

White Paper

The Promise of eLearning and the Practice of Knowledge System Design

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Introduction

This paper is about the vision and demand of eLearning along with the practices of Knowledge Management (KM), Knowledge Factories, and Knowledge System Design.

There is much confusion in the market about what eLearning is and how Knowledge Management system methods work. Training managers and marketers have also been confused by marketing claims that standard training programs pushed onto the Internet satisfy the demands for eLearning. In addition, claiming that Knowledge Management is training when it has been a separate industry for years only adds to the confusion. Many training technologies and companies have misguided the market by calling Training Management Systems technologies “Knowledge Management Programs” when training is just a small subset of a company’s over all Knowledge Management plan.

This white paper is designed to provide a clear understanding of the Learning market and its relationship with true Knowledge Management technologies. It will also provide invaluable information that defines what Knowledge Management is from a leader in the Knowledge Management industry. The market and strategic section of the white paper is written by Richard Close, an industry business development consultant with 10 years’ experience in the IT Training and eLearning business. The Knowledge Management section is written James Li, PhD, an industry leader in Knowledge Management and CEO at LeadingWay Corporation, a company that has been using KM to manufacture knowledge for eLearning and marketing support programs since 1994.

This paper is timely and mission critical for any organization looking at building large-scale eLearning systems for training, marketing, or support application reasons. The very near future will demand the management and delivery of massive amount of competencies, business processes, and product information via the Internet. Individuals building web page management systems will soon find themselves with unmanageable departmental silo systems. Those providing eLearning, using relational database Knowledge Management systems, will discover a way to thoroughly integrate massive amounts of an organization’s knowledge with their employees, channels, and customers.

What created the eLearning Market?

The real question is “What created the learning market?” Life used to be simple: getting the word out on new products through three different corporate departments. The training department sat people at desks and pushed information onto students for hours. The marketing department made available catalogs of information and brochures that consumers and sales staff could search to find information. And third, customer support desks and help desks would answer questions that were pressing or out of the box.

How we Learn

Think of how you learned Microsoft Office. You might have taken a class but you did the majority of your learning by poking through menus, software help systems, or you asked someone in the next cube how to do it. The majority of our “learning” is on the job, not in the classroom.

The majority of how we learn is not by a sequential training process; it is by an exploring process.

The three key strategies on how we learn that can be leveraged in order to build a solid Learning Technology strategy are these:

- Training is only a small subset of the entire learning process
- No matter if you learn by training, searching, or help, you learn the same information (knowledge) but it is presented in different ways
- The three ways we learn: training (pushing), marketing (searching), and help (interactive) can now be handled by one Knowledge Management Learning System. We will discuss this system in detail later.

The Pressure for Massive Global eLearning Systems

We have become so reliant on the speed and distribution of networked information and computer technology that we are beginning to expect it to deliver solutions to our problems of global learning faster than they can be brought to market. Based on a year of querying audiences in eLearning lectures and client interviews, the most significant consistent trend we see is:

- It is inevitable that we will need to learn about anything, anytime from anywhere

Because there is too much to know about too many things that never even existed when we went to college (if we did), we must learn how to use anything right when it comes out of the box, or when we step up to the job. The Net has the ability and the trend has begun.

The Pressure for Instant Knowledge

The days of 18-month management training are gone. So is apprenticing for years at Dad’s drug store to inherit the business. Even the short-order diner cook is becoming more rare to find. In our quest to make workers more efficient, we tend to build what the worker needs to know into the system. Even bartenders moving from one hotel to another do not have to remember the different costs of a martini, they just push the button for martini. Day one productivity demands that what a person needs to know can be served up to them the moment they need it. Learning what to do now has to move through the very technology we use.

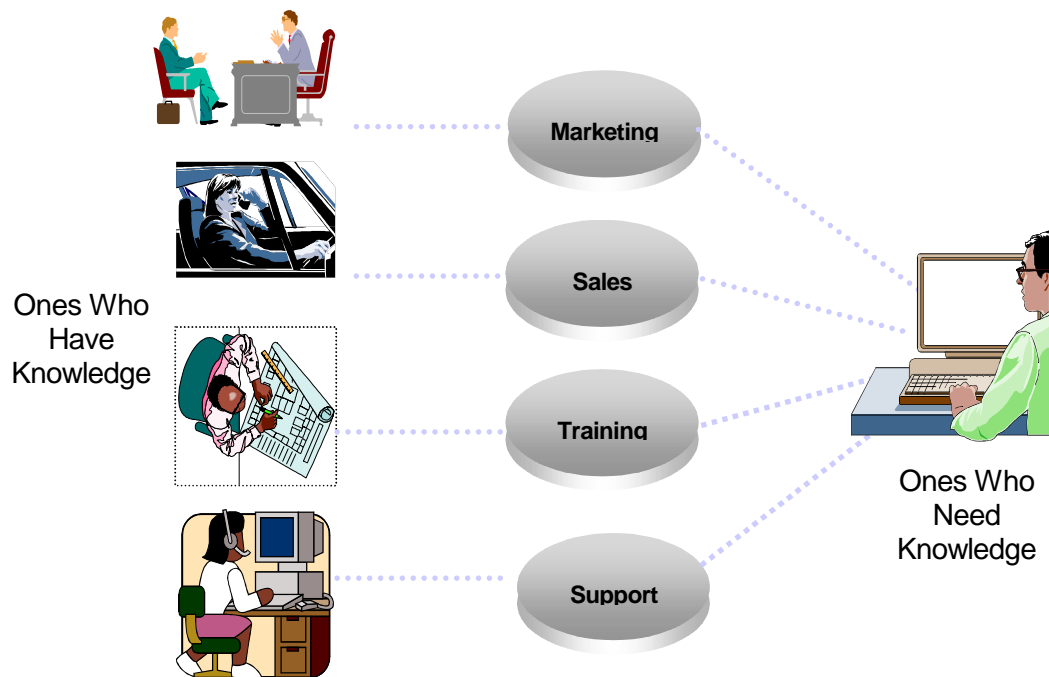
At one time we hired a TV repairman to tune the color TV -- then we read the TV manual -- now we follow an on-screen menu.

To make day one productivity possible, learning and doing must take place at the same time – this is all part of eLearning.

Learning and Marketing Merged Long Ago

In 1998, we announced in an Online Conference that there was no difference between training and marketing programs. It caused quite a stir, however, infomercials and Sesame Street are examples of both marketing and distance learning via an electronic system. Today, a multimedia company may develop training programs for fire safety one minute and use of off-road trucks the next. They will use the same development tools and the same Learning Management systems, CDs, and web site for distribution.

“It’s no longer just about training, it is about our relationship with learning and the learning experience. It’s about marketing, training, and support.”



What is eLearning?

Learning has many technical and academic definitions, but perhaps “adoption” of a piece of knowledge followed by a change in behavior is a simple way to view it. We see an ad and we buy a product. We invest in extensive training (brain washing) to get certified and feel that a certain product is the best technical brand to use. If we search for cheap tickets, or a faster path from point A to point B, we buy the ticket. No matter how we slice it, a piece of knowledge is added, or reconditions another piece of mental knowledge, resulting in changed behavior and beliefs.

Yes, this is a broad definition, and almost everything hitting us electronically can be called eLearning. It is now a huge all-encompassing market -- a market and technology that is so broad that it encompasses the Training, Marketing and Support industries combined. The point is:

“eTraining represents only a tiny segment of the eLearning market.”

The pitfall of most eLearning strategies today is that they use Training Management Systems that train students in a linear, sequential format of assessment, and conditioning lessons comprise only part of the equation. This legacy way of learning, with the teacher holding the ruler in front of a silent class for an 8-hour course, has little place on the Internet. Yet, almost all Training Management Systems, when they fail to train, claim that the solution is to give the students more assessments. Remember that the teacher, when all else fails, will throw out a test. This linear view of learning is understandable because training departments believe training is a “push” process, marketing embraces the philosophy that it is an attention-getting search process, while support departments believe it is an interactive process. Fundamentally, all are right in their own application to learning. The solution is to combine all three modes of learning on one system.

“The irony of different departmental silos doing different types of learning is that they are all serving up the same knowledge, or at least they should be.”

Imagine if a major software product vendor’s trainers, web managers, and help desk staff could all tap into the same product knowledge base? Should help desk know what is in the head of the best instructor? Or, should an instructor be able to answer a question about the price of an emergency help solution? If they all tapped into one single knowledge base they would. Knowledge Management relational database technology makes that possible. Knowledge Management Learning allows single point global learning via the Internet.

Imagine a software channel that every field engineer and channel partner could tap into -- a real-time knowledge base that could deliver a piece of information about every course, technical CD, product datasheet, and help desk question that a company had. Would they have a thoroughly branded and loyal channel, conditioned to the logistics of how that company did business? Absolutely. Building such a system requires the understanding of how to integrate massive-scale Knowledge Management systems with Learning Methodologies. This system was developed in 1994 by James Li, PhD and CEO of LeadingWay Corporation, during his Doctoral thesis. In that thesis and project with Caterpillar Corporation, Dr. Li combined AI practices, Knowledge Management, and Learning practices to develop a way to manufacture, manage, and deliver raw knowledge to a profiled individual. Not only did the program demonstrate the successful manufacturing of knowledge, a commercial application, it also linked a set of knowledge to a specific individual. Today, LeadingWay Corporation builds these Knowledge Systems using LeadingWay KM Learning System and LeadingWay Knowledge System Design methodologies.

Understanding Knowledge Management and Manufacturing

Knowledge Management now comes in two different forms. The data side of Knowledge Management works by consolidating or connecting information silos and the Learning side of Knowledge Management manages “Who knows what.”

The same way Henry Ford figured out how to move from crafting cars to manufacturing and distributing cars, Dr. Li figured out how to manufacture, manage, and distribute raw knowledge. The story becomes even more fascinating when you

discover that the theories of manufacturing knowledge came from the process of how Japanese workers manufacture cars.

Understanding eLearning is mission critical to understanding how we manage organizations in a knowledge-based economy. If a CEO cannot globally change the knowledge base of the company's works, then he/she will not be able to change the company fast enough to survive. If one company can virtually train, market, and support a global workforce overnight, how will a company that takes three months to launch training programs, marketing programs, and customer service programs compete?

"When you think of it, building all these courses from scratch is like building kit cars in your garage. We should be mass-producing and distributing knowledge with higher-quality, predictable results with less cost."

Search Learning – I want it now with no waste

The second radical shift will be from sequential page learning to modularized "Search Learning." We have less and less time to sit in a class turning pages for hours while being preached to. We have become a community of "Search Learners." Search learning is the process of having a specific question, searching for an answer, finding the solution, and then exploring a matrix for related topics. No wasted time and no wasted travel -- fast food learning -- anytime, anywhere.

The TV and remote wand launched us in into 28-second surfers and the Internet conditioned us with search engines that sift through hundreds of thousands of servers and billions of pages of information. Think of it, we went from walking across the room to click the knob on the TV to access three channels -- to a wand with hundreds of Cable channels -- to Internet search engines. All in only 50 years. Companies must be able to manage the intellectual focus and mission of their work against massive media and learning experiences. How will employees and management sift through so much information?

Understanding that we learn by searching is critical to understanding how linear training methodologies alone fail. Think of what works better, getting directions from a local in a foreign town and remembering them or using a GPS to politely talk you through each turn. Global organizations need to turn to the company's internal eLearning web site to tap into what they need at the moment. Sadly, perhaps less than 23% of American companies have an internal eLearning site to distribute this information.

"eLearning needs to evolve beyond the single event dump of knowledge to guide and support."

The secret is to guide people's searches efficiently so they may access what they need to know at that moment and "push" the right amount of information to guide them in their job. In short, we need to manage the learner and massive amounts of information all at the same time -- we need to manage the search and delivery of small amounts of knowledge when an individual needs it

Matrix Learning -- It's all connected to something else.

We also have become "Matrix Learners." Matrix learning is learning about one solution and either coming up with another question to be searched/answered or being distracted by Internet "push" technology to see what is related to that solution.

A paradigm shift is happening from the TV to the Internet. On TV, I haven't a clue what is on another channel unless I intentionally click to it. In contrast, the Net links everything with something else. On the web we start with a search engine, which will give us a matrix of thousands of choices about a piece of knowledge or a related topic. Imagine if you were watching a TV show and the announcer turned to you and said, "If you like this game there is another one that's even better on channel 33." You say that is very pushy. Yet the Internet Matrix does just that all the time. Order one book from Amazon.com and you get hit with emails about hundreds of related books. Amazon.com gets it -- interrelated knowledge on the Matrix in a Matrix format.

"If what is in my head is a matrix of how to use more than 20 different software products and hundreds of technologies, why can't an eLearning system deliver it the same way? As bits of interrelated knowledge."

This Matrix Learning strategy is important to eLearning because it is inevitable that a field engineer working on a Novell and Cisco System will need to tap into the knowledge for installing the two products through one learning system. This application of search Learning is inevitable but will require massive relational database Knowledge Management Learning systems to deliver such a solution.

What is Driving eLearning Expectations?

Use this section to analyze how you can use eLearning for business strategies.

"Never build a strategy around a vendor's technology sale," has been echoed since the beginning of the IT industry. If an organization selects a sequential Training Management System to do Search Learning and Matrix Learning applications, they will be deeply disappointed. Large eLearning efforts tend to start by driving business strategies. These strategies frequently fall under the following eLearning Mega Trends:

The Competitive Demand for Zero-Time-to-Market

Company A has the marketing department and an ad agency develop data sheets and product catalogs in a process that takes three months and a million dollars. No pricing information can go on it because the pricing changes. In contrast, Company B's marketing manager fills out a desktop template for a new product sheet on his laptop that is instantly formatted into a datasheet available to millions of people on the web as a PDF file download. Company B's marketing manager does not even print anything because every sales rep world-wide prints out data sheets on demand through their high-resolution color printers. Not only that, but the data sheet is integrated with the company's pricing and eCommerce system. Company A has to transport the sales force to train on the product, while company B trains the sales reps, channels, and clients all at the same time via the Internet. The first company has 6 months to market; the second has 6 seconds.

“eLearning trains, informs, and supports multiple layers of people simultaneously.”

From Single Point to Global Influence

Product information, business strategy, policies, and culture start at one point and need to be distributed to global workforces. There simply is not enough hours or trainers to do this in the traditional classroom way. Amazingly, less than 80% of companies have central web sites that internal employees access to retrieve mail and get the latest news and direction of the company. Basically we are still just sending email back and forth. Can you imagine if AOL had no front community site to serve up the weather, news, and hot stuff and all you did was send email back and forth? Not much of a community. Yet most companies are doing just that, just sending email back and forth with broadcasts of whose lights are on in the parking lot.

People need to learn about the company direction and culture not only today, but moment-by-moment through company virtual communities called digital wraps. When these internal virtual communities are built, CEOs will not only change global company positions from a single point, they will get virtual feedback as well. The days of tying up the chain of command would stop if a CEO could run a quick survey of 70,000 employees in the Asian sales force in an hour or so. ELearning offers centralized organizational change and virtual feedback.

Marketing Integrated to the Order

Once upon a time we bought gym equipment from Sears, went home and read the manual, and then bought the book on how to lift weights. Now we use cable digital technology to learn how to look magnificent using the exercise system. We are also conditionally trained on TV and then buy a product in the same learning experience. Is an infomercial or Sesame Street learning? Absolutely. It is just electronic media, utilized to get someone to adopt a new concept, belief, or behavior. Product marketing through electronic systems is eLearning and the measurable results are sales and brand loyalty.

7 by 24 Mentoring

How do I plug this in? What are the rules of changing this type of ticket (changing rules)? Support systems and people are learning programs designed to serve as a mini-instruction events about how to solve a problem. They also serve as invaluable feed back to the company and indicate what can be done to make their product easier to use. The more familiar or easier it is to use or adopt and produce, the less the support costs are to maintain the product in the market place. ELearning can take the knowledge base of the support center and place it not only online, but integrate it with the marketing and training process as well.

Taking up as Much Mind Space as Possible

Many articles about branding and the acquisition of mind space have been written. When it comes to the Internet, no one has come even close to how AOL has wrapped its brand around everything from astrological communities to consumer goods. ELearning also uses certification programs as the ultimate in mind space branding programs. Microsoft NT was going nowhere until Microsoft had an army of

support people confident in Windows NT install it. In the beginning, Novell had 70,000 certified professionals and Microsoft only had 7,000. It was frustrating for Microsoft not to have the brand recognition in the beginning. Now the frustration is on Novell's side.

Maintaining as Much Mind Space as Possible

Again, brand is maintained and repeatable, and the positive association with every repeat experience with your brand teaches lessons. Learning about a product, how to use a product, and questions about the product all must be quality learning experiences to the association for the brand to be quality as well. ELearning can centrally control the entire product cycle.

"There is no greater brand loyalty than someone who has gone under weeks of technical brain washing and calls themselves a certified something-or-other. Or is that called brand washing."

Knowledge Management and eLearning

It is no Longer Just about training - It is about Managing Knowledge

ELearning is the merger of eTraining, Internet Marketing, and eSupport (CRM). How big this market will be is anyone's guess, by 2002 -- anything over 10 billion to 20 billion might do. The relevance is in understanding the importance and scope of eLearning applications for your company and the competitive strengths of managing knowledge transference form one single system.

Why Integrate Learning with Knowledge Management?

Goods and services are produced with capital, materials, technology, people, and knowledge. Of the five components, only people and knowledge create an enduring competitive advantage. Knowledge Management ensures that the knowledge moves freely and swiftly from those who have it to those who need it. Learning management ensures that people can effectively acquire the knowledge and skills they need in order to be productive and competitive.

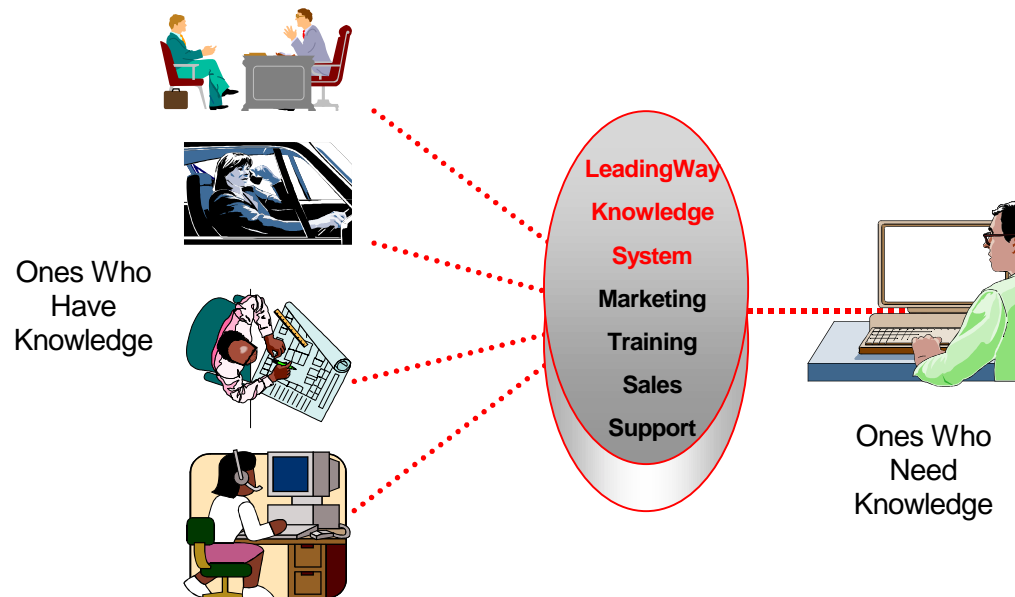
LeadingWay's revolutionary Learning and Knowledge Management technology has been developed with more than 15 years of award-winning research, development, and industrial applications in artificial intelligence, instructional design, and data modeling. Our solution leads a new generation of learning technology: **LeadingWay KM Learning System.**

Integrated Knowledge Management and Learning

The purpose of effective knowledge management is to successfully transfer knowledge. Transferring Knowledge does not mean simply transporting it using technology or a document. Effective knowledge transfer requires the integration of

learning and knowledge management: applying learning principles to the creation and organization of knowledge.

The following diagram illustrates LeadingWay's Knowledge System™:



Benefits of a Relational Database Knowledge System

Manage Knowledge In Addition to Training: In addition to the training management functions, our solution provides the tools and the process necessary to manage the identification, capture, classification, distribution, and sharing of knowledge. As a result, this system enables our clients to break down the knowledge barriers that frequently exist between departments.

Reduce Training Development Time and Cost: By treating knowledge assets as reusable objects, this solution enables an organization to reuse existing knowledge in order to rapidly construct and deploy new knowledge applications and training courses. The more knowledge assets are reused, the faster the development time, and the lower the development cost.

Rapid Update of Knowledge Content: In our system, knowledge objects are created and stored once and then are available for use in many places and configurations. If the knowledge changes, this change needs to be entered into the system only once. All applications that use that knowledge will simultaneously be updated by the system. Updates and changes become easy and quick to implement.

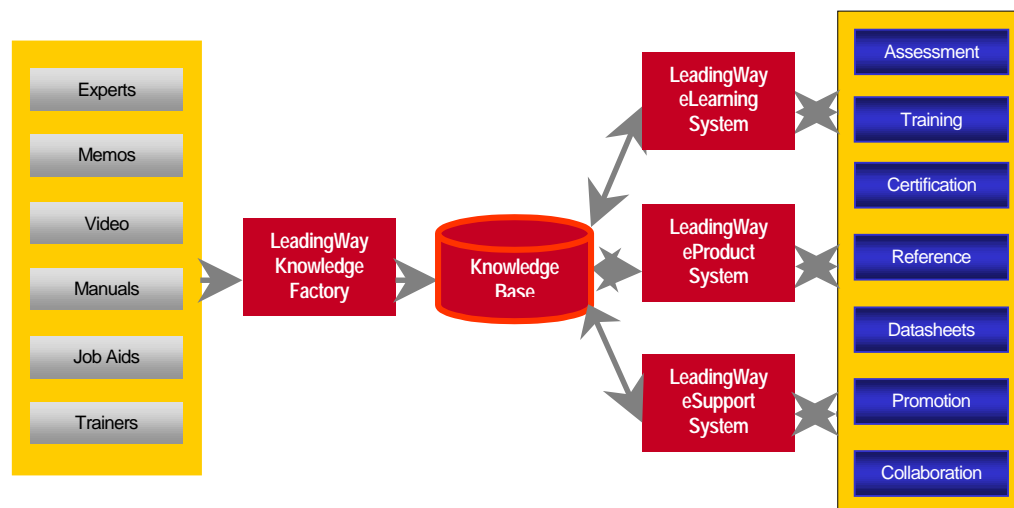
Accommodate Individual Learning Styles: Our solution allows learners to access the knowledge they need in a format that matches their individual learning style. A visual learner may want to learn the content through step-by-step tutorials using the training interface. Another learner may prefer reading a series of online hypertext files. A more expert learner can rapidly move through the process, while a novice user may want more detailed instruction. The LeadingWay solution enables the learner to select the learning style that is most appropriate.

Delivery Medium Neutral: Our system of managing knowledge uses state-of-the-art technological knowledge, which enables us to deliver on any platform and in any format. A simple formatting function can export knowledge from the knowledge management system to any designated export format. This allows an organization to focus on building their knowledge base. The method of delivery can then be selected based on what is most appropriate and cost effective.

LeadingWay Knowledge System Design

Just like manufacturing a car's raw material in different formats, a systematic process must be managed and engineered so it may be delivered in a consistent, economical, and high-quality format. The current way of building each web-training course from scratch, called crafting, is time-consuming, costly, and produces inconsistent results. Crafting courses into HTML courses for large-scale eLearning applications is not only a costly venture but also unmanageable and inflexible.

LeadingWay Knowledge System Design Model



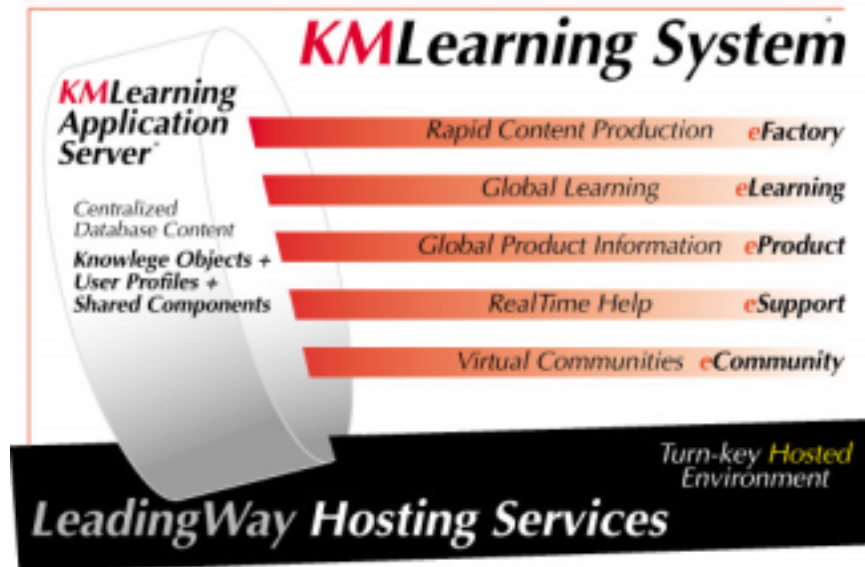
LeadingWay KSD methods study the way knowledge flows through an organization and then captures it into a Knowledge Manufacturing System and Methodology. Knowledge Manufacturing is more than just a software system. It is the people, business process, and workflow involved in manufacturing as well. LeadingWay clients treat this process as an outsourced factory and make the LeadingWay custom factory a virtual company to their business.

Another key strategy to Knowledge Management Learning is the ability to manufacture knowledge in any format, chunk it into small "Knowledge Objects" and then serve it up in any format, virtually.

LeadingWay KM Learning System

The key principle of KM Learning is to convert all information about a knowledge base from its current format by the LeadingWay Knowledge Factory into small chunks called Knowledge Objects (KOs). The LeadingWay eFactory wraps each tiny chunk of knowledge with a meta tag that communicates to the system a series of

business processes such as who is allowed to see this information, the style and format it will be presented in, and the other Knowledge Objects that are related to it. These KOs are placed in LeadingWay's KM Learning Application Server. Next, the KOs are presented in their custom branded formats, rushed as training knowledge by the LeadingWay eLearning system, searched as product knowledge through the LeadingWay eProduct system, and delivered as interactive support through the LeadingWay eSupport system. LeadingWay's ability to take diverse volumes of knowledge in its raw form, manufacture it in high-speed, small Knowledge Objects and then globally serve it up in any format is unique in both the Knowledge Management and training industries



What is Knowledge Management and eLearning?

Today, people learn in three ways: classic courses, searching for information (knowledge) and asking for help. Essentially it is the same information, but it is presented in different formats, depending on the way they need it and when they need it. Because it is the same knowledge, it makes no sense to have different learning, marketing and support systems. Why not have one system that delivers the same piece of knowledge in different ways? Today, we can do just that, with LeadingWay KM Learning System. KM Learning System stores both user profiles and information in small "Knowledge Object" chunks in a relational database and then presents the information to the user in any format. Economic and technical productivity leaps can be achieved by building one knowledge system to handle the tasks of Online Learning, Product Marketing and Support all at the same time.

We Can Now Manufacture Knowledge!

Managing and delivering knowledge is only half the story. How do we get the massive amounts of information and business processes to people who need to know? We must have a way to mass-produce knowledge in a clean, consistent, presentable format. We need to do it quickly, economically and change it virtually. The current way of building everything from scratch in custom HTML pages is way

too expensive, slow and not manageable. KM Learning System automates and rapidly produces “Knowledge Objects” that can be delivered as dynamic web pages to build a virtual community between your customers, partners and employees, enabling them to access the knowledge you want them to know. With the ability to produce and deliver knowledge quickly, economically and virtually, LeadingWay helps customers reduce training costs, improve employee productivity, build customer loyalty and manage knowledge assets.

LeadingWay KM Learning System

Imagine if we could take a body of knowledge about a product and have a totally integrated way to produce, store, distribute, support and track it worldwide...

LeadingWay KM Learning System is a fully integrated platform for online learning, marketing communication, support and knowledge management. It is built on more than 15 years of university research and industrial applications in artificial intelligence, instructional design and lean manufacturing principles. It is the core technology for companies like Caterpillar, The St. Paul Companies, Toyota and portals like eMind.com and openclose.com to manage and deliver eLearning programs.

LeadingWay KM Learning Application Server

Imagine if your web-based training, marketing and support system were truly centralized and virtual. Imagine that you could place knowledge in a central place that would instantly be available worldwide, and globally change anything on a whim...

LeadingWay KM Learning Application Server enables companies to share common infrastructure resources, knowledge bases and user profiles. The server offers an n-tier web-component architecture that supports reliability, scalability and flexibility. Today, we offer five applications on this platform. These applications can be deployed as department solutions independently, or as an integrated enterprise solution.

LeadingWay eFactory – Manufacture Knowledge

Imagine if you could build eLearning programs in half the time and at a fraction of the cost. Not just one, or a dozen courses, but mass-produce thousands of pages and screens that could be virtually maintained from one place...

LeadingWay eFactory allows companies to develop content that goes into a knowledge base as small chunks called “Knowledge Objects” for rapid deployment. The “Knowledge Objects” can then be delivered in multiple channels including Web, CDs, classroom and papers and be utilized for multiple applications including learning, marketing and support, all at the same time, using other LeadingWay applications. In addition, eFactory can also output HTML, XML or other custom formats to work with third-party Learning Management Systems (LMS) or Business-to-Business (B2B) portals.

LeadingWay eLearning – Teach the World

Imagine the freedom to globally deliver and virtually change training programs via the Internet, CBT and instructor-led courses all at the same time...

LeadingWay eLearning software automated instructional design functions to create learning activities (or Learning Objects) dynamically with built-in assessment, certification, tutorial, reference, personalization, feedback, collaboration and search capabilities. LeadingWay eLearning also blends classroom training and web-based training to deliver pre-work learning and assessment, classroom presentation and student workbooks, and past-classroom support, knowledge discussions and updates.

LeadingWay eProduct – Communicate Anything

Imagine if a marketing manager could publish thousands of professional datasheets or business communication content via the web that any consumer or sales representative could find and print out worldwide...

LeadingWay eProduct enables companies to provide product information to its employees, partners and customers from a centralized product knowledge base. It is specially designed to support marketing communication, product literature distribution, one-to-one marketing, presentation and sales support.

LeadingWay eSupport – Help Anyone, Anytime, Anywhere

Imagine if we could bottle up what your best instructors know and let the world have access to it...

LeadingWay eSupport enables companies to provide effective support using "Knowledge Objects" created with sound instructional design principles. It tightly integrates with existing software applications and websites, linking help, learning and support functions together, using a centralized knowledge base. It provides support content in multiple channels, including self-service help, solution knowledge base, peer-to-peer collaboration, email and live support. LeadingWay eCommunity – Build a Global Community

Imagine if your organization had its own community place where employees, partners and customers could go to meet one another, learn, collaborate and obtain the knowledge they need to do their job...

LeadingWay eCommunity is a virtual corporate university, learning portal and knowledge hub that combines organizational branding, profiling, content catalogs, assessment, learning, searching, eCommerce, content publishing and collaboration functions. The value of eCommunity is that it centralizes the acquisition of knowledge and allows the organization to "push" strategic information in front of the user.

About LeadingWay

Founded in 1991, LeadingWay has developed technology to integrate knowledge management and learning. Our approach is considered to be "one of the most exciting developments in the emerging e-learning space." (Thomas Weisel Partners: B2B e-Learning Industry White Paper.) LeadingWay products and services target these primary application areas:

- Product marketing, training and support applications
- Internet portals that offer eLearning content and services

- Self-service learning and support for software users and website visitors
- Virtual Corporate Universities for fortune 1,000 and fast growing corporations
- Product knowledge management for customer relationship management (CRM) applications
- LeadingWay Knowledge Factory outsource for rapidly converting existing content to eLearning

Software Requirements

Microsoft Windows NT 4.0 or above

Microsoft IIS 4.0 or above

Microsoft SQL Server 7.0

Microsoft IE 4.0 or above

Netscape Navigator 4.0 or above

Web pages created using LeadingWay eFactory can be served by any web servers running with Linux, Unix, Windows and Macintosh operating systems.

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