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The Distance Education Learning Systems Model (DEL)

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The interface of education, technology, distance education, and change is very complex. As we examined the arena of distance education, we realized the usefulness of a systems approach as a powerful tool to connect and interrelate people, goals, organizations, and technologies in the educational playing field.

Banathy's core work (1968, 1992, 1995, 1996a, 1996b) suggests an important model of the educational system as part of society—its larger suprasystem (see Figure 1). Through this model, he showed that education, as a lifelong process, is tied closely to the outputs, objectives, and purposes of other parts of society. This model simply shows several sub-systems of the same environment, or suprasystem, in which education resides.

Only recently have researchers and developers formed distance education and learning systems models (Callaos & Callaos, 1994; Moore, 1993; Moore & Kearsley, 1996; Saba & Shearer, 1994; Saba & Twitchell, 1988; Stenerson, 1998; Terry, 1997). While these efforts provide a good baseline for thinking about systems change, an efficient and effective model applicable to distance education needs further exploration.

Our purpose is to present a practical Distance Education Learning (DEL) Systems model. We believe that DEL can be used by private and public education faculty and administrators, organizational and business managers/trainers, and consortium planners alike. DEL provides a learner focused process for the development, delivery, control, evaluation, and feedback of distance education throughout the lifelong learning process.

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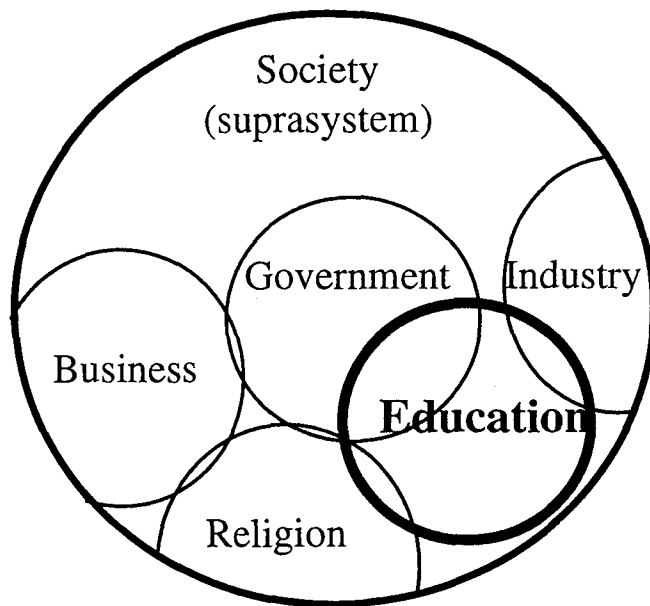
Figure 1. A societal suprasystem (Banathy, 1968).

To explain this model, we again turn to Banathy. Banathy (1995, 1996a) suggested levels of observing an educational system. Based on the three levels, the DEL model can be viewed from these perspectives: *system/environment*—a large scale bird's-eye picture of the distance education landscape; *functions/structure*—what the system is and does; and *process/behavior*—how distance education and learning act in a changing, living social system.

The **systems/environment** function of the proposed model situates the distance education system in the context of society. It defines its "relationships, interactions and mutual interdependencies" (Banathy, 1996b, p. 84) with its citizenry, community, state and nation. Additionally, DEL is a part of the international landscape. The **functions/structure** perspective of our system focuses on a given point in time. It enables us to "(a) describe the goals of the system...(b) identify the functions...(required)...to attain the goals...(c) select the components...to carry out the functions, and (d) formulate the relational...structure of the system" (Banathy, 1996b, p.84). It is somewhat akin to describing the purpose of one's home, and then detailing the various rooms (sub-systems) required to reach the goals selected. The **process/behavior** function of the DEL model looks at what the system does through time. "How it (a) receives, screens, assesses, and processes input; (b) transforms input for

use in the system; (c) engages in transformation...to produce the expected output; (d) guides the transformation process; (e) processes the output and assesses its adequacy (feedback); and (f) makes adjustment in the system if needed or...redesigns...if indicated" (Banathy, 1996b, p. 84). This function depicts the vision of how inputs are transformed into desired outputs.

Distance Education and Organizations as Systems

To study distance educational systems, we first need to consider what we mean by distance education and systems. For example, Moore and Kearsley (1996) defined distance education as:

> planned learning that normally occurs in a different place from teaching and as a result requires special techniques of course design, special instructional techniques, special methods of communication by electronic and other technology, as well as special organizational and administrative arrangements. (p. 2)

Another learner focused definition of distance education is:

> a class of methods of instruction, either formal or nonformal, that place the learner apart from the teacher, or the learning and practice detached by time and/or space from the teaching and the instruction. Communication channels and media such as computers and associated networks, print, audio, cable, satellite or videotape or combinations of these media are required to bridge the time and distance. (King & Bartels, 1996)

From these definitions, key elements emerge for distance education: a focus on the learner, the issues of instructional strategies, the types of communication channels, the instructor and designers, and the educational ends to be achieved by the process.

We also need to have some understanding of systems and distance education. Banathy (1995, 1996a), Moore (1993), Moore and Kearsley (1996), Saba and Shearer (1994), and Saba and Twitchell (1988) have described distance education systems. We follow their lead and define a system as elements which interact as a group, and are organized as a whole toward a specific objective(s) or end(s).

In its simplest form in organizational theory, the systems process is an output produced by an action or transformation process on an input (c.f., Banathy, 1995; Bertalanffy, 1968; Luchinger & Dock, 1976; Picciano, 1998). Figure 2 shows this basic systems process.

An instructional system is an open system that is "in continual interaction with its environment and achieves a 'steady state' or dynamic equilibrium while still retaining the capacity for work or energy
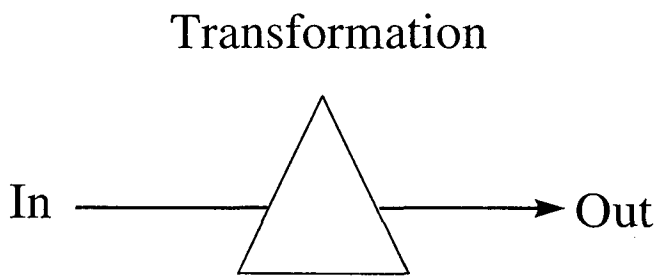
Transformation

Figure 2. Simple system model (input, transformation or change process, and output).

transformation" (Kast & Rosenzweig, 1979, p. 107). Important words here are "continual interaction" and "dynamic." Although the system is trying to maintain balance, it is still learning and developing. Luchinger and Dock (1976) suggest that in organizations, a basic "system" has five implications:

- it has an objective or purpose;
- the elements (subsystems) have an established arrangement, and each element has its own sub-objectives;
- a synergistic interrelationship must exist among the subsystems;
- the process of input to output is more important than the parts of the system; and
- the objective or purpose of the whole outweighs the subordinate objectives of the subsystems.

From an analysis of these five implications, current distance education models have both strengths and limitations. Table 1 compares and contrasts the models of Moore (1993), Moore and Kearsley (1996), and Saba and Twitchell (1988).

Distance Education Learning Systems Model (DEL)

The DEL model has emerged from the foregoing analysis. It is designed to encompass lifelong learning within a distance education framework. The DEL system can be used to design, implement, and evaluate distance learning programs. As a functional model for consortiums and individual distance education courses, it has wide applicability.

The DEL model is adapted from a foodservice systems model developed at Kansas State University in the 1970's (Spears, 1995). In an early discussion of systems applications in education, Banathy (1968) went to "the kitchen" for an example of a system model:

Table 1. Comparing distance education systems models.

Model	Strengths	Limitations
Moore (1993)	Based on a communication perspective and system Established arrangement Process/behavioral well-defined	Institution or teacher focused Quantitative output System-environmental and function/structure views absent
Moore & Kearsley (1996)	Elements well-defined Each element has sub-objectives Function/Structure clearly represented	Feedback loops not defined Synergistic relationship missing System-environmental and process/behavioral views absent
Saba & Twitchell (1988)	Focused objectives Functional/Structure Analysis	May not be transferable to other educational systems System-environmental and process/behavioral views absent

Systems surround us everywhere. In the home...the cooking equipment, the lighting, heating, water supply, storage and disposal facilities, the food, the dishes and the cookbook all interact in a planned way to make up a meal-production system. Meal production is the purpose of the system. (Banathy, 1968, p. 3)

Fittingly, we have turned the tables—adapting a "meal production system" into a distance learning model. Figure 3 shows the DEL system model.

This model is best visualized as a 3-D depiction. Instructional technology (IT) underlies and permeates the transformation, research/assessment/evaluation (RAE), and memory subsystems. Let us briefly explore each subsystem, beginning with the end.

## DEL Systems Analysis

Outputs

Even though we have shown an **Output** subsystem in our model, it should not be confused with the model of outcome based education. "Historically, the field of education has been oriented towards...*broadcast learning*...where an expert who has information transmits or broadcasts it to students..." (Tapscott, 1998, p. 129); and the student simply regurgitates this material on a test. Achievement of content mastery (competency performance) and the development of well-rounded citizens who cooperate in the community, state, nation, and world are desired outputs of our newly developed DEL model. These outputs are interactive with their environment. Learning more about how effective distance education processes are accomplished is also an important goal. Satisfaction of the individuals or teams involved in making the process happen and the fiscal accountability of the system are also important outputs. Whether in a profit or non-profit organization, educational institution, corporate training setting, or global consortium, satisfied employees and fiscal bottom lines are important to the survival of the system as an entity. DEL system design must balance and prioritize these outputs, up front, before deciding how to develop the individualized learning strategies (processes). Controls play an integral role in transforming system inputs into successful output. The bottom line for educational outputs is student performance in life, be it at home, at play, or at work.

Controls

Control mechanisms guide and regulate the system. Federal, state, and local laws guide the function of educational systems. Local school boards develop policy, administrators write operational procedures, and teacher associations provide guidelines in professional ethics. Union rules also impact formal education systems.

At the postsecondary level of education, there are federal guidelines attached to grant awards, and state budget policies affect curriculum, technology and personnel expenditures. Consortia such as the new Western Governor's University (www.wgu.edu) and A*DEC (www.adec.edu), a non-profit Distance Education Consortium of state universities and land grant organizations, also have to deal with federal and state laws, grant guidelines and international legalities. All post-secondary education institutions are involved with accreditation controls.

Corporate trainers and managers face laws such as disabilities and hazardous materials legislation. They also must design training interventions in concert with
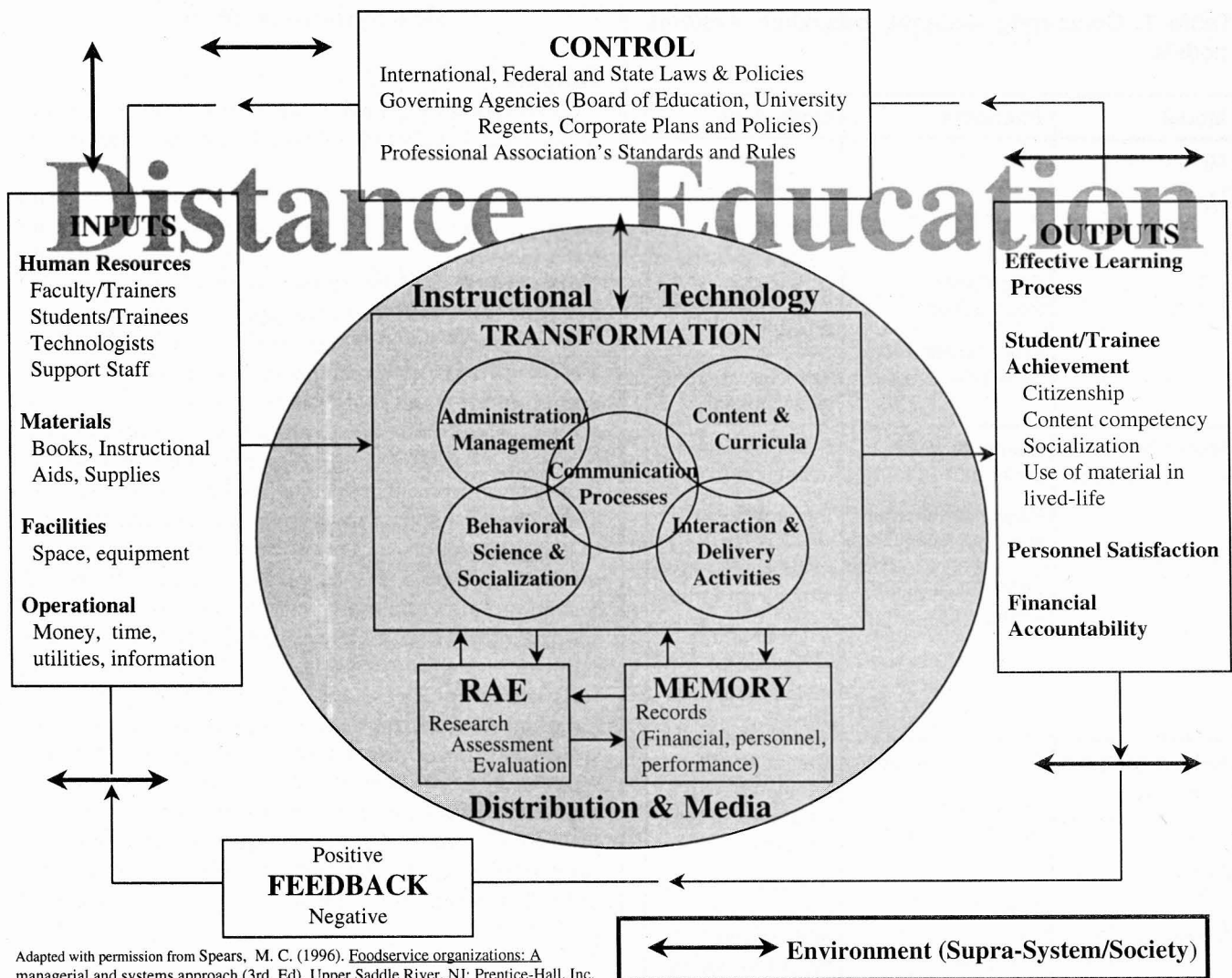
Figure 3. Distance education/distance learning (DEL) systems model.

board policies, mission statements, operational procedures, and strategic plans (Albrecht & Bardsley, 1994). Contracts are another form of control important in business. The Federal Communications Commission influences distance education through control of the telecommunications links that connect facilitators, teachers, and learners.

Inputs

In the past, education was accomplished through teacher or trainer designed linear curriculum, brick and mortar institutions, and audio-visual or print support. The learner came, the learner was presented with lessons and instruction, and then the learner went away. Whether they learned or not, the students had met most good quantitative output measurements—seat time and testing ability. Qualitative results such as competency and performance were indirect. The learner was rarely considered a system input with synergistic relationships to other system elements.

However, in today's technology-rich environment of Web-based learning, a variety of **Inputs** are needed for distance learning. Human inputs not only include the teachers, trainers or facilitators, but also the learner as an active participant in the transformation process. Because knowledge is continuously derived from and

tested in the experience of the learner, the DEL model is experiential in nature (Kolb, 1984). If learners are already competent in a skill, knowledge, or attitude, they can often bypass some of the process. The human input also includes technologists and support staff as participants in the distance education team. They may consist of Web designers, curriculum planners, site facilitators, and audio-video broadcast technicians (Freeman, 1997). Inputs come from outside the educational system itself, and are part of the larger environment of society.

Material inputs such as books, paper, pencils, overhead acetate, and a myriad of other school supplies have moved through educational and training systems for decades. Now, new supplies, such as software, multimedia CD-ROMS, laser paper, toner, Internet browsers, and computer and video systems, are important parts of today's learning system.

For some distance education operations, space is a pressing issue. As more students learn by distance—both Web and video-based—classroom space needs could shrink. However, space is needed to set up some distance teaching rooms, video equipment and computer infrastructure.

Operational inputs of money, time, utilities, and information flow are necessary to make distance learning happen. Telephones lines, satellite time, and electricity to run equipment all contribute to cost. Time is also a precious commodity. Distance education planners need to allow more time for preparation, coordination, and implementation of delivery than those involved in more traditional educational systems. This seems to be especially true of first and second time Web-course offerings.

Transformation

The heart of the DEL system model is the change or **Transformation** process. The transformation element is designed with five subsystems interacting to produce the desired outcomes and reflects a team approach. **Administration and Management** personnel interpret controls, staff the team, provide for the support and resources, and lend needed motivation and vision. Additionally, they should be actively involved in knowing their market, their audience and their learners' needs. They also control the financial resources. Bates (2000) offers some strategies for administration and management. **Content and Curriculum** specialists are involved in analyzing and designing learning modules appropriate for learner focused, just-in-time, competency based training. They are also responsible for instilling content performance standards and evaluation criteria, up front, to ensure appropriate measurement is conducted.

Interaction and Delivery have always been a part of the instructor's or trainer's implementation role. In the DEL system, interaction and delivery require specialized attention. For both Internet and video based education, facilitating and coaching are replacing the traditional, instructor lead approaches of the past. Planning for teacher-student, trainer-technician, learner-learner, and trainee-content interaction takes special attention (Telg, 1996). Conversation and feedback must be structured in advance. For Web-oriented instruction, this is becoming very important.

Why a subsystem on **Behavioral Science and Socialization**? Doesn't this just *happen*? In a perfect world, yes; but in the distance world, only maybe. In 1969, a student entering a college classroom sat up straight, took notes, memorized facts, and took an exam. Today, Tapscott's (1998) Net-Generation, persons born since 1977, are being socialized in a whole new world through e-mail and the Internet. Planning interactive activities such as introductions, teamwork, cooperation, and required comments is an ongoing process. Each person is unique, his or her learning styles vary (McCarthy, 1996), and putting everyone in Web-based classes most likely will not work. **Communication** is the linking process that interconnects management, content, delivery, and socialization. It is essential to the planning and delivery of knowledge and experience, and to the evaluation and continuous improvement of the process.

Every organization is faced with keeping track of its efforts, especially its history. Student and trainee records, accreditation history, communication files, personal data, performance criteria, benchmark data, testing, assessment and evaluation records, and financial reports are just some of the **Memory** records kept in education systems. Technology greatly reduces the "file" size once required; much of today's historical data are found in corporation and school computer networks. Closely related to the memory of an operation is what we have combined to call the **Research, Assessment, and Evaluation (RAE)** subsystem. Research based content, process evaluation, and learner assessments provide the needs on which to base competencies. RAE is important in the early stages of developing a DEL course or consortium (marketing, needs assessment, formative evaluation); through the operational phase (competency measurement); and on to the final output (team satisfaction, budget analysis, learner performance, and summative evaluation). RAE processes both feed and draw from the system memory, and they are key supports to the transformation subsystem in the distance education learning system.

Feedback

In an open social system, like the educational system, both **positive and negative feedback** support continuous improvement. In a closed system that does not interact with its environment, feedback is primarily negative, and focuses on corrective action (Banathy, 1995). Output boundaries are essentially permeable.

They interact with their suprasystem and help correct (negative feedback) or improve (positive feedback) controls, transformation functions and required inputs. Successful outputs create positive reinforcement and growth in the system, while negative feedback helps self-correct the system. Feedback lines are broken in places to indicate the give and take relation with the larger societal environment because society holds the system accountable.

Suprasystem

The **Environment or Suprasystem (Society)** in which lifelong learning operates can further be seen by observing the small arrows that penetrate the DEL system. Constant environmental changes impinge on the system, such as: a satellite going down during delivery, a fax failing to provide planned-for interaction, net-congestion occurring during video streaming, or a corporate headquarters cutting training dollars. Understanding this permutation should help planners visualize various contingency plans needed to minimize adverse environmental impacts—proper planning prevents poor performance. It is important that everyone involved in the system understands how his or her individual activities affect the whole.

Instructional Technology (IT)

Instructional Technology underpins and permeates the DEL system. It is the backdrop to this system. Without the foundation in instructional technology, the RAE, Memory, and Transformation sub-systems fail to communicate; and the system will fail. "Instructional Technology is a delivery vehicle, a means of presenting information in ways that foster...learning..." (Delaney, 1993, p. 31.1). In a distance education system, technology is used not just in presenting, but as the linking process across time and space (Reiser & Ely, 1997; Roberts, 1996). The central ellipse in the DEL model is the information processing infrastructure of technology: satellites, voice-video streaming, interactive multimedia, T1 lines, hardware/software, white boards, and other digital information transfer devices. The equipment bridges the gap of time and distance between sender and receiver. As a setting, IT provides the uniqueness which separates this model from a traditional educational system.

Three Applications

The DEL model can be applied to all distance learning situations. Testing the model on three examples—a worldwide distance education consortium; an individual course delivered by distance; and a just-in-time, hypermedia, corporate training solution—illustrates its application.

A*DEC

A*DEC is a nonprofit distance education consortium owned and operated by 50 state universities and land-grant colleges. It partners with government agencies and private sector organizations to provide responsive, high quality, and economical distance education programs with emphasis on food and agriculture, nutrition and health, and environmental and natural resources (Poley, 1999).

A*DEC provides a combination of high powered technology (IT), content and support experts *(human input)*, solid business structure *(operational input)*, and student supply coordination *(material inputs)* to a market researched (RAE) learner *(human input)*, while providing lifelong learning *(output)*. All of this is done with limited space, but extensive equipment *(facilities input)*. A*DEC is managed from a Midwest university campus *(administration and management)*; and a vast *communications* infrastructure coordinates instructional design *(content and curricula)*, course *delivery* and human *interaction* in a worldwide student market *(socialization)*.

Controlled by a board, A*DEC is subject to various international, federal, state, and local laws; university policies and professional standards; rules; and ethical guidelines. Substantive and evaluative assessment *(RAE)* provide continual *feedback* for process improvement. A*DEC is a complete system that is reactive to the larger lifelong learning *environment*.

An Individual Course

In another application of the DEL model, we turn to a specific course. In 1997, Kansas State University offered an individual course in hotel operations, by distance, through its continuing education division. It was distributed solely for students at the University of Nebraska's Omaha and Lincoln campuses. Course content was research based *(RAE)*, and *interaction and delivery* was provided over the Internet on the instructor's *(human input)* home page. The class *(human input)* met several times face-to-face *(interaction)* and combined net-lectures *(delivery)* with team projects *(interaction)* and on-line exams *(RAE)*. A short practicum experience in local hotels *(performance based outcome)* was also woven into the course.

Facilitators *(human input)* at each receiving school were responsible for handing out course *materials,* and coordinating computer infrastructure *(IT)*. *Feedback* was assessed several times during the semester through online questionnaires. Final reactions and outcomes were measured with an online final exam *(RAE)*. Course planners had to look at accreditation issues between campuses and deal with rules such as collecting student insurance fees for a field trip *(controls)*. This course could have been easily developed within the DEL system model.

A Corporate Training Solution

In our third example, Gayeski (1998) presented a just-in-time corporate training solution based on a non-linear instructional system design (ISD) concept. A client wanted a CD-ROM on sales skills and product knowledge for a new line of equipment in eight weeks. Immediately training consultants assembled a team of project engineers, sales and marketing staff, and customers *(human inputs)* to gather inputs and analyze needs *(RAE)*. These meetings of worldwide players were held by audio and video Internet conferences. A single digital movie *(IT)* was created along with an Internet fill-in-the-blank spreadsheet form that allowed sales people to analyze customer payback data. An on-line chat room *(interaction)* for engineers, product managers and the sales force to exchange questions, answers and tips was also established.

The creative team *(human input)* assembled all material via the Internet and e-mail *(content and curricula development)*. The physical *materials* consisted of a server and net-ware with limited space needs *(facilities)*. The company's design and management team participated readily, and the CEO and board of directors *(administration and management)* had previously established a business environment of learning, performance and mentoring. Performance evaluation *(RAE)* was ongoing.

Communication is at the center of the transformation process. It makes all three examples work. Without oral, written, or computer-generated correspondence, whereby decisions and other information are transmitted, coordination (linking) of the characteristics of the system in the transformation of resources into goals would fail (Spears, 1995).

Summary and Conclusion

This Distance Education Learning model provides a multipurpose tool to assess current distance leaning applications and to aid in the development of new uses. By "overlaying" this model onto current distance-delivered course outlines, corporate training structures, or worldwide delivery processes, planners can gain insight into system shortfalls. For instance, Internet delivery of content may entail copyright controls that have not been secured; or possibly a governmental consortium has relied too heavily on grant funding to provide low cost delivery to distance students, and now find themselves in fiscal disarray. Using DEL as a benchmark can help determine shortfalls.

This model can also function as a design template when planning a new DEL course, distance learning partnership or just-in-time training solution. By correlating outputs with those identified here, designers can determine required inputs, face necessary controls, define applicable transformation sub-systems, research content and needs, and create historical data files. The

key then is to envision the instructional and informational technology interfacing required to link the process together.

The DEL system model is not all-inclusive, but can serve as an environmental design, functional template, and process for developing distance education. The constantly changing world of technology and education will continue to improve the process of lifelong learning. Our hope is that the DEL model will help bridge the time and space between distance learning inputs and outputs, and we welcome further research into its applicability. □

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