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ABSTRACT

Career and technical education (CTE) is the appropriate and preferred channel for leading a software-supported experiential mission shift to prepare, support, and evolve flexible, information-producing, high-performance knowledge workers for a continuous innovation society. Knowledge management attempts to capture human knowledge in the form of units or objects that can be networked to other people or to software/machines. Five learning approaches share this common purpose: human capital development and application. Heuristic scenarios of work forces using these learning approaches and their supporting technologies convey a profound shift away from learning and performance as ends in themselves, in favor of continuous innovation as a process of working, living, and learning. Deconstruction of repetitious tasks frees human and other resources for continuous innovation. Information-based skill-concentrated distributed competence (DC) software is at the same time a direct threat to all repetitive human functions at work, in learning, or in community and the most hopeful and compatible equalizer for the ignorant, unskilled, slow, blind-sided, and unimaginative. Performance-based learning can effectively create learning in the context of tasks supported by DC software. CTE, with its technical focus and performance innovation outcomes mandates, is ideally positioned to lead the rest of education into new leadership and prominence. (Contains 61 references.) (YLB)

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The Future of Career and Technical Education in a Continuous Innovation Society

Arthur M. Harkins

CTE
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TABLE OF CONTENTS

Table

FOREWORD

Two years ago, the author visited the Marshall, MN public schools as a consultant in support of a strategic development team made up of teachers, students, parents, local professionals, and administrators. As part of his introduction to the team's work, the author was given a tour of the Marshall schools.

What he found was astounding. Marshall was operating its schools within two service paradigms: business as usual, with emphasis on standardized tests and Minnesota learning profiles; and knowledge-based learning, in which students, supported by state-of-the-art software, hardware, and netware, conducted research in small groups.

After 2 years of dual-service experience, Marshall administrators found considerable acceptance for the double approach in elementary grades, some in middle grades, and virtually none, save among vocational faculty, in the high school grades. The vocational faculty and students were fortunate to have a robotics/artificial life laboratory donated by a wealthy patron. The local college faculty were invited to work with high school faculty in support of knowledge-based learning, but refused. The local technical school complained that recent Marshall graduates were critical of its offerings.

As a result of his consulting experience and subsequent visits to the Marshall schools, the author concluded that he was witnessing the evolution of a functional dual-market model for public education. The key managerial element in support of the knowledge base model appeared to be "Give them the tools and then stand back. No training, no extra pay. But plenty of autonomy." The key managerial element in the business-as-usual model appeared to be "Help the teachers keep control over the students. Do little that would indicate the presence of experimentalism."

After arranging for several of his colleagues and administrators to visit Marshall, and for Marshall teachers and administrators to visit the campus, the modal campus response appeared to be "Very interesting, but why would we want to support two service delivery paradigms when one is so dominant and butters our bread?"

The author considers his experience with Marshall a lucky opportunity to spend time and energy exploring the knowledge base model of learning. He has projected learning into the experiential context of performances supported by software and technical resources. Into the context of performance competence, he has projected continuous innovation. He has begun to consider software-supported changes in the workforce as the strongest indicators of a growing market for knowledge base school services.

In the essay that follows, the author attempts to shape a future for career and technical education (CTE) that mirrors the last 20 years of software- and technology-driven changes in the workforce.

He thanks the Marshall superintendent, Dr. Thomas Tapper, his board president, and his marvelous staff for stimulating these interests.

FOREGROUND I: A NEW FUTURE FOR EDUCATION

This is a conceptual essay from a sociologist/anthropologist. He is not a CTE professional; he is not an educator. What is this essay about?

- It is less about the past than the future.
- It is about human purpose and the creative development and management of software and technology for both humane and efficient purposes.
- It is *not* about improving conventional teacher education in career and technical education.
- It *is* about shifting the role of CTE professionals away from teaching, and toward performance and innovation modeling.
- It is about the experiential use of software, netware, and real or simulated contexts to help make this role shift possible.
- It is about the contextual and experiential re-formatting of education to permit "instant" human performance competence through software, with the intent of using still more software to substitute excellence for competence and innovation for excellence.
- It is about the technologically supported cascade of this approach across the societal meta-institutions guiding learning, living and working.
- It is about the potential role of CTE leadership in developing and testing a human capital paradigm that leaves repetitious performance and information storage to machines, even as it provides new and saved resources for the growth of creative, inventive, and innovative human beings.
- It is about synchronizing CTE with a knowledge-driven *continuous innovation society*.
- It is not inclusive of the other futures that CTE leaders might entertain.

This essay will argue that all levels of American education must undergo a software-supported experiential mission shift to prepare, support, and evolve flexible, high-performance *knowledge workers* for a continuous innovation society. Knowledge workers, supported by software and information, are the newest source of continuous innovation in the labor force. In education, this means that software will teach what is known, teachers will become role models for performance competence and excellence, and a new genre of professionals will collaborate with students in the practice of continuous innovation.

America needs 100% of its students, workers, and citizens performing well and learning the skills of continuous innovation at school, at work, and in the home and community. Continuous innovation marks a shift from working well at a known task to working toward the development of new tasks that are driven by a host of change-inducing factors, including competition, shorter business and product cycles, and pressures to automate well-known tasks.

The upshot of this change is that present standardized testing based on memorization could shut down over a few years, and be replaced by software-supported performance-based learning aimed at creating a nation of innovative students, workers, and citizens. The American economy will benefit from this change through the production of lifelong performers and innovators representing nearly the entire age span.

America is already moving toward rapid-cycle organizational deconstruction and continuous innovation based on distributed software. In such a society, workers must change rapidly. They must be assisted by appropriate technology, such as computers and hand-helds, together with the software and netware required to make these connectively useful.

Many school boards and administrators will face the prospect of realigning educational services to meet the needs of a knowledge-based continuous innovation society. Fortunately, the U.S. workforce is already pioneering the use of distributed software and hand-held devices to support the growing percentage of knowledge workers. As the role of software grows, the focus on just-in-time performance evolves with it. Performance competence stimulates innovation by taking advantage of cost-effective improvements supplied by software. The primary cost-effectiveness measures following performance success are job automation, skill down-grading, and the freeing of worker time for innovation of next- generation jobs.

Accordingly, this essay will argue that pre-K–12 and higher education should emulate the worker software movement by bringing it into the common experience of students. The essay will be premised upon the assumption that software-based preparation of students for success in a continuous innovation society will be driven by performance-based learning, in which the skills of 1) software and device management, and 2) developing and working within fast cultures will become the new CTE basics.

This essay will assume that the separation of technical/vocational education from liberal or general education will greatly diminish, and that career education will shift to career creation and career cycling. The essay will delineate the potential for significant social and employment-sector leadership in helping schools and colleges understand the requirements for technical and software support in all forms of education, employment, and daily life.

This essay will argue that no one should be permitted to fail in the development of software-supported performance and innovation. If Johnny cannot read, the software will do it for him. If Johnny cannot do calculus, the software will do it for him. If Johnny can operate the software, Johnny in theory can do *anything the software can*. Johnny will get *A*s in everything that he alone, or his software alone, or both together, can accomplish. For example:

> It is 2005. You are S.E.L., a second grader. (S.E.L.'s initials are the same as the acronym for Software Enabled Learner.) You are being asked to learn a new math process: multiplication. It is the first day that multiplication has been presented to you. You are having a terrible time getting the right answer all by yourself, so you move to another problem. You are marking time. The teacher seems to make no sense. Some other kids understand her but some, like you, do not.

On the second day of multiplication class the teacher gives you a wireless device to clip into your shirt pocket. If you pull the small pen out of the device and scan it over your multiplication problem, the pocket device talks to you and tells you how to get the right answer. After a while you are making *A*s in your multiplication class.

Unfortunately, you get stuck after a few weeks' success with multiplication. The problems have become more difficult and you are unable to do them any more. But it doesn't matter. Your teacher makes some adjustments to your pocket device. Afterward, when the teacher calls on you for results, your pocket device tells you the answer and provides explanations of how the answer was framed and arrived at. You are still making *A*s in your math work, and you always will—because even if you cannot do the work, sooner or later the software will.

In this scenario, multiplication tasks have been supported by a wireless pocket device that makes S.E.L. capable of performing at the *novice* level within a few minutes. Over time, with the assistance of the wireless pocket device, S.E.L.'s performance levels will move from novice to *competent* to *skilled* to *excellent* to *master*. The speed of S.E.L.'s performance progression will depend upon how S.E.L. and the *distributed competence* software of the wireless pocket device work together.

For S.E.L., the basics of education include software and technology management. With properly managed software, S.E.L. could theoretically become a productive scientist or a garage mechanic with little knowledge of multiplication or higher math. *What counts in S.E.L.'s world, in education, living, and eventual working, is performance. Nothing else is as important, including what S.E.L. knows.*

Later, in graduate school, when S.E.L. cannot master a performance even with the assistance of software, S.E.L. simply waits until the distributed competence software is upgraded to permit the performance. By this time, S.E.L.'s mastery of software and machine supports will have produced a horizon much more important than competence alone—continuous innovation.

Educators ask: will S.E.L. be motivated enough to take advantage of these performance opportunities afforded by software, electronic nets, and machines? Will S.E.L. become indifferent to performance improvements, even though the software supplies answers to questions that might have taken years of conventional schooling to acquire? Does S.E.L. care about moving beyond performance to innovation?

This essay assumes that we do not know what S.E.L. will do with performance- and innovation-based learning opportunities. Nor do we know what S.E.L. will do when these supports are encountered in the workplace. We may assume that S.E.L. could fare better in the workplace if school learning formats were more in line with the software-supported formats of modern work. Many S.E.L.s are chosen today, but many do not come to the trough. Our approach is to offer S.E.L. the choice to experience school as usual, or knowledge-based services such as those at Marshall.

FOREGROUND II: HEURISTIC CONCEPTIONS OF THE ARGUMENT

Knowledge management is the attempt to capture human knowledge in the form of units or objects that can be networked to other people or to software/machines. This essay's position is that, once captured, knowledge becomes information, since the act of extracting it from context strips it of its personalized and localized qualities. (Every real-world context is different. Therefore, retention of artificial context in simulations does not keep original knowledge alive, but can result in dynamically useful heuristic "information engines.")

The implications of the failure of current knowledge management are many, but perhaps no liabilities are greater than the de-personalization and de-contextualization of meaning. It follows that implications for the future workforce of re-personalization and re-contextualization are also many. Some of these implications would make Marx smile, for they promise to return to workers the control of their minds and bodies in the context of uniquely innovative work in theatres of living, learning, and working. Such multi-institutionality will erode the boundaries already undergoing "slow dissolve," as networks cascade computing and software capabilities to all institutions. For CTE, the implications are enormous—including the support of personal careers and social careers, as well as traditional work careers.

The five learning approaches in the chart below share a common purpose human capital development and application. They are often confused or in conflict with one another. Individually, they represent different intentions, assumptions, and methods on how to accomplish this purpose. The chart compares some of the core properties of each approach. All of the approaches refer to what have become large-scale human capital development efforts. They are: Earlier Industrial Training, Generalized Mass Education, Information-to-Knowledge Transition, Cybernetic Supports, and Performance/Innovation Base Learning for the Continuous Innovation Society. The chart is intended to be heuristic, rather than to represent a historically faithful reconstruction of employment history.

Table 1.
Learning Approaches with a Focus on Human Capital Development and Application

Learning System Attributes	**Earlier Industrial Training**	**Generalized Mass Education**	**Information/ Knowledge Transition**	**Cybernetic Supports: Person-Focused Electronic Performance Support Systems**	**Performance/ Innovation Base Learning for Continuous Innovation Society**
Primacy (Learning/ Perfor-mance)	Performance (Learning is secondary)	Learning (Performance is secondary)	Performance/ Performance Focus	Performance (Learning unnecessary)	Creativity, innovation and learning are synchronous
Purpose	Prepare individuals for specific task performance	Prepare individuals for general performance	Provide explicit information to enhance performance	Guide performance	Advise, guide, consult, facilitate, *perform-for, innovate-with*
Approach	OJT Prepare	Class Preparation	Inform	Coach Perform-with-for)	Partner, *innovate-with*
Occurrence	Episodic instruction	On-going tutoring	On-demand information	On-demand performances	On-demand innovations
Focus	Group cohort	Age cohort	Group/ Organization Members	Employees	Integrated systems within contexts
Basis	Informal Training Program	Academic Curriculum	Electronic Information Base	Software-Based Explicit Knowledge	Individualized creativity within chaotic, emergent contexts
Learning Sequence	Learning occurs prior to performance	Learning occurs prior to performance	Need-driven	Event-driven	Continuous (concurrent and post-performance)
Delivery Platform	Human and Machine-based	Human-based	Machine-based (electronic information base)	Agent-based for individuals-in-context	Agent- and human-based upgrades of Distributed Competence software
Learning Initiative Determinant	Trainer determines how individuals will learn	Teacher determines how individuals will learn	Need-driven	Event-driven	Learner-tool-task-context co-determine nature of innovation base learning

Context and Person Dependency	Partially context dependent Person is a muscle/ command-response worker enticed to repetitive labor	Context independent Person is a brain/information worker enticed to repetitive work	Context independent Person is a mind/knowledge worker asked to adapt *continually* and to innovate occasionally	Context dependent Person is a software-backed knowledge worker choosing to adapt *continuously* and innovate frequently	Context creative Person is a strategic innovative knowledge worker seeking to generate new information, automate DC software, and continuously innovate new contexts, DC software, and PBL
Delivery Location	OJT/Classroom	Classroom	Computer Node	Software Network Nodes	Anywhere/ Anytime/Any Pace (User/task/ context-determined)
Delivery Time	Unscheduled/ Scheduled	Scheduled	On-demand (anytime)	On-demand (anytime)	Continuous (anytime)
Performance Determinants	1.Individual cognitive aptitude /motor skills 2.Quality/ quantity of training	1.Individual cognitive aptitude 2.Quality/quantity of Education	1. Ability to use information base 2. Quality of information base	1. Ability to use performance support systems 2.Quality of performance support systems	1. Motivation of user 2. Quality of DC, PBL & PBI systems 3. Quality of interaction with context
Workforce Implications	High relevance, but usually lags behind needs	"Just-in-case" relevance; sometimes only chance applicability	High situational relevance but very inefficient to store/access due to information management limitations	High situational relevance; essential for supporting PBL	Uploaded situational competence/innovations to points of need "just-in-time" or "just-ahead-of-time"

As the chart above connotes, it is technology that drives the five approaches to worker/citizen preparation. These vary greatly—from the earlier industrial period through the projected continuous innovation society. Examples of the technologies for each of the approaches above are:

- *Earlier Industrial Training*—steam- and electrical-powered factory tools, ships, and trains. Simple electrical and electromechanical dials and gauges. No electronic instruments, except the telegraph and telephone, which might be considered electronic precursors. Mechanical governors to control machine speed. An 8th-grade education was adequate for the vast majority of jobs.

- *Generalized Mass Education*—radio, television, telephone, and electric typewriters. Vacuum tube and early transistor circuitry, permitting mainframe computer development. A high school diploma was adequate for the vast majority of jobs.

- *Information-to-Knowledge Transition*—arrival of the desktop computer and the cell phone begin to permit "distance" relationships for living, learning, and working. Growth of the service industries and the movement of many heavy industries to offshore locations. Introduction of robots in some manufacturing and assembly processes. Information management systems become necessary. Postsecondary education and training are no longer options for many types of jobs. Perhaps 5% of workers are knowledge workers. Some of these are futurists.

- *Cybernetic Supports: Person-Focused*—advanced software and networking permit automated processes to enter nearly every sector of living, learning, and working. Expert systems—precursors to artificial intelligence—permeate banking, the military, and dozens of other industries. Some companies embed chips in credit cards. Worries commence regarding the future roles of humans in the face of competition from cheap, job-capturing hardware and software. The effect of many technologies, especially the Internet, is to drive more knowledge workers into existence, to cope with increasingly unpredictable customer and competitor behaviors. Advanced technology, software and netware allow knowledge workers to become 40% of the workforce. Virtually every knowledge worker becomes a futurist within the purview of their specializations, contracts, and employment. Free agency culture grows in response to massive layoffs by employers. Doubts arise as to the future of education and training; on-the-job self-preparation emerges as an expectation by employers and workers alike.

- *Performance/Innovation Base Learning for Continuous Innovation Society*—tiny terabyte disk drives; pocketable optical and quantum computers operating at room temperatures; circuitry woven into clothing or sprayed onto skin; early implants; large percentage of flat surfaces receive painted-on interactive displays; heads-up delivery of high-resolution images to the retina; automatic language and dialect translations; obsolescence of the keyboard; "nano-marketing" to *individual* consumers worldwide; projections of the eclipse of *Homo sapiens* by a wide range of intelligent technological and genomic varieties of humanity. Jobs whirl into and out of existence quickly—sometimes overnight. More and more, human work creates jobs that are carried out by automata. Traditional separations of living, learning, and working have vanished, as the same technologies are used in all three domains. Learning is experiential, through simulations and direct, real-world involvement. Performance and innovation are paramount. Humans are expected to move forward—creating low-cost, highly efficient automated processes in their wake. Innovative knowledge workers make up perhaps 90% of the work force. Intelligent machines, capable of competing with innovative knowledge workers, are on the 20-year horizon. The individual resumé replaces the transcript.

These heuristic scenarios of work forces and their supporting technologies are intended to convey a remarkably profound shift away from learning and performance as ends in themselves, in favor of continuous innovation as a process of working, living, and learning. A major casualty of such change is the loss of stability in the "job" market, and the parallel growth in the "opportunity" or "work" market.

FOREGROUND III: IMPLICATIONS FOR JOBS VS. WORK

For purposes of this essay, *work* is what gives rise to *jobs*. In other words, work invents and innovates jobs. Compared to work, jobs are better codified. Therefore, jobs are the logical and appropriate targets for *automation,* since relatively low-level software and machines can be taught to perform them. The future of relative wealth will be tied directly to the capacity of societies to turn jobs over to non-human resources as early and successfully as possible. Rapid deconstruction of jobs will free human capital for invention and innovation. The continuous deconstruction and construction of jobs, driven by continuous innovation, offers a current opportunity for CTE leadership.

In the author's opinion, it is a losing choice to combat the trend of software support/replacement in human tasks. The deconstruction of repetitious tasks frees human and other resources for continuous innovation. However, if the choice were made otherwise, it would be consistent with an institutional unwillingness to derive maximum benefit from technology (read: innovation resistance)—a durable characteristic of American educational conservatism and job protection.

On the other side of the coin, *innovation is the sine qua non of the Continuous Innovation Society.* Innovation is the means by which high-performing humans and their machines create new wealth. Innovation is built on *invention,* or the potential for innovation. Like invention, innovations may be purposive or accidental/serendipitous. Innovations may be incremental/large or linear/non-linear. Together, inventions and innovations are the symptomatic outward evidence of discontinuities, or breaks with tradition.

The role of *discontinuity* in the emergence of continuous innovation cannot be overstressed. Discontinuity is literally the engine of change, whether in markets, technology, personal lives, or education. Until recently, American education appeared to operate on the presumption of continuity, resisting calls for substantial change. The time and resources reserved for the management of discontinuity were meager, in part because it was assumed that discontinuity could not be managed. In effect, school managers assumed that discontinuity was synonymous with chaos, and therefore was, by definition, unmanageable. This essay's assumption is that discontinuity/chaos are inevitable accompaniments to creating and sustaining a continuous innovation society. Organizations will have to learn to trade out activities that will not be valued in the future, in order to justify the redirection of resources toward strategic projections and goals.

Achieving a better balance between *convergent thinking* and *divergent thinking* is a requirement for achieving reliably continuous innovation. Convergent thinking emphasizes order, linearity, and objective problem identifications and solutions. Convergent thinking thrives on the qualities of the educational bureaucrat, the visionless legislature, and the conventional student. Order, simplicity, routine, clear responsibilities, unambiguous measurements, and predictability are the foundation of convergent thinking. Convergent thinking works effectively in slow-changing circumstances with high levels of cross-institutional resonance and homogeneity.

Divergent thinking is the first step in creative deconstruction and reconstruction, the one-two punches of creative persons, organizations, institutions, and societies. Capitalist societies derive their discontinuities, and therefore their potentials to respond to change and create new futures, from a willingness to destroy old systems and forge new ones. Creative divergent thinking produces inventions and the potential for innovations, or applied inventions. The continuous innovation society is a case study in discontinuity, surprise, unpredictability, and synergy—the banes of conventional minds and all bureaucracies, but the engines of globally competitive capitalism.

Performance capital derives its efficiency and innovational qualities from the management of discontinuity/chaos at both individual and collective levels. The performance base economy requires *performance-based learning*, or the use of software-supported living, learning, and working within a 24/7 framework. Performance-based learning is supported by continuously upgraded and ubiquitously available *distributed competence (DC) software*. The role of DC software is to help guarantee a sustained high level of competence in accomplishing well-defined tasks.

Performance base innovation (PBI) builds upon, but is not limited by, performance base capital. Performance base innovation is intended to automate or eliminate all forms of human competency that are now, or could be, accomplished by DC software. The preferred role of humans in the innovation context is to create new work and products—not to mimic machines through repetitious thinking and motions. Education for performance base innovation will be experiential, either in real-world or simulated circumstances. It will employ *body area network* technologies that are worn on the body, woven into clothing, or implanted.

Innovative knowledge workers will be the largest percentage of workers in the continuous innovation society. Innovative knowledge workers create their own work and often their own jobs. Most of today's knowledge workers convert the potential of information into locally applicable knowledge that does not flow to a network. Tomorrow's knowledge workers will continuously create knowledge within specific living, learning, and working contexts, and they will routinely network this knowledge in the form of new information to help modify distributed competence software. They will do this because the markets, technologies, and networks are available to do so, and because they will be rewarded for doing so. While networking newly created information to each other, they will attempt to automate their current tasks by acting as resources for upgrading distributed competence software. As a function of performance base innovation, innovative knowledge workers will always be working themselves out of their jobs. Indeed, this will be an expectation of and for such workers.

FOREGROUND IV: CONTEXTUAL OPPORTUNITIES FOR LEADERSHIP

This essay argues that career and technical education (CTE) is appropriate and preferred channels for leading an educational mission shift to prepare, support, and evolve flexible, information-producing knowledge workers for a continuous innovation society. The temporal framework of this essay is 2001–10, a frame in which Artificial Intelligence is not expected to play a major role in living, learning, or working.

For this essay, knowledge is defined as information in perceived transition or transformation, animated by the interactions of individual and collective purposes, contexts, and software-driven technologies. Creativity, invention, and synthesis all require the perceived sense of information in transition or transformation. Knowledge is constructed by the individual and then provided to people and machines as new or modified information. Stable information is the raw material of knowledge, while information in perceived transition or transformation (knowledge) is the raw material of the continuous innovation society.

Because it loses both contextual and personal meaning in the process of transmission to others, knowledge acquires the properties of information. Knowledge, therefore, is a very personal resource, while shareable information is both a precursor to, and a product of, knowledge. Codified, task-focused information fuels software and machines. It can be very exact.

Human knowledge, on the other hand, is born at the edges of chaos in experiential contexts. It can be very volatile. A major human requirement, therefore, is to capture knowledge as information and quickly network it, so that software-supported machines and humans can partner in performance competency and continuous innovation.

Perhaps the greatest opportunity awaiting humankind is the use of networks to distribute continuously upgraded information in the form of distributed competence software. The first use of such information is to improve performance in codified tasks; the second is to transform it for use in continuous innovation.

The continuous innovation society will be platformed, not upon schools, but upon contextually competent and upgradeable performances supported by software-fueled machines available to everyone anytime, anyplace. While knowledge is localized and ephemeral because it is very personal, information is shareable and enduring. It is rapidly becoming the culture of domesticated, cognition-supporting machines.

Focused information pertinent to specific contexts and tasks is becoming the realm of the software-driven machine. The construction of innovation and emergent purpose are functions of the human supported by networked software-driven machines. The intent of this essay is to support the leadership of CTE in considering an Innovation Society in which repetitive labor, including cognition, is accomplished by machines in support of innovative humans.

Many trends are impacting work and education in new ways and at increased rates of change. One of these is the advent of wireless hand-helds or PDAs (personal digital assistants). Wireless devices may outnumber wired ones within a few years, perhaps earliest in countries without wired infrastructures. Among the problems facing wireless developers are bandwidth, compression, viruses, cross-platform interfacing, display quality, key size, appropriate and reliable software, and affordability. For this essay, the key problems and opportunities lie in software and its very timely connectivity with human performances and innovations.

There is much evidence that learning, both for students and workers, is shifting to software-supported performances. Such performances may be in the form of simulations and/or real world outcomes in the school and community, and on the job. The position of this essay is that the emergence of DC software is creating a performance-based learning (PBL) macro-trend in the United States' work force. This macro-trend is consistent with, and a major contributor to, the rapid growth of knowledge workers in continuous innovation economies and societies elsewhere on earth. What are the signal features of an emerging knowledge society?

- Work and learning are beginning to merge, fusing two environments that education has treated separately since the success of the Industrial Revolution.
- Society is relying more heavily on the mass media to provide cultural background awareness to learners and workers—shifting from industry and information cultures to emerging knowledge and innovation cultures.
- Much learning on the job is shifting away from training, moving toward more reliance on worker-initiated (and DC-supported) on-the-job learning (OJL).
- Mass learning customization is appearing in DC-supported workplaces because of worker-initiated learning, which is intended to supply enhanced performances.
- Educational institutions are laboring to reinvent themselves for relevance in the emerging innovation cultures, but this progress is too slow to accommodate the rapid change that is occurring around them.
- At the same time, user organizations are demanding altered and enhanced performance outcomes from graduates, leading to a persistent performance crisis that educators are currently not able to solve.
- Educators are, like virtually all professionals, baffled when reality outruns their current curricula, pedagogies, and experiential or simulated contexts.
- Educators must learn to produce graduates who can almost immediately perform the currently unlikely or unthinkable, and promptly innovate beyond those achievements.
- This will require that CTE and all professional leaders learn to move beyond the artifices and inefficiencies of pre-preparation to experientially valid just-in-time performances supported by DC software.

- Such performances ideally will be short-lived as human activities, and replaced by task-dedicated software that will free humans for continuous innovation.

What is the generic utility of wireless devices and DC software? Their major purpose is to impact PBL directly, without removing individuals from their classroom, community, or work contexts. The venue of PBL lies in the situation, backing up, augmenting, and even replacing the performances of individual learners and workers. Real-time DC is required to accomplish this. It is important that DC be available instantly within the performance context.

One may ask: are not developing education and instructional technologies such as computer-based training (CBT) and intelligent tutoring systems already available to enhance learning? Isn't the purpose of these systems to prepare learners to learn more quickly, and to transfer information more efficiently? In some instances, new instructional technologies have helped students learn faster and better. However:

- Transferring existing information is not the same as making students, workers and citizens performance competent.
- Instructional technologists continue to apply new technologies to old models of learning—creating persistent inefficiencies and low-quality transfers of information and skills to performance outcomes.
- Educators and trainers continue to separate learners from the contexts of their performances (e.g., the community for young learners and the job context for workers).
- Educators are reluctant to focus on school and non-school performance outcomes as the appropriate measures of their service relevance.

This essay's position is that a major goal of learning must be to produce competence-to-master performance levels at the times and places of need. Education that continues to produce expertness, rather than onsite performance guarantees, faces continuing problems:

- The learning curve is too time-consuming, while change does not wait for new curricula and for instructor upgrades.
- Because "expert heads" are expensive to produce and limited in application by chaotic change and unpredictable future performance needs, *everyone* will have to become an "expert mind" as a function of altered expectations and software/netware supports.
- The half-life of expert knowledge continues to decrease even as knowledge managers have yet to find effective ways to transmit actionable knowledge human-to-human or human-to-machine; instead, they are transmitting information and skills—in the author's opinion their most important function prior to the arrival of artificial intelligence.

It does not require much imagination or insight to read the handwriting on the wall for education: support the emerging knowledge economy by adding to or reengineering your services, or face the threat of obsolescence and its consequences.

FOREGROUND V: PROMISES & THREATS OF DISTRIBUTED COMPETENCE

Perhaps the ideal future is one in which age, incapacity, educational level, or ignorance are no longer factors in solving problems and capitalizing on opportunities. Distributed competence software and its supporting technologies make possible the cascading of formerly esoteric and difficult skill sets into the contexts of human performance. For example:

> Five year-old Yolanda brushes her teeth in the bathroom of her family's small apartment on Chicago's South Side. As she moves the smart brush up and down, its tinny voice coaches her: "Move up onto your gums. That's it! Not so hard, now.... OK, let's do the bottom teeth." After Yolanda finishes, she rinses the brush and places it in its holder. Within seconds, a data stream carrying gingivitis, plaque, and bacteria types and levels has been sent to an analytical program in a dental hygiene office.
>
> While Yolanda brushes her teeth and prepares to leave for school, two late-model automobiles are tested on a snowy slope in upper Michigan. The cars are positioned at the top of a winding, ice- and snow-covered road that descends steeply into a valley about 1 mile away. Both are driven by certified test drivers. The first car moves down the hill, and within 1,000 feet slides into a ditch. The second car also starts down the hill. Employing smart steering software, however, it negotiates the winding road perfectly—arriving in the valley without control problems.
>
> At about the same moment as the car arrives safely in the valley, flight control software refuses to permit a tired pilot's command to pitch up the nose of his airliner while descending into Chicago air traffic. "Your speed is too low for that maneuver, Captain," says the voice in his headphones. "Entered in the flight log," the voice concludes.

These scenarios illustrate the real-world functionality of DC software embodying information base skills. DC enables Yolanda and the driver of the second car to accomplish tasks beyond their current experiential, skill and information resources. In effect, Yolanda's smart toothbrush performs some of the dental hygienist's capabilities, while the driver has benefited from partnering with driver-enhancement software. The airline pilot may face further simulator time and even a proficiency check ride, but his passengers arrive safely in Chicago.

Information-based skill-concentrated DC software is a direct threat to all repetitive human functions at work, in learning, or in community. At the same time, it is the most hopeful and compatible equalizer for the ignorant, the unskilled, the slow, the blind-sided, and the unimaginative.

Performance Point competency and learning, as illustrated in focused scope and scale within the scenarios above, demonstrate the argument for a post-education paradigm. For any of the scenarios, several principles of the post-education paradigm apply: devices with *help-me, show-me, advise-me* and *do-this-for-me* features can: *move* information and skills through space and time, *amplify* human performance and learning, and *transfer* responsibility for task coordination to humans. Performances therefore replace old learning-to-do. Performances are either machine-enhanced or machine-accomplished, and machine competence gradually replaces human competence in selected tasks.

These principles, when put into practice, can provide task-by-task tests of propositions asserting:

- That classroom pre-learning is no longer a precondition for selected performances supported by DC software and appropriate devices and networks.
- That every person supported by DC software can perform new tasks in selected situations and contexts.
- That PBL can replace low-efficiency and often person-destructive classroom education.
- That traditional distinctions of learning, training, education, and performance can compress into body-area, network-supported DC software supporting performance-based learning followed by performance base innovation.

When DC functions in these and thousands of other examples, it acts to support increments in human performance. It permits *constructed performance,* first; *constructed innovation,* second; and *constructed understanding and intuition*, third. In the DC framework, understanding and intuition are the products of experienced performance and innovation. *Constructed knowledge*, the fourth product of DC software applied in context, permits the person-level codification of experience. This knowledge then may be transmitted to others as new or modified information.

PBL is premised on the use of DC to support increments in human learning. PBL is already in use in the work force. What are the challenges faced by the work force that have resulted in expanded uses of DC? Here are some of the more important challenges to (receding) information workers and burgeoning knowledge workers:

- Requirements for point-of-contact performance and innovation,
- Continuous changes in required competencies,
- Increasing task complexity,
- Demands for reduced response time,
- High costs for development of competencies,
- Demands for high quality, and
- Low tolerance for errors.

These challenges to the work force suggest guidelines for the renovation and revitalization of education services in countries such as the United States. The pioneering uses of DC in business and industry will have to be emulated by educators to help prepare students for the work force. We propose that the DC paradigm emerging in the world of the work force be directly applied to the student force. Here are several trends to support this position:

- The United States and several other societies are moving toward continuous innovation founded on the performance capital generated by knowledge workers.

- Knowledge work increasingly will be supported by advanced software, amplifying the advantage enjoyed by knowledge workers. Currently, 40% of the U.S. work force, it is anticipated that innovative knowledge workers could form over 90% of the U.S. work force by 2010.

- Digitization of knowledge worker support is part of a long-term process that has created reductions in earlier work forces, such as farmers, blue-collar laborers, and information/service workers.

- Legacies, or preexisting factors, are acting both to promote and inhibit momentum toward continuous innovation driven by knowledge workers and their intellectual capital. One of these inhibiting legacies is the dominant industrial paradigm of K–12 and higher education.

What are some of the problems and inefficiencies in the preparation of students who can meet these challenges? One major impediment is the paradigm of *meritocratic pre-learning*, which limits access to software-supported simulations and experiential learning that could provide improved transfer of learning to both school and non-school performances. Several historical factors acting to limit the application of DC and PBL in K–12 and higher education settings are:

- Schools are social technologies driven by legacy factors strongly associated with the assumptions, values, and organization of industry-based society. We believe that they should be focusing far more resources on preparation of learners for a performance base/innovation base society.

- Schools are usually conservative. The schools were set up to selectively channel some students toward success and others toward failure. This is still their functional contribution, carried out within an obsolete and damaging industrial paradigm.

- Schools consistently lag behind social and economic change. Some estimates of this problem measure school response time on the order of up to, and beyond, a generation.

- School personnel are highly aware of, and defensive about, their lagging indicator status. They are concerned that children in their classrooms often know much more about new technologies than many teachers do, and they fear the professional impacts of this gap (hence, the fear of being replaced by technology).

- Schools are generally resistant to technologies or processes that threaten teacher status and control. The blackboard, textbooks, and overhead projectors are permissible technologies because they sustain, rather than erode, teacher control over students.

- Communities, for the most part, rate their local schools highly even though they are often quite critical of national education. This dichotomy is suggestive of similar data about families—mine is OK; yours has problems.

While changing schools is very difficult and time-lagged, adding *parallel services* (e.g., PBL supported by DC) can be easier and faster. Dual-service schools (i.e., traditional and PBL co-streams) can be managed effectively within a co-service paradigm driven by consumer choice. The Marshall, MN, public school system already successfully operates such a dual service, in partnership with Microsoft. In the Marshall schools, technology-savvy students act as valued instructors to other students—and to faculty.

What set of assumptions is traditional education service built upon? Here are some of the more basic ones:

- Information is a precondition to performance.
- Teaching facts about things will translate into being able to do things (*things* are defined as methods, procedures, processes).
- Jobs are fairly static and entail predictable tasks.
- Learners are largely homogeneous, and can be mass trained/educated.
- Proficiency requires significant practice (demonstrated repetition) outside the experiential context of the task.

These suppositions are at the core of an obsolete industrial paradigm that is paralyzing the transformation of educational services to meet current and emerging societal needs.

This essay argues that digital technology will force students into co-adaptive relationships with advanced software, exactly as it is already forcing the work force. This will foster the emergence of productivity criteria, placing students and knowledge workers within the same paradigm of assessment, support, and development. We may, therefore, logically and accurately speak of students as developing knowledge workers.

As is already the case in Marshall, MN, parents and children will choose whether they wish to affirm PBL and select the corresponding educational services, or whether they wish to refuse PBL and receive traditional or other services. CTE leaders will therefore be permitted to design services based on two paradigms driven by two markets.

Regardless of whether there is a conservative legacy market for CTE, society is arriving at a point where the integration of learning services and workforce requirements is overdue. Contrary to the arguments against technological dependency, we will not return to the days of software-free work. Performing to learn is replacing learning to perform, and as this occurs, the demand for embedded DC software rises. We offer the following as premises for the necessary dovetailing of preparation and support for students and workers in the knowledge and performance base continuous innovation society:

- Pre-learning and practice are no longer absolute preconditions for acceptable performance.
- The work force increasingly includes large segments of the population who are trained continuously through DC software through On-The-Job Training (OJT) and On-The-Job Learning (OJL).
- Traditional distinctions of training, learning, education, and performance are blurring.
- Performance-based learning is replacing low-efficiency classroom/lecture-based learning.
- Traditional concepts of job roles are shifting to performance roles.
- Learning is moving from the classroom to the point/moment of value
- Specific descriptions of jobs are giving way to performance-in-context expectations.
- Life itself is being recognized as a performance event.
- Intensified technology support is basic to performance conduct and improvements.
- Performance-supportive DC is increasingly transparent, ubiquitous, self-reconfiguring, and cheap.

In the traditional learning paradigm, learning is a scheduled event that occurs prior to performance (Just-In-Case, or JIC). In the PBL paradigm, learning is a Just-In-Time (JIT) event that occurs in the moment of performance or in highly detailed Just-Ahead-of-Time (JAT) simulations that are continually revised by smart DC software. JAT simulations, to be most effective, must be present at pre-operational points-of-performance within continuously running simulations. This capability will be driven by Strategically-Ahead-of-Time (SAT) projections and pilot projects.

CTE leaders can benefit from considering SAT, JAT, and JIT as interactive and equally worthy of their attention and development. CTE leaders can promote bi-paradigmatic education by helping other professionals recognize that no field is immune from the invasion of technical support, and that such support will downwardly alter the roles and statuses of existing educators even as it elevates the positions and influence of nouveau knowledge base practitioners.

FOREGROUND VI: IMPLICATIONS OF DISTRIBUTED COMPETENCE FOR CTE

Continuous Innovation Society as a coinage marks the experiential development and application of personal creativity capital to support continuous invention and innovation. This essay defines innovation capital as an index of socially shared actionable information, based on the cumulative, transmitted knowledge constructions of individuals.

The U.S. is moving toward rapid-cycle organizational deconstruction, reconstruction, and continuous innovation based on distributed software. In such a society, individuals must change rapidly. They must be assisted by appropriate technology, such as computers and hand-helds, together with the software and netware required to make these connectively useful.

Many school boards and administrators will face the prospect of realigning educational services to meet the needs of a continuous innovation society. Fortunately, the U.S. work force is already pioneering the use of distributed software and hand-held devices to support the growing percentage of knowledge workers. As the role of software grows, the focus on just-in-time performance evolves with it.

Accordingly, this essay has argued that K–12 and higher education should emulate the worker software movement by bringing it into the common experience of students. The essay assumes that software-based preparation of students for success in a continuous innovation society will be driven by both performance-based learning (PBL) and innovation base learning (IBL), in which the skills of 1) software and device management, and 2) developing and working within fast, temporary traditions will become the new CTE basics.

This essay has assumed that the separation of CTE from liberal or general education will greatly diminish, and that career education will shift to career creation and career cycling. The essay has argued for energetic CTE leadership aimed at helping school managers understand the requirements for technical and software support in all forms of education, employment, and daily life. In effect, this approach elevates technical and career education to an umbrella relationship over *all* other forms of education. (Will familiar education formats remain stable? K–12, for example, may become K–10, as state governments attempt to eliminate redundant and inefficient high school years, replacing these with collegiate or other human development services.)

This essay's approach to knowledge creation has assumed that units of knowledge are generated only at the intersection of people and contexts. Some contexts may be hypothetical or simulated. We adopted this experiential working definition of knowledge construction because it denotes the importance of individual-in-context as the nexus of knowledge innovation. This definition also serves to set apart information, which is seen as a raw resource for the experiential development of actionable knowledge.

Therefore, this essay's approach to the future of CTE is individualized and closely tied to the working and community contexts of students and faculty. Students increasingly will develop knowledge individually within the contexts of living, learning, and working venues. Their common goal will be to develop shareable information for use by humans and machines in *all* phases of life.

Developing and implementing this integrated, experiential approach to knowledge creation and application is de rigueur for U.S. and other economies aspiring to move toward continuous innovation—and is not limited to the workplace, but manifested in all institutions. The leadership potential of CTE is multifold in this context. It may be to lead the way to the continuous innovation society, to resist it, or to wait for leadership to develop elsewhere.

In light of this heuristic continuum, we are able to venture several premises concerning current approaches to career and technical education (CTE).

The first premise is that the U.S. and other advanced societies are moving toward continuous innovation founded on individual human capital and supported by information technology.

The second premise is that knowledge work increasingly will be rationalized and brought within the capabilities of advanced software, continuing and even accelerating the evolution of the natures of living, learning, and working.

The third premise is that digitization of knowledge worker capabilities is part of a long-term process that has created huge reductions in earlier work forces, such as farmers, blue-collar laborers, and now information/service workers.

The fourth premise is that digitized knowledge work will permit, or force, most workers and students into complex *proactive* relationships with advanced software. This will foster the preeminence of innovative knowledge workers.

The fifth premise is that legacies, or preexisting factors, are currently acting both to promote and inhibit momentum toward the formulation of an innovation society driven by continuously enhanced human capital.

The final premise is that the goal of educational systems should be the production of flexible, resilient, software-supported students, workers, and citizens who can successfully compete, thrive, and live with dignity in a technology-driven continuous innovation society.

Clearly, CTE leaders will be asked to cope with futures that are increasingly driven by serendipity, synergy, and counterintuitive, self-organizing forms of personal and collective organization. Individuals are becoming networked selves with planetary mind prints. Organizations are here today and gone today.

Creative, exponential approaches to self-development and career construction are challenging stovepipe models of upward mobility and advancement. Free agency culture is challenging, and will defeat, conventional organizational loyalty. Embedded sensors and self-analyzing/self-repairing capabilities in machines and software will mimic the healing and evolutionary processes of advanced organisms, including humans.

In the face of these changes, CTE leaders, as all educators, will be asked to help create career and technical education futures unlike any before. Fortunately, these CTE futures are partially forecastable. Hopefully, the most preferred of these projections will be realizable.

In the short term (2001–10) we can expect to see a mission shift toward invention and innovation in higher education and 9–12—if 9–12 still exists by 2010 in states such as Minnesota. Some of the changes that will accompany this shift:

- Learning will become performance and innovation based.
- Software and machine management will become new basics.
- Standardized tests and other forms of testing will disappear.
- Contextual analysis and co-evolution of persons and contexts will become a required theory area.
- Faculty will become consultants to students, who will become clients
- Students will become innovators and entrepreneurs.
- The elimination of barriers to self-development will be a new social concern.
- New legal services will support student copyright and patent products.
- Higher education will become a for-profit industry, focused on the development and testing of new products and services, some of which will have historical foci.
- Higher education will support the continuous innovation society by preparing *prosumers*, or persons who both produce and consume constantly changing goods and services.
- Parents will become investors in colleges.
- Employers/clients/benefactors will pay tuition bills, but expect to share in stocks/profits.

Some of the CTE barriers in coping/leading in this change context are:

- Constructivism is a necessary but insufficient approach because it implicitly presumes the continuity of CTE organizations, traditions, and legacies over the future of unknown contexts.
- Contextualism is a necessary but insufficient approach because it too narrowly defines context in an era of interactive global networks.
- Training and education are insufficient approaches because they presume the necessary preexistence of pre-defined curricula to cope with unknowable, just-in-case futures.
- The rigid application of JIC education not only prepares students, workers, and citizens for the past; more importantly, it creates a legacy of powerful tradition that works ceaselessly against creativity, invention, and innovation.

The conventional educator is doubtlessly appalled at the loss of efficacy being experienced by education's industrial model of preparation and subsequent performance. But the exigencies of change demand that each must collapse, one into the other, to meet the demands of change. But learning and performance are not enough—tomorrow demands continuous innovation to support successful competition and hedges against unexpected events, such as 9/11.

FOREGROUND VII: NEW DIRECTIONS FOR CTE?

This essay has been about moving from *learning to perform* to *performing and innovating to learn*. The essay has argued that performance-based learning (PBL) can effectively create learning in the context of tasks supported by distributed competence (DC) software. The essay has submitted that PBL is a process that encourages learning based on authentic performances supported by DC software, and that such learning should lead to performance upgrades and innovations in task conception and accomplishment. Such upgrades and innovations are not guaranteed; they are potentials in the futures of human performers and their networked DC software.

Many educators have expressed concern that all individuals require knowledge basics. They argued that while machines can break, education provides knowledge that is always available to serve the individual and society. The approach taken by PBL is very different from the administrators' should-be-learned, or just-in-case information. This essay's approach is based on could-be-learned, or just-in-time information.

The Knowledge Age has produced an explosion in the generation and accumulation of just-in-case information. At the same time, schools are facing limitations in their ability to transfer information in ways that produce enhanced, quicker learning and higher quality test performances. The volume of just-in-case information that can be developed, retained, and effectively used by ordinary individuals has, arguably, remained relatively static.

This is why the essay argues for DC software—to take the pressure off humans, permitting them time and resources to invent and innovate. The resulting opportunities for development of human creativity, invention, and innovation far outweigh losses in the capacity to note-take, to recite, to earn honors through mechanical memorization, and to require massive re-education after graduation. Time and resources saved through networked DC software, coupled with a new mission for earliest possible automation or elimination of human tasks and jobs, permit CTE and other professions a clear field of transition to conceptualization, simulation, and support of the emerging continuous innovation society.

Indeed, the power of machines and software to store and process both just-in-case and just-in-time information is increasing exponentially. PBL provides an opportunity to balance just-in-case information with an accelerating availability of just-in-time, performance-driving information. In countless work venues, JIT information is now available on-demand, very often with 24/7/365 updates.

To some, education employs tried-and-true learning approaches that have been developed over several millennia. Could PBL produce many unknown and potentially harmful impacts? Where, they asked, is the long-run assurance that PBL will be more effective than existing school-based learning?

While it is true that the full range of future PBL impacts cannot be known, the future of contemporary education is also at risk. PBL offers another choice in how we address the issue of education-related task proficiency. PBL expands the concept of learning driven by software-supported performances.

PBL does more than enhance the potential ability of learners and workers to function in task environments; it regards functionality as the *primary* learning experience. The aim of PBL is to upgrade, automate and replace the tasks performed by DC-supported humans. These follow-on steps are exactly in line with the creative destruction and reconstruction processes that are now fixtures in leading industries.

Task performances can be measured through outcomes and a variety of first- through *n*-order contextual impacts. It is axiomatic that DC-supported PBL will degrade the intellectual content of existing workforce and student tasks, and that it will de- and re-skill existing jobs and professions. PBL is already changing the ways in which work is performed, and is in the process of redefining work itself. Under these circumstances we argue that the purpose of learning will increasingly focus on the application of just-in-time information within pre-defined and emergent performance contexts.

Technology has enabled the development of new machines that are capable of expanding the scope of human performance and learning at both the individual and networked levels. Many of the administrators in the study argued that the ability to create more powerful machines does not assure more effective performance or learning. We would have to agree that, if machines are applied to learning within the present just-in-case model, something like neural implants probably will be required to produce large learning increments.

Realistically, numerous precedents suggest that the potentials for failure amplify when humans and machines are coupled in new ways. However, contemporary manifestations of Greco-Roman, German, and British educational models, with their assumptions, pedagogies, curricula, and assessment tests, are increasingly unable to keep pace with demands for enhanced performances and faster learning cycles. We argue that DC-supported PBL will increase the potential for successful performance and learning outcomes while actually softening traditional levels and ranges of risk. The bonus of this change is the vastly enhanced support for continuous innovation by all citizens—not only workers or students.

PBL enhances the opportunity to prototype future learning in increasingly powerful fail-soft experiential venues, i.e., PBL enables learner-performers to address the new while simultaneously reducing the risk factors historically associated with exploration, invention, and innovation. In the labor force, PBL is designed to take advantage of growth in networked software-mediated work-learning opportunities by substituting doing-to-learn for learning-to-do. Only one of the effects of this change is the shift in employee recruitment from degrees earned to personality characteristics such as motivation, anticipation, vision, experimentalism, and the capacity to learn from novel experiences and performances.

The exercise of human purposing remains at the core of PBL. Humans must now do more than apply pre-determined strategies when they work. Humans must craft strategic purpose in the form of preferred future outcomes. They must continuously redefine themselves and their performance contexts and tasks in order to achieve desired strategic outcomes, and respond to surprise. In turbulent times—now the norm—increased importance is placed on the distinctively human capacity to anticipate and cope with the unanticipated. This indispensable and characteristically human trait manifests itself in the form of continuous performance changes, including ceaseless knowledge/information creation and continuous innovation.

It is important to recognize a crucial capacity difference between today's software and humans: while software contains embedded worldviews, humans create worldviews. A major goal of DC-supported PBL must be to design systems that are supportive of human heuristic thinking, goal creation, and innovation. The growing competency of software to perform a wide variety of delegated tasks enhances the opportunity for humans to experiment in fail-soft environments and engage in otherwise high-risk performance and innovation ventures. PBL relies on distributed competencies to enable authentic re-definition of learning in a manner that couples it directly to performance. This amplifies the human ability to deal with ambiguity and unanticipated variety through praxis (intelligent action).

We have identified a major requirement for students and workers shifting to PBL— they will increasingly use machines to work with other machines. In that sense, the future of work is becoming tied to the ability to manage technology. People will also learn to use software and machines to work with people—including themselves.

Of course, none of this means that CTE must do anything about it—including help to lead its development. In many respects, it would be easier, and perhaps even prudent, to side with those agencies and individuals who wish to continue the inefficient and non-strategic development and utilization of human capital, innovation capital, and the other forms of value that are associated with a continuous innovation society.

Will increased reliance on just-in-time knowledge through DC software limit the need for human learning? Some of the administrators from whom we have drawn data forsee the possibility that PBL might actually limit the need for learning, or control learning in disabling ways. We submit that PBL enhances opportunities for human learning by placing humans in the context of expanding prospects for effective personal and collective action. DC-supported PBL emphasizes both personal and networked group learning through engagement in task performances.

Will DC and PBL degrade the intellectual content of job and professional tasks? Will both be de-skilled? We think PBL will change the ways in which work is performed, and probably redefine work itself as a humanly creative process. The purpose of learning will increasingly focus on motivation, innovation, and context creation, rather than the application of accumulated just-in-case knowledge and engagement in pre-defined work. Performance-based learning is merely the beginning—the take-off point for the development of performance base innovation and innovation base learning.

Several countries are creating cultures based on continuous innovation in industry, business, and civic life. Their systems of K–12 and higher education are refocusing their missions to prepare performance base students, workers, and citizens for continuous innovation cultures. Such cultures will offer students and faculty opportunities to examine and assess trends associated with continuous innovation and improved productivity. By far the most important characteristic of this trend is its relative slowness in the face of growing need—in particular, for innovation in the civic, governmental, societal, community, and personal sectors.

What can CTE leaders begin to do on Monday morning?

- It is an opportune time for CTE leaders to help society cope with two schisms that, in the author's opinion, are more important than the digital divide. One of these is the performance divide, an ancient and traditionally devastating differential productivity problem. The second is already on the horizon and will soon rival performance and productivity imbalances—the coming innovation divide.

- The task for CTE leadership can be to shift from teaching to software-supported construction of performance-based learning (PBL) and performance base innovation (PBI).

- This means relinquishing adherence to curriculum downloading and testing within a brain-as-disk-drive approach to human capital development. It means moving to a software-supported experiential approach to constructed performances and innovations based on understanding, intuition, and emergent knowledge transferable as new information.

- CTE leadership must choose to become comfortable with the heresy that virtually everyone can eventually perform, at least at the novice level, virtually all codified tasks that are supported by appropriate DC software. These tasks can range from cooking a wiener to setting a broken leg to innovating new products and services and new social and cultural systems.

- CTE leadership must ask itself to become comfortable with the value of DC-supported universal success—a direct attack on the meritocratic paradigm that has crippled the educational, employment, and quality-of-life hopes for millions of people throughout U.S. history.

- CTE leadership must ask itself to confront the importance of performance over learning, and innovation over performance. It must learn how to help free humans from machine metaphors and models (the Industrial Age syndrome), leaving these to the machines and their software and netware.

- CTE leadership must ask itself to realize that the future of its profession is to become an umbrella paradigm for software-supported high performance and continuous innovation in what are increasingly borderless interactions among living, learning, and working contexts.

- CTE leadership must ask itself whether local- and national-level heuristic simulations of the continuous innovation society and its human development potentials are worth drains on time and resources, and, in some cases, personal reputations.

- CTE leadership must ask itself about the projected consequences of resistance or inaction in the face of what this author firmly believes is the first serious opportunity to create a continuous innovation society—one founded upon creative, inventive, and innovative thinking and practice by all U.S. citizens in their everyday learning, living, and working.

The urge to control and dole out educational software in support of traditional and contemporary CTE interests is understandable, but it is not leadership. While it is easy for an outsider to recommend changes in somebody else's shop, we are talking about our shops now, in the sense that no public or private enterprise is immune from the changes explored in this essay. Education has an opportunity to move from lagging followership to decisive leadership within the change contexts we have described. As we have maintained, CTE, with its technical focus and performance innovation outcomes mandates, is ideally positioned to lead the rest of education into new leadership and prominence.

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