information is "layered" over top. You see, feel, and hear both the real and the augmented.

The first applications were used to augment the view of pilots, projecting some of their navigation controls and information about their weapon systems, etc., into their immediate field of vision on the windscreen. However, more innovative applications now merge the two realities into one. The IBM "World Board" on the left suggests a whole new and innovative application for this technology. Start simple and imagine the benefit of seeing overlaid text and sound as you pan and zoom the camera around a new city you are visiting. Now step up to imagining pairs of clear glasses worn by an emergency response team that has just been airlifted into an unfamiliar city and culture halfway around the world in response to a natural disaster. Now imagine a mechanic or a surgeon who can see a two-second advance image of her virtual hands and equipment flawlessly performing a revolutionary new technique, which she first heard of only even briefly that morning! Is it learning? Is it working? Yes: learning, working, and technology, fused for peak performance.

AUGMENTED REALITY

IBM's "World Board" puts entire libraries of travel information in the palm of your hand *Wired*, January 2000). Looking through the GPS-assisted viewer and select a wireless network channel; the real-world things you see will be overlaid with text and graphics.

Imagine trying out several "virtual" buildings you set in place next to the real ones in the screen. Imagine...



MIT Media Lab has developed a snug-fitting suit with metallic fibers woven in that detect where and when the fabric stretches, deducing the movement of your individual muscles and limbs. The onboard processor then uses this data to reconstruct body motion and diagnose trouble spots. Plug the unit in, see yourself onscreen as a 3D, animated model and



GOLF INSTRUCTOR UNDERWEAR

use this technology to reveal bad habits that simple videotapes miss. The cloth even generates its own electricity, so you'll never need batteries. Imagine adding some force feedback so you feel the suit guide you to the perfect swing. Now THAT is performance support.

(Model Tee, *Wired*, January 2000)

Collaborative filtering nets great recommendations

Collaborative filters help people make choices based on the opinions of other people. It is often necessary to make choices without sufficient personal experience of the alternatives. In everyday life, we rely on recommendations from other people, either by word of mouth, recommendation letters, movie and book reviews printed in newspapers, or general surveys such as Zagat's restaurant guides.

By harnessing the knowledge of communities to make recommendations to individuals, this technology presents new solutions to an acute problem: overwhelming choice. Just as in everyday life, the trick is in knowing who you can trust to give you recommendations that will help you make the best decision. Creation of "community knowledge" of tastes and preferences enables the anticipation of what individuals need, even before they know they need it. This works by comparing an individual's preferences with those of other people who have expressed similar interests, automating, improving, and accelerating the ability to make recommendations for individuals.

Recommender or collaborative filtering systems augment this natural social process. In a typical recommender system, people provide recommendations as inputs, which the system then aggregates and directs to appropriate recipients. In some cases the primary transformation is in the aggregation; in others the system's value lies in its ability to make good matches between the recommenders and those seeking recommendations.

Augmented intelligence yields predictive technology

Packing lots of information and pre-programmed actions into tools and technology has led some to label them as "smart." However, this should not be confused with intelligence. A robot with lots of pre-programming and information, while very helpful in automating the processes it is built to perform, can only be as good as the programming. Its value increases dramatically with the ability to analyze inputs, behaviors, and actions and form new information by recognizing patterns, identifying cause-and-effect relationships, and making deductive decisions. This kind of augmented intelligence adapts to its surroundings; it learns, and it improves with use. In contrast to fixed programming with built-in best guess information, augmented intelligence offers the missing element of predictability. Being able to accurately predict what someone is doing or what he or she needs enables action such as providing specific content that is now highly relevant to the unique person and situation at hand, or technology that is able to adjust itself. This ranges from simply knowing the location and time to more complex understanding of moods through biometric feedback, face and gesture recognition, and overall pattern recognition.

Standards make it all possible

No previous new economy or revolutionary change in our ways of working and learning ever came about without the widespread adoption of standards. Railroads, telecommunications, VCRs, and the Internet itself are only a few examples. The new learning and knowledge-based economy takes off only when open, accredited standards become universally adopted. They enable full interoperability, interchange, sharing, and reuse of information, tools and technology.

The Impact on Learning

"There are two fundamental equalizers in life — the Internet and education."

John Chambers,
CEO, Cisco Systems, 1999

Technology: The world's greatest equalizer?

In the world we are creating, technology is breaking down the walls of privilege. Networks carry the best educational opportunities to the most remote corners of the earth. The Internet cuts through socioeconomic prejudice, offering people work based on their ability to perform, rather than on the color of their skin or the cut of their clothes. As technology connects us, enables us, and lets us do our stuff to match one another's needs, the balances of wealth and prosperity change dramatically. While the outcomes are not guaranteed, the potential for a new balance comes as opportunities to learn, work, and create the new currency called knowledge are increasingly available to all.

Seeing is believing!

In the cause of accelerating individual, collaborative, and enterprise-wide learning, this statement could not be more relevant. Visualization will be at the heart of knowledge and understanding in the coming decades. In a world characterized by increasingly complex information sets, our ability to acquire and understand them quickly will become central to effective performance. As visualization technologies evolve, we can expect to see the spoken and written word, our dominant modes of sharing today, eclipsed in many instances by 3-dimensional, highly interactive and compelling models, simulations, and augmented realities. These technologies and content enable all types of information to be modeled and presented visually: business practices and processes, customer behaviors and preferences, organizational relationships and responsibilities. Dynamic models and simulations enable us to learn much more rapidly and effectively than we might through conventional means of training, and they will also help us collaborate productively in the creation of new knowledge.

Learning to use technology: One less problem

Technology for learning is changing *how* we learn and *what* we learn. Instead of spending all our time figuring out *how* technology works, we now focus on putting it to work for us (right away, no learning curve required) to complete projects, solve problems and do the work for us. The potential of intelligent technology to enhance learning and performance is staggering. Working becomes an integration of learning and performing, facilitated by discipline-specific technology that adapts to the uniqueness of the individual using it and the work and conditions at hand.

Agent 24/7: Licensed to learn

Wrap up a mix of augmented intelligence, pattern recognition and predictive technology, and the ability to communicate, and we have another great advantage: autonomous intelligent agents and learning assistants. These tireless intelligent agents are out there working for us, getting just the right information, finding new tools and techniques, and putting us in contact with the right people and knowledge at the right time. Learning is not only personalized, so is the service!

The Impact on Learning

Intelligent computer-assisted instruction has proven to improve learning exponentially, rather than incrementally.

The illustration on the right (Bloom, 1984) shows that for the average tutored students, achievement is better than 98% of the untutored classroom students.

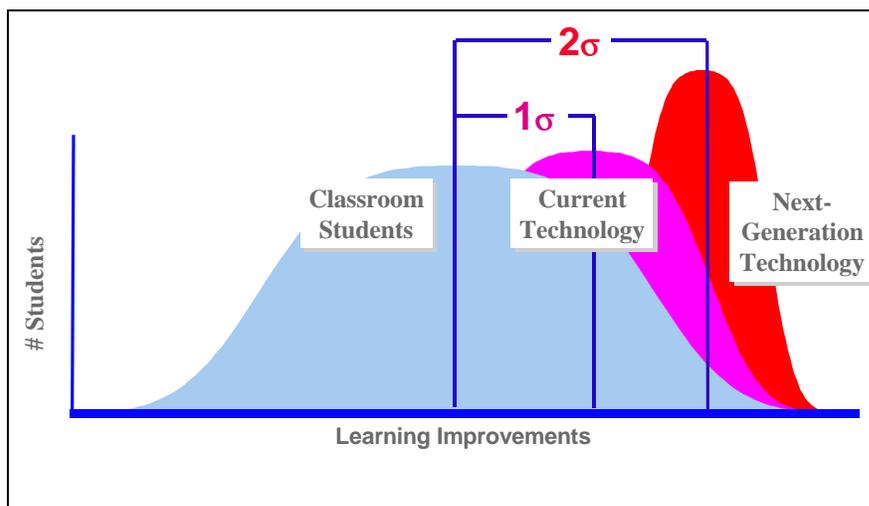
Advance Distributed Learning Network, 1999)

Out with the old; in with the new (basics, that is)

Technology will largely obviate the need for formal, event-based learning in the workplace that seeks to provide know-what and know-how. This change creates a demand for higher-order, highly transferable thinking skills of the know-why variety needed to work with the predominant performance support and augmented intelligence technologies.

Personal learning assistants and intelligent tutors

With “intelligent tutors” that look over our shoulders, anticipate what we will need next, and offer us suggestions for our next move, our rate of learning increases by two units of standard deviation (at least). With performance support, instead of going down blind alleys, we keep the course, and make faster and more accurate intuitive leaps. Teachers focus on helping us see the patterns that consistently affect our performance, rather than on correcting our mistakes as they arise. We encounter new tasks confidently, knowing we will be productive immediately, even while we are learning



Falling on the asymptote toward zero

Education and training focused on how to use technology, which make up the majority of all current IT training, testing and certification, fall closer to zero, obviated by human-centric design and transparency of technology, embedded knowledge, and performance support.

Balancing value, privacy and performance

Of course, the personalization of technology is rife with questions regarding privacy. The technology functions better the more it knows about us. How much you are willing to share and how far you are willing to let technology into your life is directly proportional to how much it can help you. There will therefore be a precarious balance between privacy, protection, trust, and rights, and the degree of benefits received.

Points to Ponder

<p>Work & Learning</p>	<p>How will we cultivate the characteristics that let us use technology wisely, and how can we know what those characteristics are?</p> <p>How can we rapidly expand the use of technology for training and re-training the adult workforce?</p>
<p>Individuals</p>	<p>As technology advances at its exponential pace, and as technical limitations are resolved equally quickly, our ability to develop innovative and creative applications becomes the limitation on how quickly benefits advance. How do we accelerate the rate of <i>human</i> advance?</p> <p>What basic skills are needed to function effectively in the new world of technology-enhanced performance?</p>
<p>Teams</p>	<p>How can we create teams that have cohesive identities, yet enough flexibility to allow the useful participation of short-term consultants?</p>
<p>Organizations</p>	<p>How can organizations encourage the creation of technology that enables us, and see that it reaches the marketplace?</p>
<p>Policy & Practice</p>	<p>What are public and private roles and responsibilities in developing intelligent technology supports for learning?</p> <p>How do we ensure that the necessary technology infrastructure for just-in-time access and delivery is available? What level of investment is required? What is the mix of public and private sector investment?</p> <p>The digital divide has its roots in more issues than the literal connections to technology. How do we ensure that all communities share the positive assumptions and expectations about the benefits of technology?</p>

Adults

Imagine.....

Adults (defined here as people who are in or about to enter the workforce) typically define themselves from several perspectives: as individuals, as professionals, as team players, as members of a community of practice, and as part of an organization.

- *We all know precisely what we need to know and learn at any given time.*
- *Every individual carries a detailed and continuously updated “inventory” of his or her skills and knowledge.*
- *For any given project, we can assemble the ideal team, based on skills, availability, costs, etc., and we know exactly what learning and support to provide for peak performance.*
- *Project teams learn as a single organism and get smarter as they work.*

Today	→ Tomorrow
Corporation	Project Team
Technology Operator	Process Manager
Mass Certification	Skills & Knowledge Inventory
Managed	Motivated
Control	Responsibility
Diverse Masses	Unique Individuals

AT A GLANCE

- *Individuals, teams, and communities replace employers/workers/customers.*
- *Personalization is the key to enabling personal best performance.*
- *The motivation of the individual will be at the heart of knowledge creation, and the relationship between individuals and organizations will undergo profound changes as we uncover issues of ownership, intellectual property rights, authority and responsibility, etc.*
- *Working and learning will be the same thing.*
- *To be all that they can be, people become both in control of and personally responsible for their own development and learning.*
- *People primarily identify themselves through project teams and communities of practice.*
- *Teams and communities are enabled to create and grow their community knowledge.*

The Vision

Multi-tasking now applies as much to individuals as it does to computers that can handle multiple tasks concurrently.

Large organizations perform more like schools of minnows than whales.

Cisco Systems has replaced “time to train” with “time to perform.” Sun Microsystems automatically assesses how long it will take to assemble a new project team, factoring in such things as personnel availability, competencies required by the team, and how long it will take team members to master necessary new skills.

The individual is in control of the future

We are each responsible for our own learning and personal and professional development. Workers concentrate on problem solving and customer service, as computers take over the linear, repetitive functions people used to do back in the twentieth century. The choices the individual makes determine the success of the organization, and what the individual chooses depends on what he or she knows.

Project teams: The new unit of working and learning

Once the domain of large corporations, projects are completed by autonomous, “virtual” organizations or project teams. These teams consist of inspired workers (individual contractors, advisors, sub-contractors large and small) who are equipped to make sound decisions on the fly...to initiate and innovate ...to execute good ideas in a snap. Work is but a series of projects. People move from one project team to the next, according to project needs, incentives offered, and their abilities, aptitudes, and preferences, often serving on more than one team at a time.

Organizational structures rise and fall

Adaptive virtual organizations replace rigid organizational structures, and the organization at any one time consists of the sum total of people and companies involved in successful completion of a project. Organizational structures form and re-form continuously in response to immediate needs. Large organizations perform more like schools of minnows than whales. Individuals recognize that continuous learning and nurturing of skills are vital to productivity and professional satisfaction. People seek opportunities to stretch themselves while employing their unique abilities, choosing jobs and projects that provide them with the best learning experiences and opportunities to excel.

Personalization is the key

Providing the opportunity for everyone to learn and perform at his or her personal and team best is accomplished through the ultimate in mass customization: personalization. This tailoring of technology, information, and support to match the unique characteristics that define any individual at a specific moment makes learning truly personal for every learner. This is an increasingly vital phenomenon in a world where people are much more different than alike. The workforce continuum expands in age (people expect to work productively into their eighties and nineties) and cultural background (in the United States, many minorities replace the majority). The highly diverse needs of this highly diverse workforce are met through focusing on the individual, and providing learning tailored exactly to their needs, saving time, money, and energy by optimizing their performance.

We all have a skills gap, all the time

When new knowledge is created at a rate faster than workers can learn it, a shortage results, no matter what the subject matter. This is not a problem that we need to fix. The skills gap is a ubiquitous characteristic of life in the future we envision, because everyone will have needs for new technology (and other) skills. Creating support for lifelong learning in a variety of forms is imperative to successfully addressing this fact.

The Impact on Learning

"In the knowledge-creating company, inventing new knowledge is not a specialized activity—the province of the R&D department or marketing or strategic planning. It is that way of behaving, indeed a way of being, in which everyone is a knowledge worker—that is to say, an entrepreneur."

Nonaka, 1991

Metcalf's Law is as true for networks and groups of people as it was for nodes on the web: The power of a network increases exponentially with each additional node. With networks, big is better -- ubiquity is the goal. The telephone network as an example: When only a few people had phones, the value was limited -- same thing with faxes. If one person is added to a project team of 10, the team's value does not increase by 10% but perhaps by 100% because of the connections and synergy the new person provides.

Shifting responsibilities for learning and educating

The relationship between individuals and organizations will undergo profound changes as we uncover issues of ownership, intellectual property rights, authority and responsibility, etc. The migration of control to the individual will have a profound impact on learning as individual learners place their unique demands on those seeking to meet them. Conversely, those in control of the learning, the individuals, also inherit the responsibility for their learning and performance, which will have equally profound implications and reverberations.

Storming, forming, norming, performing . . . And then what?

In a world where project teams are continuously forming and reforming, it becomes critical to be able to form them rapidly, bring the members together into cohesive groups, elicit their peak performance to complete the projects, and then dissolve them so the individuals can move on to new teams. Organizations must learn how to address the social implications and consequences of creating and dismantling teams, pulling people away from those with whom they have "bonded" and constantly shifting them onto new teams and new projects, with new roles, responsibilities, and even locations.

An effective project team acts more like a single organism than a collection of individuals, with its own capacity to learn and create knowledge as it works. Understanding how a team learns, being able to capture the new knowledge it produces, and fostering the relationships that define its identity become the critical success factors. What's the etiquette for mentoring someone twice your age with half your experience? Learning in organizations must effectively foster knowledge transfer across a wide range of ages, cultures, and experience.

Professional and personal profiles

As the experiences of individuals and teams are increasingly captured through tracking, recording, and analysis of their performance, there is the opportunity to develop extremely powerful profiling information. This can be used by individuals, teams and organizations alike for everything from credentialing, knowledge and skill inventories, hiring, compensation and recognition, mapping individuals to learning content, and much more. What's more, all this is fully portable and interoperable, enabling adults to build their performance portfolios continuously and take them along wherever they go.

Communities of knowledge and learning

It is human nature to form communities of like-minded people with common interests. This natural grouping is inevitable and powerful. While project teams represent a type of temporary community, it is the communities of professional interest or practice that prove to be most durable and effective, as they become the knowledge base or brain trust of each profession or practice. Aided by technology and driven by demand for new learning, each representative group grows this community knowledge pool as it captures nuggets of knowledge from each member and provides them to the individuals in the community.

Points to Ponder

<p>Work & Learning</p>	<p>Who controls and is responsible for work-related learning, if individuals control learning and are working predominantly in teams?</p> <p>When knowledge is created, who does it belong to?</p> <p>Who tracks the learning profile of adults and what issues related to privacy must be addressed through public policy?</p>
<p>Individuals</p>	<p>In the previous economy, ROI represents “return on investment.” In the new knowledge-based economy, ROI represents “return on <i>individual</i>.”</p> <p>How do you pay a person for inspiration?</p> <p>How do we balance individual rights and responsibilities in ways that offer some protection to the learner and guidance to the employer/organization?</p>
<p>Teams</p>	<p>As we increasingly understand teams as single organisms, how will we assign responsibility and compensate individual excellence?</p> <p>Project teams by definition exist for a finite time and then need to be dissolved. How do we deal effectively with the human resistance to breaking up such well-formed and bonded teams?</p>
<p>Organizations</p>	<p>How do organizations most effectively shift the focus of their capital investments to the new priority of the knowledge-based economy, human capital? How do they account for and value this?</p> <p>“Democratization” as a byproduct of technology-driven learning will mean that organizational success will depend upon a responsible, well informed, and educated populace. What kind of cooperation and shared vision will be needed to produce this?</p>
<p>Policy & Practice</p>	<p>Who tracks the learning profiles of adults and what issues related to privacy must be addressed through public policy?</p> <p>What policy change, creation, and application are needed to match the completely new valuations of assets when most assets are intangible?</p> <p>What new systems of certification and credentialing of competencies are needed and what are the public and private responsibilities for creating and maintaining such systems?</p> <p>Is a learning profile as confidential as a medical record?</p> <p>How can individuals, organizations, and governments change the system while operating within it?</p>

Learnativity

Imagine.....

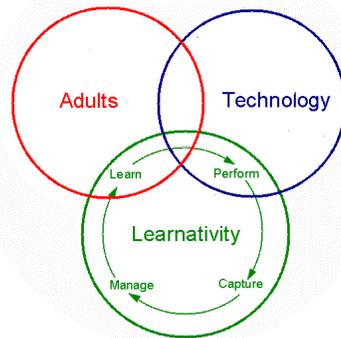
Convergence

Perhaps the most prevalent theme of the future is convergence. Technologies converge to create new technologies, and professional skills converge to create new professions. However, these convergences pale in comparison to the implosion of learning, working, capturing knowledge, and the management of their sum total. These previously disparate and relatively independent activities have converged to become one. Just as in nuclear fusion, their intersection creates a previously unimagined new state producing equally unimaginable amounts of creativity, innovation, productivity, and performance. This fusion creates an infinite supply of the new energy source of the new economy: *knowledge*.

Learnativity?

It is perhaps revealing that we do not have a word or a name for this new state. What do you call that which you and ever other person are doing every day as you solve problems, work, plan,

communicate, and learn? When they used to stand still long enough, when they were independent activities, we simply called them by their own names. But when they happen all at once and all the time, fused together into one single state of just being, what do we call it? For the purpose of this paper we will call it *learnativity*.



- *There is a new way of being that fuses learning, working, creativity, and knowledge creation into a single synchronous state.*

AT A GLANCE

- ▶ Learnativity, the nuclear fusion of capturing and managing knowledge, learning, and performing, releases the power of individuals and teams.
- ▶ Human attention is becoming our most scarce and most precious resource.
- ▶ Learning becomes a part of working and working becomes a part of learning.
- ▶ Learnativity creates an infinite supply of knowledge, the raw resource of the new knowledge-based economy.



The Learnativity Spiral

Redefining learning, working and knowledge

Expertise used to demand constant improvement of one's ability to perform the tasks or skills of a profession or trade. However, as multiple professions converge and fuse, as tasks and skills are constantly replaced with new ones at an ever-increasing rate, expertise becomes a matter of steadily renewing one's knowledge base and extending it to new areas. Critical expertise has transformed into the continuous creation and acquisition of knowledge and skills. This lifelong cycle of learning is the new foundation of personal self-worth and that of all teams and organizations. One's primary responsibility, and perhaps the only sustainable competitive advantage, is to improve one's ability to learn and apply the right things faster.

Putting learning (back) into context and motion

A classic and historical problem with most approaches to education and training has been to see learning as an end in itself, an activity that is designed and studied independent of the learner and most importantly, independent of the overall system within which it works. Learnativity is *not* a mechanical, static, linear process, nor one that can be understood by examining any of its components outside of its systemic context. It is a very human, dynamic, and complex flow that resembles an organic structure more than a mechanical one.



The Learnativity Spiral

Knowledge creation in action

Learnativity is knowledge in action, a continuous spiraling conversion of tacit knowledge (such as know-how and experience) into explicit knowledge that can be captured, shared with others, diffused within groups, and turned back into new tacit knowledge gained from learning by doing. Learnativity is a way of continuously creating new, actionable knowledge. The key is to see this as a single state, with the following four primary elements swirling within:

Performing

Let's start where we want individuals, teams, and organizations to end: peak performance. Performing, as used in this paper, refers to the application of knowledge. We put knowledge to work, solving problems. Performing is the integration and application of knowledge in the activities, products, and services of the project team or organization. Explicit knowledge converts to tacit as successful performance achieves results and the workers move on.

Capturing

Capturing knowledge means converting it from a tacit state into an explicit, comprehensible form – such as a video, a simulation, a model, or words and illustrations in a document – so that others can understand it.

Managing

Management of information, learning, and performance is the conversion of explicit knowledge (formal and expressed) into complex and valuable combinations of ideas, insights, and experiences so they can be shared with others.

Learning

Learning is the means by which tacit knowledge (informal and subjective) is exchanged between individuals and between the learner and the learning resources. It is therefore both social and personal in nature. It occurs in both formal and informal settings, and includes connections and direct interaction among people. Learning is also the personal transformation from explicit to tacit within the individual through reading, observation, and reflective thought.

While this is obviously a complex model, we can use a simple example to illustrate. As the owner of a small business, you continuously learn what the customers like or dislike by walking around, asking questions, speaking with them and with the employees. You write down what you've learned or you invite your customers to fill out questionnaires and make suggestions. You share what you learn with your employees and invite them to suggest ways that the products and services you provide might be improved. Finally, you put these suggestions into action, incrementally improving your business and ensuring that your clientele remains loyal.

This all takes place on an ongoing basis within the context of this group of individuals and this company. It yields a sense of loyalty and value, a sense of purpose and accomplishment, for all those involved. This group bonding and learning produces yet more valuable knowledge, which can be subsequently utilized to bring more value to those being served, in the form of tangible services and goods.

Organizations that are successful in the creation and management of knowledge cannot mandate that knowledge will be created, nor can they automate the process. The organization can, however, provide conditions, an environment, that will foster, nurture and support this type continuous learning, which in turn results in peak performance.

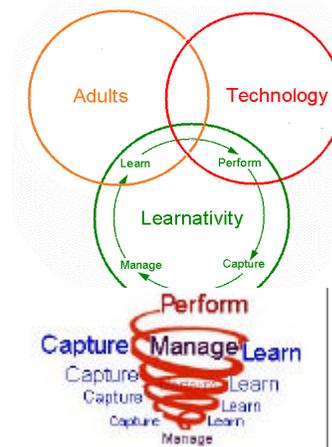
It may seem that learning has been eliminated when in fact it has just faded from conscious awareness as it increasingly embeds itself into our products, services, tools, and technology. Learning takes its rightful place as a fundamental requirement of just being. It is no longer always an event, an activity, that is divorced from the rest of our life and existence. Perhaps this is the ultimate form of the much-discussed convergence we see happening in most other areas, such as technology.

The four elements of learnativity:

In the following four sections, we examine each of these elements, always with the understanding that they do not exist individually, but are integrated in the single state of learnativity.

Understanding such a complex fusion presents a fundamental challenge. It is too complex to consider all at once, yet if we break it down into smaller pieces and examine them independently, it is no longer a fused whole. Our solution here is to do both. We will identify and study the four different elements of learnativity capturing, learning, managing and performing and we will constantly observe their connections and context as being part of a single unified state of being.

Learnativity is much more than just a word or a term. It is literally a new existence, a new way of living, a new way of being who we are.





Performing

Imagine.....

- Working and learning are synonymous and synchronous activities.
- Peak performance is a continuous state, first time, every time.
- Working and learning are all project-based.

You know. But can you perform?

Technology, learning, knowledge, content, and the management of these things are all only the means to the end we seek: constant improvement and peak performance. In the future, these means continue to fade from view as the lens of performance brings everything into clearer focus. As Paul Strassmann says in his book, *Information Productivity*, “Knowledge-based strategies cannot be developed unless they are linked to measures of performance.” Just as informal learning is now understood as the primary and most effective means of learning, so is learning while performing real tasks (a.k.a. working) understood as a new-age version of *apprenticeship*. Learning and learning technology find a very comfortable fit in this context of performance in the workplace. Measuring the end result, the performance, provides one of the more meaningful benchmarks against which to make smart decisions, determine benefits, and provide meaningful assessments for improvement

AT A GLANCE

- ▶ Effectiveness, rather than efficiency, is the new measure of performance.
- ▶ Cognitive readiness is the goal state of being.
- ▶ Innovation becomes the primary source of increased performance, creating new ways of solving problems faster, better, and more cost effectively.
- ▶ The bottleneck of human performance is in the limitations of available attention and learning capacity.
- ▶ Performance support technology enables peak performance for all by supplying continuously adaptive and dynamic support in real time as we work.
- ▶ People do not predominately *operate* technology; it is ubiquitously present, augmenting individual and team knowledge and performance.

Today	→ Tomorrow
Organizations	Project Teams
Time to Train	Time to Perform
Generic Technology	Job/Task Specific Technology
Incremental Improvements	Order of Magnitude Gains
Automating Known Process	Innovative New Process
Pre-planned Training	Adaptive Performance Support
Trained	Readiness
Technology Operators	Process Managers

PERFORMING *The Vision*

Poised for the performance and productivity explosion

We are now on an exponential productivity gain curve into the future. In terms of performance/productivity, humanity has experienced major phase changes in the past. Consider the Industrial Revolution. Adam Smith described how we moved from the age of guilds and crafts to the age of mass manufacturing. “[Smith] showed that the factory workers of the industrial age were not 2 times or 10 times more productive than craftsmen were, but 5,000 times more productive. A key reason that specialized workers can produce so much more is their faster process of learning. Each worker has to master only one part of the process. Because he gets to apply his intelligence to that one component more frequently, he accelerates his learning” (George Gilder, 1999). In the factories, learning was captured, converged, and utilized to create an overwhelming increase in performance. However, it might be argued that it was a case of machines, rather than humans, becoming more productive. In any case, we moved from shovels to bulldozers and the gains were dramatic.

In epidemiology, a tipping point is the nearly instantaneous shift from a few people having the flu to a full-scale epidemic. Our economy and our society are today at a tipping point. Enough little changes are present to usher in a sweeping, seismic change that will change what we mean by working and learning.

The Industrial Revolution’s 5,000-fold increase in productivity was created over a period of years in a time when capital was scarce, equipment was expensive, standards were rare, communication was slow, the path was unclear, and getting anything done required assembling every worker in one building.

It is a much different scenario in the new knowledge-based economy. Technology and the Internet erase many of the historical obstacles and create expanding numbers of opportunities. Capital flows freely, bits are replacing atoms, systems operate on a universal language of open standards, communication is instantaneous, and perhaps most important, we can envision the future.

The Vision

Efficiency is doing things right.

Effectiveness is doing the right things.

Recognize knowledge and technology as key enablers, but do NOT confuse them with results!

Innovation vs. automation: Effectiveness over efficiency

In the new knowledge-based economy, efficiency takes a back seat to effectiveness as entirely new and innovative ways of delivering value to those being served become the norm. By not having to spend so much time operating machines or technologies, people have more time to focus on putting technology to work in wholly new and innovative new ways to achieve the desired end result.

Computer-assisted design (CAD) is a good example. CAD was originally hailed as “revolutionary” and highly productive when used by architects and drafters to draw up plans using a mouse and keyboard instead of pencil and drafting board. Because it was more accurate, much faster at redesigning, and able to produce more drawings faster, it certainly provided a performance gain. Or did it? Was the objective to create better drawings, or to create better houses? With more innovative thinking, CAD came to be used to create simulated 3D models that, when combined with virtual or augmented reality technology, let the customer know what it would be like to walk around a kitchen before it was built. The innovation came at the level of exploring the product’s potential effectiveness in achieving the end goal (a great house) rather than increasing the efficiency of the means (drafting).

Performance becomes less a matter of getting the job done than of redefining how to do the job, eliminating previous procedures and going after entirely new ideas for achieving the same end results. Innovation becomes the primary source of increased performance, and as such, the most valued ability of any individual, project team, or organization.

What does it mean to be competitive?

Individual, project team, and organizational performance form a continuous loop. When considering how to increase productivity and performance, it’s important to see the performer both as an individual and as a member of a group. Performance for the individual means problem solving, utilizing creativity, and sharpening or adding new skills. For the project team, it means completing the project and meeting or exceeding expectations. For the organization, it means fulfilling its mission better than any other.

Much of this is driven by the new choices available to those being served. When technology makes it is quick and easy for anyone to locate every available product or service that meets a given criteria, find out how it is rated by experts and other consumers, learn how to determine and refine choices, and even have suppliers bid for the business, there arises a whole new definition and understanding of what it means to be competitive in the new economy. Whether it is the individual, the team, or the organization, being competitive means being the best choice available and providing the best overall experience for whoever is being served.

The Vision

The motivation factor

Peak performance as a goal has the additional benefit of providing much of the critical motivation for individuals and groups. Learning and performing to either personal or team best is a primary part of people's sense of self-worth and pride. Professionally, people learn in order to improve their performance within their occupations and contribute to the larger world as members of their communities of practice. This sense of position relative to one's professional peers is a similarly significant motivation factor and determinant of an individual's sense of self-worth.

Project teams as single organisms

Project teams have a set of behaviors and characteristics that are strikingly similar to those of any living organism. Just as with an individual, the performance of a project team is primarily rooted in its ability to learn and to respond effectively in solving problems and completing the project at hand. Unlike the individual, though, performing teams have just one goal: to complete the project successfully.

Project teams supported by collaborative technologies

Technology not only enriches the individual through continual, unobtrusive performance support, it offers the same benefits to teams. Team-level tutoring assists the interpersonal functioning of the group, smoothing the exchange and utilization of information. Ongoing evaluation programs provide continual course correction. People matching (finding supply to meet demand, connecting on the basis of interest or expertise) through real-time audio and visual communication provides teams with the flexibility, accountability, and easy communication that lead to better performance.

The primary responsibility and commitment of an employer may well be to provide the opportunity for their employees to excel.

Organizational performance

Peak performance for the organization means learning, identifying, and managing the potential of all the individuals involved--mixing them in just the right way and at just the right time to elicit optimal productivity. It may well be that the primary responsibility of employers and organizations is to provide opportunities for the people and teams within them to excel. They create environments that foster learning and performance conducive to success, recruit and retain the right talent to match their chosen mission, develop new business opportunities, and provide other attributes that support peak performance of individuals and project teams.

Performance portfolios

The tracking and recording of performance create a continuously updated professional and personal profile for every individual. Management systems and standards make this information fully portable, enabling the individuals to take it along wherever they go and use their skills, knowledge, and performance histories to assist them in everything from securing new places on project teams to matching compensation and learning to creating project teams. However, the information is kept confidential through extremely robust and unambiguous security and privacy measures.

The Impact on Learning

Performance: The measure and the means of learning

Performance-based learning is the result of a transition from “teaching by telling” to “learning by doing,” assisted by technological and human coaches providing the low-level and high-level support. Learning is facilitated through technology (such as simulations and augmented reality) that lets us participate fully in the experience without risk or expense.

Learning by doing

Learning by doing predominates as methods such as simulation, performance support, and augmented reality become the norm rather than the exception. We have known for a long time that people learn best by doing. There’s something about plunging right in that accelerates our grasp of new skills. Simulations that let us behave as though we were really there move learning to the verge of performing. Flight simulators that capture the knowledge of the best pilots let the student fly through dangerous weather without risk. Physicians in training perform operations on authentically behaving and reacting “virtual patients” who are indistinguishable from the real deal. Teachers now focus on mentoring, motivating, creating simulated crises, showing how failures are attributable to poor communication or lack of foresight, and identifying areas in which the teams excel or fall short.

Augmented reality provides augmented performance

Virtual and simulated reality is replaced by augmented reality technology. Instead of simulating an environment, the real one is augmented with overlays and additional inputs of information and knowledge. For example, a surgeon is guided by augmented reality through her first use of a new surgical technology and is able to perform with mastery. The augmented reality might include something like an “advanced déjà vu” retinal projection. This would enable her to perform the operation with full competence by seeing, feeling, hearing and smelling not only the “real” reality, but also five seconds into the future via the augmentation that has been overlaid on top. This technology would be fully adaptive, in real time, to the surgeon, the other professionals present, and the patient, responding and adjusting constantly as it monitors all the inputs of their vital statistics, movement, and medical equipment.

Frequency of repetition fades; so do the old “basics”

Repetition and mastery as ways of achieving excellence are being replaced by unique solutions to each problem. As the frequency of performing a given task the same way drops toward zero, the time between learning and applying what was learned increases, making fixed and pre-determined learning virtually useless. Various forms of performance support and just-in-time delivery of just the right information resolve this problem. Instead of “know-what” (facts and figures) or even “know-how,” it is “know-why” that emerges as the most critical skill set for adults to have. The new basics of education and training shift to higher-order skills and knowledge that are, perhaps most surprising and valuable of all, highly transferable. These new basic skills include innovation, problem solving, creativity, analysis, diagnostics, planning, and the ability to capture and articulate the results of such knowledge work in order to share with others.

The Impact on Learning

Innovation requires learning to learn, all over again

Innovative new processes and technology require innovative thinking. Learning whole new ways of doing things means un-learning previous ways, abandoning conventional wisdom, and changing well-established habits. Learning therefore becomes a “subject” and skill that can itself be learned and continuously improved. It is one of the new basic skills of the future.

Learning is dissolved into working and performing

Learning and performance-support technology, combined with the ubiquitous infrastructure connecting every person, place, and thing, allows learning content to be supplied in micro-quantities “dissolved” into the flow and context of the work being performed. Just as technology fades from our conscious awareness, so does learning become embedded in almost all aspects and all times of work and life. This life-long learning more closely resembles the continuous intake of oxygen by breathing than the intermittent intake of food by eating.

Performance support requires performance learners

As performance support becomes the norm for most jobs and tasks, it is possible to deal with the increasingly frequent situation of everyone being a novice. Drafters and cartoon animators need to become 3D modelers, hamburger flippers need to become food processing managers, and cashiers need to become customer service experts. Performance support not only lets people master new technologies, it helps them accommodate innovative processes that require whole new ways of doing something.

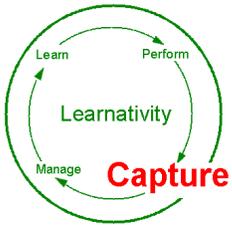
Exponential curves are deceiving

Most of us have never experienced an exponential increase. For the longest time at the beginning, there doesn't appear to be much change at all, and later, when there is some noticeable change, it seems to be very linear. In the early years of the new knowledge-based economy there were plenty of detractors who noted this apparent lack of performance results. However with every tick of the clock an exponential curve gets ever steeper, ever faster, and in the case of the new knowledge-based economy, productivity and results appeared unexpectedly to start shooting straight up.. Stepping back, we see that the evidence showed that the rate of increase was exponential, and we realize that this phenomenon was actually highly predictable.

As organizations cycle through the knowledge creation and learnativity spiral ever faster, we are poised on the verge of experiencing 5000-fold gains in learning and performance, as we did in the Industrial Revolution. However, this time the cycles are measured in seconds, minutes, and hours rather than years, decades, and centuries.

Points to Ponder

<p>Working & Learning</p>	<p>How can the ability to “think outside the box,” to innovate rather than refine, be identified, cultivated, and rewarded?</p> <p>With greater integration of work and learning, how should work be defined for purposes of compensation?</p>
<p>Individuals</p>	<ul style="list-style-type: none"> • Short of joining an organization for life, how can individuals “keep” the fruits of their labors, since in the knowledge economy that is what they have to sell? <p>What is it worth to know what <i>not</i> to do?</p> <p>Is cognitive readiness the ultimate goal for the workforce?</p>
<p>Teams</p>	<p><i>What are the incentives organizations can offer to encourage peak performance?</i></p> <p>When team performance proceeds seamlessly, how can individual contributions be recognized?</p>
<p>Organizations</p>	<p><i>How can organizations promote learning as a way of life and the innovative thinking it stimulates?</i></p> <p>How do we make information and knowledge an explicit measure of performance?</p>
<p>Policy & Practice</p>	<p><i>The metric for learning will increasingly be its effectiveness at improving human performance. Many of the current policies are based on a metric of learning in and of itself, such as how much an individual “knows” on the basis of memorization of facts and figures or the performance of set routines, both of which are increasingly obviated by technology and the ubiquitous access to information anytime, anywhere. How will new performance metrics be developed and implemented? Who is responsible for this?</i></p> <p>What are the implications of a competency-based approach for credit, credentialing, and financing systems?</p> <p>What incentives and supports might be put into place to expand learning and performing for those in low-skilled, entry-level positions?</p> <p>How can policies and practices work to better transform the recognition and reward of workers from measurements of how much they do and how hard they work to how productive they are at creating the new knowledge and better ideas that lead to sustainable and scalable success? How to you reward someone for thinking?</p>



Capturing Knowledge:

Imagine.....

The most valuable natural resources of the new knowledge-based economy are the know-how and expertise trapped in the heads of best performers. Like other natural resources, this knowledge has no value until it is extracted, refined, and put to use.

The goal is to convert what's second nature to an individual into a form that can be shared with others in conversation, a model or simulation, illustrations, the written word, or other means. Moreover, we automatically repackage knowledge and deliver just what a learner needs to know, no more and no less.

"Information causes change; if it doesn't, it isn't information."

Claude Shannon

"You are sitting in a chair" is not information. "The person sitting beside you has an infectious disease"--

THAT is information!

James Burke

Information redefined

Information informs. Otherwise it is just interference or noise competing for your all-too-scarce and precious time and attention. Information resides in many varieties of media: graphic, audio, anything that you perceive that has value. A painting is information, a concerto is information, a recorded conversation is information, experience is information.

- All the information you receive truly informs you. It is neither redundant nor superfluous. It is just what you need, when you need it, and it causes a change in what you think or do.
- Continuous and automatic knowledge capture happens dependably.

AT A GLANCE

- ▶ Rapid, robust and rigorous extraction of what people know (tacit information) is converted into readily sharable, small chunks of reusable and manageable information objects.
- ▶ Simulations are readily available for all appropriate applications and situations.
- ▶ Technologies enable the routine and rapid development of affordable, adaptive environments and content that are robust and reliable.

Effective capturing of knowledge requires:

- **rethinking** what constitutes information
- **chunking** information into tiny pieces
- **labeling** the pieces (or "objects") with descriptors ("metadata")
- **adopting common standards** for connecting the pieces
- **profiling** the needs of the learner

Today	Tomorrow
Mega Content Containers	Information Objects
Keywords	Metadata
Static Content	Dynamic Content
Proprietary Authored	Standards-based Interoperability
Power Publishers	Self-Publishing

The Vision

Information causes change; if it doesn't, it isn't information.

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"You are sitting in a chair" is not information. "The person sitting beside you has an infectious disease"-- **THAT** is information!

James Burke

Chunking information into small, reusable objects

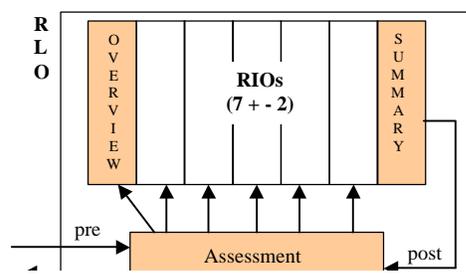
Size matters: Smaller is better. Before digital convergence, learning and information were usually trapped in oversized containers, designed for delivery to many people at once in the name of efficiency. In this assembly-line style of learning, courses came in one-hour chunks, off-site workshops in one-day chunks, and an MBA was only available in a two-year package. People had to plod through irrelevant information (noise and interference by our definition of information) in order to get at what they needed to learn, solve the problem at hand, and be productive. It didn't matter that they already knew or didn't need to know most of it. You got whatever other people decided you needed, when they decided to make it available, and packaged the way they wanted to deliver it.

With digital convergence, knowledge and skills needed to be taught in self-paced, media driven formats such as the Web. The reusable information object strategy addressed this problem, necessitating a shift in how content was designed, developed, and published.



CISCO SYSTEMS RLO MODEL

A reusable learning object (RLO) is a collection of seven plus or minus two reusable information objects (RIOs) that are grouped together to teach a common job task based on a single learning objective. In order to make the collection of RIOs into a complete *learning experience* or "Lesson," an Overview, Summary and Assessment are added.

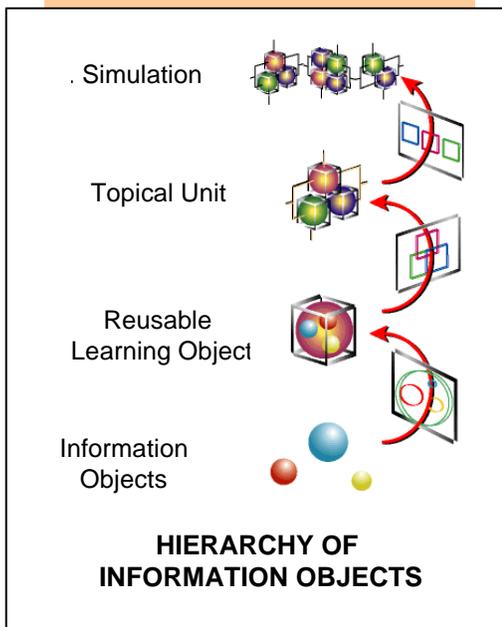


Information objects: Knowledge building blocks

Breaking knowledge down into information objects, the smallest useful chunks of information, frees it to be used again. Think of this as creating and assembling Lego™ blocks. Whether you're assembling a bridge or a house or a spaceship, you use the same Lego™ pieces. Similarly, personalized learning can use – and reuse – the same content or information "objects." Using these as the basic building blocks, the just-right assembly of personalized learning content can be easily created to form a "learning object." Depending on the amount of content required for the individual, these can be further aggregated in a hierarchy of these assemblies or learning objects nested within each other. The Cisco Systems example on the left shows their implementation of this powerful model. As with their Lego™ counterparts, these can all be disassembled and reused again and again to create entirely new and different learning experiences, tailored exactly to the people who need them.

The power of this dynamic, adaptive assembling of information is equivalent to Eli Whitney's invention of interchangeable parts. Information is rendered reusable, interchangeable, durable, accessible, and affordable

CAPTURING *The Vision*



The microtization of information by having it all available for selection and filtering from a common pool of small stand-alone information objects enables the creation of truly effective information (that which informs) and lets us have it “just right.” The power of this dynamic, adaptive assembling of information is equivalent to Eli Whitney’s invention of interchangeable parts. Information is rendered reusable, interchangeable, durable, accessible, and affordable.

Metadata

Metadata enables us to assemble learning objects automatically. Metadata is information about information. A map provides metadata about geography. It’s tough to navigate the World Wide Web because it *lacks* metadata. Being without metadata is akin to trying to find a house when someone’s taken away all the street signs, or to prepare a meal from cans that have no labels. Metadata is the full and rich set of information you and technology need in order to find, filter, select, and combine the information that is out there.

For a system to assemble learning objects automatically, it needs to know what each object contains. We tell it what’s what by tagging each object with descriptive metadata.

Subjective and objective metadata

Metadata comes in two flavors: objective and subjective. *Objective metadata* is factual information, most of which can be generated automatically – things such as physical attributes, date, author, operational requirements, costs, identification numbers, and ownership. *Subjective metadata* is the more varied and valuable attributes of an information object determined by the person or group who creates the metadata. The labels on the cans are objective metadata; your opinion of the product, or whether it worked as well as a fresh ingredient in your favorite spaghetti sauce, is subjective metadata. With new technology that can extract and recognize these attributes, it is possible to find, combine, and use not only text-based information but also a person’s face, a sound, a smell, a shape, or “things like _____”. Imagine the possibilities . . .

As personalization becomes the key element of learning, subjective metadata becomes increasingly important. The value of the chunk goes up as its associated metadata increases in volume, richness, and completeness; the value of the chunk also goes up as it approaches its smallest potentially useful size.

Gathering metadata isn’t necessarily labor intensive

Technology to capture metadata, especially objective, uses advanced pattern recognition to automate the categorization, cross-referencing, hyperlinking, and presentation of information, virtually eliminating the need for manual labor for this part of the process.

The Vision

Imagine this...

Start with a generic flight simulator template. Have access to repositories of reusable information objects that contain such data as terrain maps, specific aircraft instrument panels, laws of flight and physics, and best practice information from recent top-gun testing and analysis. Combine these information objects with metadata that provides all the attributes of this information and profiles of the individual in the simulator, and you have a fully adaptive learning environment for a pilot. It would not only be able to simulate the flight and behavior of any given airplane, it would also provide the terrain for any location in the world and specific flight patterns and missions. It could challenge the learner with adaptive levels of difficulty, including such factors as inclement weather, mechanical failures, etc. Taken a step further and put into a real aircraft, this can now form augmented reality and performance support, not just simulation.

Now imagine that these simulator templates, this type of reusable information and this metadata, are all readily available for literally any function, job, or task you can name.

Assessment

Working with people means relying on metadata about them. When metadata isn't available, colleagues don't know how to take advantage of the learner's expertise. Organizations aren't able to make rational job assignments and fail to reward knowledge of particular value. Hence the need for assessment and certification. Assessment and certification make explicit what learners know and don't know, enabling learning management systems to help fill in the gaps.

Intelligent agent technology maintains dynamic mappings between student test results, certifications, and skill requirements to ensure appropriate choice of assignments, hiring, and automated professional improvement plans and strategies for both individuals and teams. When assessment is an automatic, ongoing aspect of individual and team performance, it is possible to construct integrated, seamless education and training that increases productivity on all fronts. It allows cost-effective training to be effectively managed, tailored to the needs of individual learners (personalized) and to the context of working and performing.

Content-on-demand

Storing all available information objects and all their associated metadata in multiple repositories and managing them with a content management system makes all content readily accessible from a virtual single source. There are actually multiple repositories, but because everything from the information objects to the metadata to the architecture is based on accredited and open standards for interoperability and reusability, all these repositories can be accessed and managed such that they are available as one enormous "pool" of content, information, and metadata. Verification and validation tool suites and "underwriter laboratories" function to certify the quality and reliability of objects. All the metadata and information objects you would ever need are stored in a practical repository of reusable, verified, and validated instructional objects that conform to federal mandates, and include payment mechanisms to reimburse authors.

Simulations get real (available, that is)

Common, affordable, easily created simulations are published for almost any situation, job, and task. They are adaptable to the level of the individual, and replicate any known (current) set of data on such things as geography, terrain, weather conditions, equipment, etc. They can also simulate imagined or possible future scenarios. Dynamic content simulations include behaviors of other virtual people in the simulation and full consequential results. Multi-player simulations allow the addition of other real people in the same simulation, and this is scalable to include large numbers of individuals (thousands) to be involved in the same simulation (thus making this more of an augmented reality than a fully virtual one). Once the unique domain of high-risk professions such as pilots and emergency response teams with large budgets, simulations are now easy and affordable due to a plethora of new authoring tools.

CAPTURING The Impact on Learning

The “**ABILITIES**” list of content enablers:

Accessibility: access instructional components from one remote location and deliver them to many other locations

Interoperability: use instructional components developed in one location with one set of tools or platform in another location with a different set of tools or platform

Adaptability: tailor instruction to individual and situational needs

Reusability: incorporate instructional components into multiple applications

Durability: operate instructional components when base technology changes, without redesign or recoding

Affordability: increase learning effectiveness significantly while reducing time and costs

M. Parmentier, 1999

Standards

Widely adopted, open, and accredited standards are a fundamental requirement. Revolutionary changes do not “take off” or hit their inflection point without widespread adoption of common standards. In the case of electricity, this was the standardization of voltage and plugs; for railroads, the standard gauge of the tracks; and for the Internet, the common standards of TCP/IP, HTTP, and HTML.

Common standards for metadata, learning objects, and learning architecture are mandatory for the similar success of the knowledge economy and future. The “abilities” listed on the left illustrate the benefits of a future where these are all enabled through widespread adoption and application of open standards.

Capturing experience

When technology is able to capture and learn from its own experience and from its user, it gains a critical new power: accurate prediction of what will be needed next, in terms of information it can provide or suggestions it can offer. This is possible through the analysis of the experiential knowledge that has been collected, and it creates new knowledge in the form of patterns and profiles. It has often been overlooked that just-in-time learning and performance support are *only* possible with this predictability. Learning is now truly as adaptive as the technology itself.

Profiling learners

No system can personalize a learning experience for a total stranger. To avoid redundancy, the system must know what the learner already knows. To assemble appropriate learning experiences, it must know about the learner’s past experiences, learning preferences, career goals, and more. Personal profiling enables new approaches to productivity. A profiling system that automatically identifies people’s areas of expertise based on the issues they research on the Internet, the ideas in their documents, the e-mail messages they create, and the topics they follow in their knowledge bases facilitates creation of virtual workgroups, encourages communication, and reduces duplication of effort.

The more a learning system knows about a learner, the greater the opportunity to provide on-target information. At the same time, one’s learning record should be at least as secure as one’s credit record and medical record.

The ability to capture knowledge such that it can be analyzed, reused, and shared with others, thus developing a spiraling of more new knowledge creation, is perhaps the most powerful promise information technology can provide. The impact on learning of just-right information flowing to the right place, person and time, cannot be overstated.

Points to Ponder

<p>Work & Learning</p>	<ul style="list-style-type: none"> • Knowledge creation, the capturing of what people know from their experience, their thinking, their observations and their learning, is not currently on many job descriptions in the workforce. • If the requisite for the knowledge economy is being able to capture the knowledge of everyone, given that everyone has knowledge to contribute, then expectations, behaviors and roles will have to change dramatically.
<p>Individuals</p>	<ul style="list-style-type: none"> • • Capturing the knowledge of individuals will necessitate the restructuring of fundamental systems such as rights of privacy of personal information, ownership, recognition, and payment for intellectual property. •
<p>Teams</p>	<ul style="list-style-type: none"> • Who owns content?
<p>Organizations</p>	<ul style="list-style-type: none"> • How does any organization determine the right allocation of resources for converting, capturing, and indexing (creating metadata) for information that already exists, balanced against the return realized on this investment? • • Will this new form of wealth (knowledge) be hoarded by corporations, or will there be grand alliances and mergers - mega businesses and brain trusts.
<p>Policy & Practice</p>	<ul style="list-style-type: none"> • • What are the public and private sector roles in developing, maintaining and implementing common standards for metadata, learning objects and learning architecture to assure access, interoperability, adaptability, reusability, durability and affordability of learning? • How can the investment of organizations, state and local governments, or other entities in knowledge and information be secured for return-on-investment? How can such investment be encouraged? • Who will write the “Learner’s Bill of Rights?” • What public policy questions regarding intellectual property rights are raised by the envisioned changes in technology and adult learning? •



Managing

Imagine.....

All the best technology, content, and metadata in the world are virtually worthless until they are well managed and put into action. Action is worthless unless it is well managed and directed towards solving a worthwhile problem. Almost any work can be seen as a series of continuous decisions: what to pay attention to at that moment, what direction to turn, what question to ask, what technique to use, etc. The ideal, of course, would be to make every one of these decisions the right decision for the situation.

We used to think this was possible only in hindsight. However, in the new economy, all the information, resources, people, and technology function within an environment where our existing hindsight is continuously and thoroughly mined and managed. This creates new knowledge, which can be captured and added to the overall knowledge or information pool, where it is put into action through the management infrastructure.

Now all the right information can be provided to all the right people at all the right times and in all the right contexts, which enables the right decisions to be made, every time. "Right" in this case is defined much as it always was: the best of what is known at the time to produce the desired result, based on the situation and the information that is available. The difference between then and now is that both the situation and the information have changed. Both are radically improved, so that "best" continuously becomes a whole lot better.

Today	Tomorrow
Independent Patchwork	Networked Learning Infrastructure
Proprietary	Open Standards
Disconnected	Connected
Help Yourself	Delivered to You
Figure It Out	Let Me Help You Decide
Hindsight	Foresight
Good Guess	Best Decision
As Good as You Can Remember	As Good as Possible

- *There is a ubiquitous, transparent, standards-based management system and infrastructure.*
- *Hindsight is available as foresight, and every decision you make, big or small, is the best one you could make.*
- *Every project is automatically managed for peak results.*

AT A GLANCE

- ▶ In a world characterized by plentitude and abundance, human attention has become the most scarce resource. Management of information, learning, and performance works to optimize people's time and attention.
- ▶ Open standards enable the critical abilities: reusability, interoperability, discoverability, and manageability itself.
- ▶ A global and national learning management infrastructure provides the critical connections between all things and all people.
- ▶ Making the best decision every time becomes a reality within a learnativity management system that provides continuous decision support.
- ▶ Managing information means getting it all "just right": putting together just the right mix in just the right way and delivering it just in time to just the right person, requiring a simultaneous focus on the content itself and on the people who will be using it.
- ▶ The ability to accurately predict what someone needs to know or do unlocks the promise of continuous peak performance.

The Vision

Knowledge resource management

Given that all four of the learnativity elements--performing, capturing, managing and learning -- create knowledge through the effective utilization of resources, it is useful to think in terms of *knowledge resource management*. This is the underlying process and infrastructure required to enable the scenario described above to exist. It forms the transparent and ubiquitous foundation for effective working, learning, capturing (of knowledge) and performing. The management infrastructure lets us create and share knowledge by connecting everything to everything, everyone to everyone, and managing the resultant intersections and connections. This is *not* a simple set of point-to-point connections. It is a complex, interwoven set of dynamic and adaptive relationships that are constantly evolving, growing, and changing. In this process, additional new knowledge is created, spiraling every upward and onward.

Management technology and infrastructure: A mirror?

An increasing body of evidence suggests that it is not entirely coincidental how much more this knowledge resources management infrastructure resembles a living organism, the brain in particular, than it does a technology or a machine. It may well be that as we create and evolve our technology, it increasingly reflects its creators.

Project perfect

Imagine watching a time-lapse video of a large construction project happening at peak performance throughout. As you watch the literal blur of materials being delivered to just the right spot on the building site, picked up by just the right tradesperson who puts them into just the right locations, you are aware that there is an amazing complexity of planning and management that had to be in place. Much of this relies upon forecasting and scheduling based on highly accurate information from previous projects to make everything happen so precisely. All of this happens because there is a well-managed supply of the right information to the right people at the right time, and a system for making decisions dynamically and in real time. If the concrete truck is going to be 35 minutes late, the perfect project can dynamically determine the best adjustment of all other activities so there will be no delay or disruption, and update the schedule accordingly. The result? Continuous peak performance: a quality building delivered just as planned, right on time and on budget. The entire project information and decision flow is traced and recorded, including a detailed post analysis of lessons learned and how it could be improved, and all this new knowledge is captured and cycled back into the system to be managed further and made available for the next project, or even for ones currently underway.

In this scenario, skilled and knowledgeable adults are still leading and making the critical decisions; however, they are continuously guided and given just what they need to make the right ones. *This* is the function of effective management of information, adults, technology and learning.

MANAGING *The Vision*

Pattern Template?

A pattern template is something like a personalized paint-by-numbers canvas for every task. The individual defines the attributes of the scene to paint, and everything else comes with it: the canvas with an outline of the figures, exactly the right colors, the brush, the solvent, even the cleaning rags. The learner refers to the numbers to place each color exactly where it belongs, and creates just the finished product he or she has chosen. Now imagine that the pattern components are all infinitely reusable and managed such that you can have the perfect paint-by-number canvas to solve any problem--on demand!

Augmented, not artificial, intelligence

The notion of augmented intelligence does *not* suggest that we are seeing the evolution of some alternative or artificial form of intelligence. What we are seeing is the very much welcomed and needed *augmenting* of our own intelligence. Nowhere is the need for this extension and enhancement of our intelligence more apparent and acute than in managing the overall fusion we are calling learnativity.

Decision management

With the microtization of information, individuals need to make more decisions quickly and well. To keep from being overwhelmed by the superabundance of choices available, workers/learners/managers rely on the learning infrastructure to provide decision support through intelligent technology that makes the lower-level decisions so people can focus on the broader picture of solving the problems they are currently facing.

The learning technology and information infrastructure enables all this to happen quickly and effectively, in the background without conscious awareness. Just as everyone the world over relies on a dial tone to connect us through the telephone without giving a thought to the complex technology behind it, a learning infrastructure in the background enables us to put together customized learning packets and performance support tailored down to every detail.

Assembling information is the first task of managing

Capturing knowledge involves making it explicit, recording and storing it in just the right sized small chunks or information objects. This enables all these information objects to be managed for reusability, discovery, reusability and assembly into just the right size learning objects adaptive to the individual needs and situation. The infrastructure in the knowledge economy tracks pre-identified information and puts it together on demand, tailored to the recipient's immediate need and personal characteristics. Delivering just the right mix of digital information, physical classrooms, job descriptions, and work processes, the infrastructure creates packages of explicit knowledge (learning objects) to be used by the individual for specific purposes.

Managing the patterns of knowledge with templates

Managing knowledge also means using pattern templates that reflect predictable patterns gleaned from previous observations of usage, behavior, and learning to deliver exactly what's needed and when—no more, no less. Pattern templates capture the underlying principles and best practices of a particular task and use these to deliver precisely the right learning objects at the right time. In this way, the pattern template acts as an intelligent agent, selecting just the right content and serving it up at just the right time, thus guiding and managing the performance of the person receiving this input. A pattern template allows the user of a new version of a technology or an entirely new process to function at full competence the first time and with *no* prior training. Such management of information and process ensures that people are always choosing and using the right tool for the job, with no extra effort on their part. At all times, they are assured of using just the right combination of technology and technique to yield their peak performance.

The Vision

"The biggest innovation is in the use of technology to improve the effectiveness of knowledge sharing".

Steve Mecklenburg, 1998
CKO, A.T. Kearney

Imagine knowing that you were always using every appropriate feature available and using it just right! This applies to everything from your car, to your camera, to your computer, to every other tool or technology you use. What used to be a user manual is now a well-managed adaptive performance support system. It knows your precise level of use, understanding, and experience, and through a pattern template it provides just the right learning object delivered without repetition or omission, at the time it is needed as you use the program.

Dynamic management of content puts the learner at the center

When content was static, we literally knew what page we were on, and we could all be taught together. A book had the same words on page twenty, no matter who was reading it, no matter when it was being read. In the new dynamic information environment, truly dynamic content is continuously assembled on demand or even slightly beforehand, based on the ability to accurately predict who, what, when, and where the information is needed. Dynamic content meets the particular needs of the individual at the moment of need, and is presented fully adapted to fit the learner's unique background, learning style, and history.

With the advent of such things as digital paper (actual sheets of paper, embedded with chips that display changing information as needed or directed), the learner is at the center of a world of information delivered at will and adaptively designed for him or her alone.

The infrastructure delivers it all "just right"

Successful information management makes it possible to deliver just the *right* information, in just the *right* amount, to just the *right* person in just the *right* context, at just the *right* time, and in a form that matches the way *that* person learns. When this happens, the recipient can act—immediately and effectively.

Information delivery is a kind of orchestration, taking into consideration the particular person's learning style, preferences, and technological facility, as well as the task at hand. In musical orchestration, using just the right notes, and only the right notes, is critical for success. In management, relevance is the critical characteristic of just-right information in just-right amounts, and the infrastructure does the filtering necessary to deliver just what learners need (no more, no less) to make better decisions. In music, the right notes are pointless unless they come at the right time. In management, delivering the information right when it is needed (even just before the need is felt) is crucial to project success.

Predictability: The previously missing capability

In order to provide information "just in time," it is necessary to predict what people will need just before they need it, otherwise it isn't possible to know what to deliver or when! Intelligent technology that learns as it is used supplies much of this predictability. It anticipates the needs of the user based on previous behavior. This technology lets us anticipate (and meet) higher-level needs before they are felt, increasing productivity.

The Impact on Learning

Choice is the challenge

With the microtization of information, one of the biggest constraints on learning is the need of the individual to make more and more decisions quickly and well. Decision-making will need to be treated as more of a science than an art, and learners will need opportunities for practice. Strategies for prioritizing choices, and determining which choices can be made by technology, will become a focus of learning.

Learning presupposes agreement

Common standards for “chunking” knowledge (regarding interoperability, exchange, distribution, and access) will be necessary to maintain pools of content from which to draw knowledge that can be used to increase productivity. The enormous advantages of just-right learning will not be possible without careful and continual development of widespread standards for the creation and management of information objects, learning objects, and templates.

New roles for teachers and trainers

Learners in the future are supported by technology, but they still rely on information received through direct people-to-people contact and implicitly received through experience and application. The new teachers take advantage of dynamic content and the learning provided transparently by the information infrastructure, and spend their time doing what even the most advanced technology cannot: stimulating higher-order thinking, seeing new patterns, making new connections, leading communities, guiding, coaching, encouraging, and motivating.

Personalization raises issues of privacy and permission

How well dynamic content can be created depends on how well the creator knows the audience—the individual learner. For example, personal interaction (augmented by technology) remains a primary force in learning, and no system can introduce a learner to appropriate people without knowing what they have in common. The more information one shares with the system, the more likely a good match with a learning partner can be made. Safeguards must exist to protect privacy and allow people to feel safe sharing information about themselves, thus maximizing their potential effectiveness. Establishment of these safeguards (such as the conditions of permission) is needed to encourage people to reveal themselves optimally (just right for them personally).

The Impact on Learning

The ideal infrastructure offers ubiquitous access with unambiguous privacy.

Skills and knowledge inventory

Ongoing assessment and capturing of information, situations, and people—their skills, preferences, abilities, and potential—is a management function of the new economy. Ideally, managing a project means solving an equation for each team member: What the member needs to know minus what he or she already knows equals what needs to be provided. For this equation to be solved, individuals are responsible for providing and authorizing the use of information about themselves in increasingly greater detail. Optimal assessment takes place on a micro level, rather than as a rough sort: we may not need to know if the person has a degree in engineering, so much as if he or she has a certain set of engineering-related skills (which may well be found in someone with a degree in liberal arts or no degree at all). Without this quality of assessment, just-right learning isn't possible.

Rights management

Issues of trust, fairness, responsibility, confidentiality, and attribution require common understandings. People who are unsure about letting themselves be known (their learning styles, strengths and weaknesses, historical problems, personal preferences) are less able to receive knowledge or impart it. People who wonder if they will get credit for their efforts are less inclined to share. Ultimately, it is the individual who decides how much of himself or herself to make available, and thus it is the individual who determines how well the learning infrastructure can work.

The future depends on creating a climate in which the players feel secure that personal information will never redound against them, that learning objects containing their ideas, words, etc., will give credit where it is due (and recompense when appropriate). When access to information (books, music, technologies) is controlled by more than just a few, the issue of responsibility for the use of this information is compounded. Knowing and respecting the rights of others (and one's own) will be an important theme underlying all learning in the future.

In the past, management was a job for a select group of people. In the future, the management of knowledge and resources is one of the new basic skills for everyone. It becomes as constant and as natural as breathing.

Points to Ponder

Work & Learning	<p>What are the roles of the public and private sectors in creating “facilitators” of learning?</p> <p>Under what auspices do we create a new, shared vision of learning?</p>
Individuals	<ul style="list-style-type: none">• Everyone becomes a manager of his or her own time, attention, and learning. Everyone also inherits the responsibility for all these. How do we ensure that this responsibility is understood and accepted?
Teams	<p>As project teams become the predominant form of working and learning, and become more like single organisms, how do they learn? How can this be understood and improved?</p>
Organizations	<p>What changes may be needed in tax and regulatory policies governing not-for-profit and for-profit education and training providers as the process of learning “anytime, anywhere” blurs state and national boundaries?</p>
Policy & Practice	<p>How do we ensure that the necessary technology infrastructure for just-in-time access and delivery is available? What level of investment is required? What is the mix of public and private sector investment?</p> <p>Is there a need for a Learner’s Bill of Rights to deal with privacy protection, sealing of records, correcting errors, security of information, encrypted transmission, and other such matters?</p>



Learning

Imagine.....

Learning is a skill, a skill that can itself be learned. It's an open-ended process of discovery and improvement available to individuals who are skilled in acquiring, creating, sharing, managing, modeling, measuring, and applying knowledge. Learning is a process of higher-order cognitive skill development including decision-making, problem solving, teamwork, metacognition, pattern recognition, critical thinking, and situational awareness. It is part of the process by which organizations create and nurture intellectual capital and build competitive advantage

Learning uncovers tacit information held by the individual and makes it explicit so that it can be shared and expanded. It occurs alongside and within the contexts of capturing, managing, and performing, all of which repeat at ever-higher levels to create knowledge. Learning is seen as a matter of know-how, know-what, and know-why.

- ▶ You can learn 100 times faster and several orders of magnitude better than you could yesterday.
- ▶ We understand how teams of people learn, and they do so as quickly and effectively as individuals

AT A GLANCE

- ▶ Learning is a means to an end: **Peak performance.**
- ▶ Learning is maximized in effectiveness by the increasing arrival of **personalization**: getting it all just right for every unique individual.
- ▶ **Dynamic** and **adaptive** learning resources are the factors critical for success.
- ▶ Learning is **the** skill to assure success in the future and will be significantly augmented by adaptive learning technology.
- ▶ The learner is increasingly in **control** and at the **center** of learning.
- ▶ **Project-based** working and learning will predominate.
- ▶ Learning is a social skill comprising:
 - know-**how** (learning by doing, with others)
 - know-**what** (cognitive skills as well as facts)
 - know-**why** (relevance and motivation)
- ▶ Most learning occurs **informally** and this will be increasingly the focus of attention.
- ▶ When information is available from so many accessible sources, learning is less a matter of mastery of facts than it is a function of effective **inquiry.**

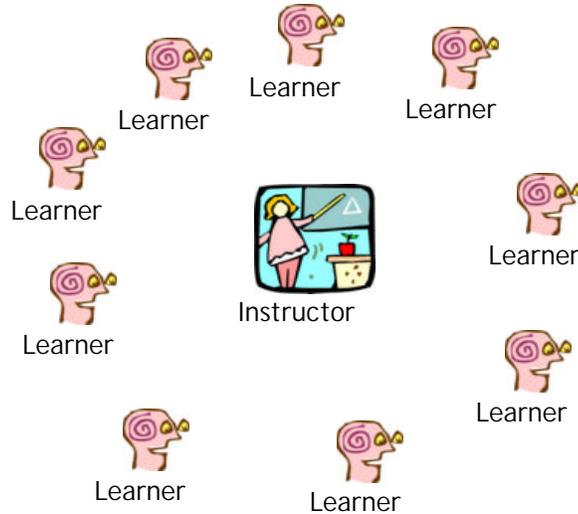
Today	Tomorrow
Technology Training	Performance Improvement
Classes for the Masses	Personalized Learning
Sage on the Stage	Guide on the Side
Instructor Centric	Learner Centric
Training when Scheduled	Learning on Demand
Time to Train	Time to Perform
Teaching by Telling	Learning by Doing
Subject-based Learning	Project-based Learning
Learning to Work Technology	Putting Technology to Work
Know-what	Know-why
Basics = 3R's	Basics = Higher Order Thinking
Skills & Information Mastery	Inquiry, Discovery & Knowledge
Re-active	Pro-Active

The Vision

Know-how is learned through action, through doing, through performance.

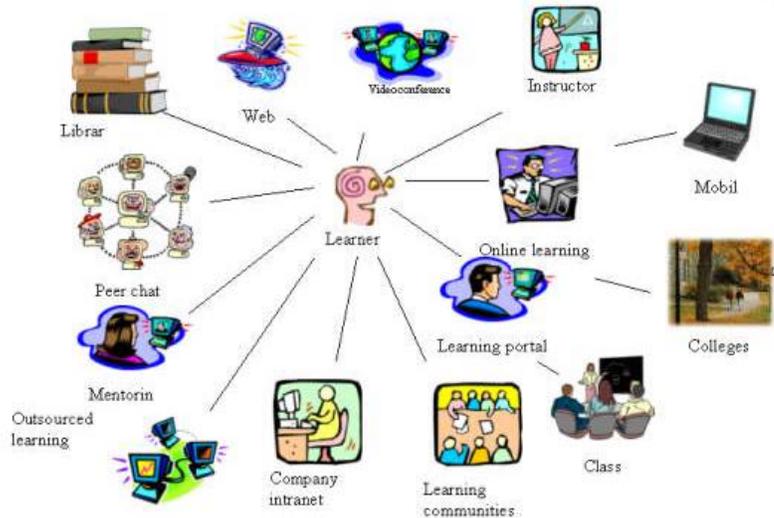
How we learn

Know-how, or actual skill, derives from the individual's experience or ability to utilize cognitive knowledge in response to real-world problems. It is learning acquired through action, through doing, and it becomes the dominant feature of knowledge creation.



Performance: The measure and the means of learning

Performance is facilitated through technology (such as simulations) that lets us participate fully in an experience without risk or expense. Performance-based learning is the result of a transition from “teaching by telling” to “learning by doing,” assisted by technological and human coaches providing the low-level and high-level support.



The Vision

"Learning is the new form of labor . . . Learning is the heart of productive activity."

Shoshana Zuboff,
'In The Age Of The Smart Machine'

Personalized learning makes excellence the norm

Technology gears learning to the individual. Technology delivers dynamic information to match the individual's unique learning style, just when it is needed, and fades into the background of the individual's conscious awareness. Learning becomes adaptive, learner-centric, and democratized, allowing everyone to participate because content can be personalized to anyone's current level of education, experience, and skill.

Individualized learning once produced fine craftsmen. The master taught the apprentice. Only a few had the time or opportunity to gain the depth of knowledge needed to achieve excellence, and excellence was rare. Then industrial-age minds saw scale economies in teaching many people at once. Learning became institutionalized, and the individual either adapted to the teacher and the standard material being taught or missed out. Now, as information from a huge variety of sources becomes available, learning again becomes individualized, and again produces excellence.

Relevance

Learner-centric learning focuses on relevance, personalization, and timeliness. Relevance is a prime motivator of adult learning, probably the only characteristic sufficiently compelling to keep the learner coming back for more. Providing an array of learning vehicles also enables the learner to select venues optimal for his or her learning style, and a mix of different learning activities packs a bigger wallop than relying on just one approach. When information is delivered in personalized packets just when it is needed, the individual can put it to immediate use.

Group learning

Just as individuals learn, organizations learn. Project teams resemble biological organisms more than machines, and each learns as a single entity. Project teams call on technological performance support to track and organize their process and smooth interpersonal communication, letting them concentrate on accomplishing the task.

Time spent on learning is revered as the most productive time of all, leveraging the organization's intellectual capital. Organizations understand that the people chatting in the coffee room or the person having an "aha" revelation of how to solve a vexing problem might well be doing the most important work of anyone.

Learning *all* the time

Increasingly, technology focuses on informal learning. As dynamic performance support technology lets us take advantage of learning opportunities anytime, anywhere, organizational resources are directed more toward supporting the ways that people learn best, and less toward "one-size fits all" education strategies.

The Vision

The “what” of learning become higher-order cognitive skills such as decision-making, problem solving, meta-cognition, pattern recognition, critical thinking, situational awareness, and teamwork.

Know-why is the carrot that motivates the individual to seek peak performance.

The magic is in the mix

The magic is in the right mix of human and technological learning assistance. When individuals and teams use higher-level cognitive skills to accomplish tasks innovatively, they also become increasingly good at working with both people and technology to achieve peak performance.

What We Learn

Know-what, or what you know, is generally thought of in terms of cognitive knowledge, acquired through formal learning and recognized through testing and certification. It consists of “stuff”: facts, figures, and specific ways of doing things.

The “what” of learning changes in the future to higher-order cognitive skill development that includes decision-making, problem solving, meta-cognition, pattern recognition, critical thinking, situational awareness and teamwork.

Why we learn

Know-why is the motivation that spurs the learner, the carrot that leads him or her to seek peak performance, personal and professional. It is the deeper knowledge about the cause-and-effect relationships underlying a discipline or practice.

Personalization of learning so that it appeals to all learners regardless of learning style, history, skill level, etc., is a major source of motivation. Learning is fun because it can be understood and put to use immediately, it doesn't waste time on repetitive detail, and people have what they need to go to the next step as soon as they need it.

Two characteristics of society produce a new focus on learning for the individual. First, all products, services, and work converge toward customization and uniqueness, reducing the number of repetitive tasks and the frequency with which the same task is performed. Second, learning and performance technology provide just the right content and information at the moment of need, obviating the need for the performer to know low-level details and make low-level decisions. These two conditions enable and require the performer to focus on higher-order thinking skills such as decision-making, problem solving, innovation, and creativity to achieve better results. The learner is motivated and curious, continually thinking differently and exploring new applications.

Points to Ponder

<p>Work & Learning</p>	<p><i>What will it take to change the common understanding of learning, held by individuals and organizations alike, to encompass the “way of being” perspective?</i></p> <p><i>How does learning transition into business and economic models such that it is indefinitely sustainable and scalable?</i></p> <p>Given unlimited resources, how would you teach?</p> <p>As learning “anytime, anywhere” begins to change the expectations and assumptions of our economy and society, how do we insure the closing of the digital divide between those who have access to technology and those who do not?</p> <p>How should current ways of measuring learning and organizing instruction such as courses, semesters and credit hours be changed to support and encourage new forms of learning?</p>
<p>Individuals</p>	<p>How will individuals access the resources they need to learn what they want to learn?</p> <p>If these resources are teachers, how will their time be used?</p> <p>How can we rapidly expand the use of technology for training and re-training the IT workforce?</p>
<p>Teams</p>	<p><i>What does it mean to say that a group “learns”?</i></p> <p>How does team/group learning coincide with personalization and the varying needs of the individuals involved?</p>
<p>Organizations</p>	<p>How can organizations come to understand and respect the individual learning styles of their members, tolerating (even encouraging) activities that appear nonproductive in the hope that they will generate knowledge?</p>
<p>Policy & Practice</p>	<p>How do we move to personalized learning without losing the socialization value of education?</p> <p>Who bears responsibility for providing access to and funding for lifelong learning? The individual, the employer, public sector organizations, governments?</p> <p>What are public and private roles and responsibilities in developing intelligent technology supports for learning?</p>

BACK from the FUTURE

*"Never confuse a clear view of the future
for a short distance."*

Paul Saffo, 1998

Welcome back from the future! Time is now restored to today. The future of working and learning is in the creation of knowledge, which is of course precisely what the Commission on Technology and Adult Learning has been created to do. Time is now, and time for the work and the learning that will be the Commission.

Back to Reality

So now it is time to step out of this time machine and come back from the future. Let's get real. This is all *only* a vision, *only* a dream, *only* a depiction of one possible scenario. Clearly there are others. Many alternative scenarios range from less bright to depressingly black.

The word "democratization" is not used lightly within this paper. While never a certain outcome and always fraught with opportunities for sabotage and misdirection, it has proven to be *the* most powerful and enduring model for sustained change and prosperity. In any case, there would not appear to be a choice on this point; the individuals of the world are in increasing control and we will all cast our votes with our actions, our imagination, our commitment, or the lack thereof.

The broad and the long view

Using the three words in the name of this Commission on **Technology** and **Adult Learning**, let's take a concluding look at each:

ADULTS:

The challenge and the solution is a human one. We are seeing people at two extreme ends of a spectrum. At one end, we see the accelerating momentum that is bringing control all the way down to the unit of one, the unique individual.

This is not a reflection of selfishness but of empowerment, and along with control comes responsibility.

*We will all cast our votes
with our actions, our
imagination, our commitment,
or our lack thereof.*

At the other end of the spectrum is the natural formation of these individuals into communities. In the context of adults, technology, and learning, there are two primary types of community: project teams, which form and dissolve with the projects themselves, communities of practice, where people of like working and professional interests connect and collaborate with their peers. In both cases, they create and share "community knowledge." These communities, as systems of learning and performing, prove to be highly sustainable, scaleable, transferable, and successful.

A bright future is dependent upon bright people. They are not simply the learned, who can memorize facts and figures; they are not just masters of their professions and crafts. They are instead those who are skilled at higher-order thinking, including analysis, planning, problem solving, creativity, and perhaps most important, learning. These are skills that anyone can attain and develop. These are skills that are highly transferable, sustainable, and scaleable. These are the skills that will lead to a bright future for individuals, project teams, communities, and countries worldwide.

TECHNOLOGY:

Technology is attaining profound abilities to learn through analysis, deduction, and memory of the conditions and consequences of use. The future we want is very real, and technology should augment this reality and improve our ability to work effectively within it. Replacing real experiences with artificial substitutes, as in simulations, is often useful, but we are increasingly able to have the real thing as the first and lasting experience. Yet, while increasingly adaptive, technology is not alive. It does not change all by itself. We must demand these characteristics of those who can create the innovative technology solutions we seek. We should accept and expect no less.

The combined power that is created by connecting every person, every piece of information, and every object in our world, and enabling these connections to flow freely at the speed of innovative and creative human thought is the opportunity before us. The old boundaries of time, distance, status, and location, and even the confines of socio-economic, political and racial status, are disappearing before our eyes. To be sure, new barriers and challenges are ahead. However, we are rapidly reaching the point where the technological capabilities and possibilities we have at our disposal are no longer the limits that contain us. The limiting factor is our ability to think boldly and differently enough to imagine and plan solutions and then form the resolve to execute those solutions.

Technology has perhaps had the least impact, relative to most other areas, upon learning. If we are prepared for the opportunities this presents, the results will be staggering. If not, we may miss or delay the greatest potential changes in learning, and subsequent empowerment of all people, that the world has witnessed.

Guaranteed?	No!
Probable?	Maybe
Possible?	Absolutely!

LEARNING:

The key to unlocking all this potential brings us back to bright people, people who have the sustained ability to learn and apply the right stuff faster. We refer to this capacity as “learnativity.” This is not a technology, not an activity, not a resource. Learnativity involves a continuous, swirling set of experiences traveling through the domains of learning, capturing and creating information and knowledge, managing all these resources, and ultimately putting it all to work in solving problems. This all occurs in real time, all the time. As is the case with technology, learning in the future will fade from our conscious awareness, as it becomes embedded in every product, every service, and every facet of our lives. This will take place all the time, just in time, and just right for peak performance

In light of the complex, broad and daunting task before this Commission, surely Warren Bennis’s phrase, “None of us is as smart as all of us,” has never been more true. Thus the creation of this Commission, a *great group* of complementary minds with an eclectic mixture of experience and perspectives to take on this great challenge.

This will not be easy. This will not be fast. It will require innovative, out-of-the-box thinking. There will be the need to both suspend disbelief and abandon previously entrenched norms, customs, and habits of our economy and culture. If this Commission can find the collective and individual strength, the commitment and the solidarity to do so, there is no doubt that this vision will be realized.

There is an opportunity matched by a need.

The future is ours to imagine, ours to create.

Glossary

Adaptive: Referring to technology and content that adjust to match the individual person and situation.

Augmented reality: An enhancement of the environment that provides learning by overlays and additional inputs of information and knowledge.

Content. What's being learned, information. If it doesn't cause change, it's not information. The challenge is how to get the right content to right person, at the right time. This involves media choice (e.g., paper versus on-screen), speed, delivery cost, relevance, learner motivation, and other factors.

Convergence: The most prevalent theme of the future, in which technologies merge to create new technologies, and professional skills merge to create new professions. Within this context, the previously disparate and independent activities of learning, working, capturing knowledge, and the management of their sum total become one activity; see learnativity.

Dynamic content. Real-time, current, up-to-the second information, delivered in response to immediate needs, and personalized to the individual.

Explicit knowledge: Know-how and information that has been expressed and is available to others; opposite of tacit knowledge.

Informal/formal learning. Formal learning occurs in a class, a seminar, a self-study course, or other environment that is generally recognized as a learning event. Informal learning is all other learning that occurs; it is also known as "working" and "living."

Information object: The smallest useful piece of information that can be used and re-used, such as an illustration, a question, a definition, a procedure, or a sound.

Infrastructure: A management matrix that enables individuals to learn with the support of technology that provides dynamic content.

Knowledge economy: An economy that is driven by Ideas and knowledge, rather than material resources; an economy in which the keys to job creation and higher standards of living are innovation and technology embedded in services and manufactured products. In this economy, risk, uncertainty, and constant change are the rule, rather than the exception. The raw resources of the knowledge economy are information, and people with the skills to continuously convert information into new knowledge, products, and services through innovative thinking.

Learnativity: A way of being that incorporates learning and working in an integrated system of performing tasks, capturing information, managing knowledge, and learning, all leading to the creation of new knowledge.

Learning. The process of gaining knowledge or information; ascertaining by inquiry, study, or investigation; acquiring understanding of, or skill, as in learning the way; learning to dance; learning the truth about something.

Learning object: An collection of information objects assembled using metadata to match the personality and needs of the individual learner. Multiple learning objects can be grouped into larger assemblies and they can be nested within each other to form an infinite variety and size. Therefore there is typically a specified hierarchy of object groupings.

Glossary

Microtization: The trend of computers and other technology to get smaller, eventually reaching the point of being virtually invisible to those using them.

Pattern template: A design for the assembly of information that reflects predictable patterns gleaned from previous observations of usage, behavior, and learning. They capture the underlying principles and best practices of a particular task and use these to assemble and deliver the right learning objects to the right person at the right time.

Performance. The goal of work related learning; productivity; results.

Performance support. Learning opportunities technologically embedded in work to provide dynamic content.

Personalization. The practice of tailoring learning content to the learner's background, style, previous knowledge, etc.

Predictive technology: Intelligent technological resources that learns as it is used and can provide information "just in time" by anticipating the needs of the user based on previous behavior.

Standards: Referring to specifications which are approved by open, accredited standards body and those related to learning. Includes those covering learner profiles, course sequencing, course interchanges, learning object metadata, etc. such as those from the IEEE Learning Technology Standards Committee (LTSC)

Skills gap: An enduring and ubiquitous characteristic of all those working in the new economy. The result of new technology and opportunity being created at a rate faster than adults can learn it. The skills gap as a ubiquitous feature of society is addressed through lifelong learning

Tacit knowledge: Know-how and information possessed by an individual that has not been made available to others. Opposite of explicit knowledge.

Transparence: The quality of technology to be useful without requiring attention or maintenance; the ability to perform a function as necessary without fuss or conscious effort on the part of the individual requiring the task to be done. When technology is transparent, the individual can "look through it" to focus completely on the task at hand.

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Additional Resources

Kelly, Kevin. (1998). *New Rules for the New Economy: 10 Radical Strategies for a Connected World*. New York: Penguin U.S.A.

<http://www.learnativity.com>.

An excellent resource for recommended reading and other resources on learning, creativity, productivity and the changes that learning is undergoing today and in the future.

Merrill Lynch & Co., Global Securities Research & Economic Group, & Global Fundamental Equity Research Department. (1999, April 9). *The Book of Knowledge: Investing in the Growing Education and Training Industry*. California: Authors.

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The authors provide an in-depth understanding of knowledge creation within an organizational context, from which some of the concepts of the performing, capturing, managing & learning spiral were abstracted.

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