# *REGIONAL STATE DOT/MPC CONTINUING AND COOPERATIVE EDUCATION SYSTEM REPORT*

by

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## Preface

Continuing education is important so that transportation professionals can fully develop and utilize their agencies' human resources. The transportation agency needs to evaluate the continuing education needs of its employees and the agency.

Continuing education programs in transportation are not being delivered adequately throughout Federal Region VIII. The Mountain-Plains Consortium was formed to combine the transportation education resources of higher education institutions in the Region VIII area. The purposes of the MPC cooperative and continuing transportation education program are to describe the continuing educational needs of Region VIII state departments of transportation, to identify alternative methods of educational delivery, and to identify and overcome institutional and technological barriers.

This project is a joint effort by North Dakota State University and the University of Wyoming. This report is the first in a series and includes a review of educational and technical literature, and reviews of existing distance education delivery systems and methods. The second report will focus on a survey of state transportation department training and degree interests.

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## EXECUTIVE SUMMARY

The objectives of this study were to describe the continuing educational needs of Region VIII state transportation departments to identify alternative methods of educational delivery, and to identify and overcome institutional and technological barriers. Surveys of Wyoming and North Dakota transportation department employees were conducted to measure continuing education interests and needs.

This report identifies and evaluates several methods used to deliver education over long distances. The criteria and delivery methods were identified through a literature search of educational materials and interviews with distance education professionals.

An overview of distance education issues is included and institutional and technological barriers are identified.

The rural nature of Region VIII provides inadequate continuing education opportunities for geographically dispersed practicing transportation professionals. An effective distance education delivery system could meet many continuing education needs.

The evaluation of distance education delivery systems revealed that systems most resembling the interaction present in a traditional classroom setting best met the criteria for educational effectiveness. The cost effectiveness of these systems will depend on the users' needs and system design. The distance education system chosen will present unique inter-institutional barriers.[1]

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## INTRODUCTION

Society's most important resources are the workforce and basic infrastructure. The workforce is made up of all people, including front line workers, supervisors, educators, trainers, and management. A specialized workforce requires training and continuing education. The ongoing explosion of knowledge and advances in technology accelerate the need for human capital development.

Federal Region VIII is large and sparsely populated. Few opportunities exist for the transportation professional to obtain graduate and continuing education. Continuing education currently requires large investments in time and money.

The Mountain-Plains Consortium and the Federal Highway Administration recognized the need to overcome distance barriers and offer continuing education opportunities to transportation professionals in Region VIII.

Technologies exist to deliver educational programs over radio, telephone lines, and satellite systems. This report summarizes the findings of the Mountain-Plains Consortium on distance education delivery systems and characteristics. Institutional and technological barriers are identified and must be overcome to deliver educational programs successfully.

## GRADUATE, CONTINUING, AND COOPERATIVE EDUCATION NEEDS

The graduate, continuing, and cooperative education needs of transportation professionals and students in the Federal Region VIII and the Mountain-Plains Consortium (MPC) area are described in the following sections. Most transportation professionals' educational needs stem from characteristics intrinsic to Region VIII.

## Region VIII

Federal Region VIII is characterized by large land areas and small populations. Region VIII has 19.2 percent of the nation's land area, but only 3.1 percent of the nation's population. See Table 1.

**TABLE 1. Population Characteristics**

| State | Population | Percent of U.S. Population |
|---|---|---|
| Colorado | 3,301,000 | 1.34 |
| Montana | 805,000 | 0.33 |
| North Dakota | 667,000 | 0.27 |
| South Dakota | 713,000 | 0.29 |
| Utah | 1,690,000 | 0.69 |
| Wyoming | 479,000 | 0.19 |
| Region VIII | 7,655,000 | 3.11 |

SOURCE: Statistical Abstract of the United States, 1990.

Low populations and few large population centers mean there are few large colleges with comprehensive transportation education programs. Professionals wishing to continue their education will most often require leaves of absence from their positions, financial loss and a substantial amount of travel. Even if major universities are located in cities with large DOT employment, universities traditionally give limited priority to continuing education programs (National Research Council 1985).

## Graduate Education

Transportation professionals need specialized knowledge of rural and urban transportation issues. The absence of and distance between major universities means few comprehensive graduate transportation programs are available to the returning transportation professional. Leaves of absence for professionals would be costly to transportation departments both in educational reimbursements they might offer and the

training required to replace individuals while they are away. The alternative, ignoring continuing education needs, would hinder business activities and would cause society to lose human potential.

Presently, little incentive exists for the transportation professional to get a graduate degree since state transportation departments do not completely reimburse individuals for time away from the job, and do not necessarily reward graduate degrees with adequate benefits.

### *Existing Opportunities*

National opportunities for continuing education include the National Technological University (NTU). NTU is the only comprehensive national degree-granting program for the distance education of technical professionals. NTU is a consortium of 43 engineering schools. Although NTU offers many credit and noncredit courses by broadcast satellite television, few classes are offered in the civil engineering field and no classes are offered in graduate transportation topics. NTU can offer courses at a relatively low cost due to the extent of its membership. Some courses are broadcast live and have limited interaction. Graduate courses would be available on a university-like schedule and may not be regionally applicable. NTU has proven that a continuing education program that spans many institutions and industries can be successful.

Local opportunities for obtaining graduate degrees are limited to the student's proximity to a major university. Very few Region VIII state transportation departments are located in cities with major universities. Most graduate degree programs allow few courses to be taken by traditional correspondence.

## Continuing Education

The pace of technological innovation has exceeded the limits of traditional education. The educational institution can no longer prepare an individual for a lifetime of professional service. Professionals in virtually any field require continuing education to work effectively. Many professional licensing agencies recognize the necessity of continuing education and are requiring it for members to

retain their licenses. Since professionals cannot be away from their job too much before the benefits are outweighed by the costs, more professionals are acquiring their education at work. "Estimates of American industrial expenditure on education range from 35 to more than 40 billion dollars per year, a sum comparable to all the funds available to public and private universities together." An increasing proportion of this is going into distance education (Moore 1990).

Transportation departments throughout the country recognize the value of continuing education. Some of the ways highway organizations are developing human resources are: improving the use of engineering technicians, using consultants for training instead of relying on in-house training, and training mid-level and managing engineers to become senior professionals (Poister, Nigro, and Bush 1990).

### *Existing Opportunities*

National programs for continuing education include the National Highway Institute, which is sponsored by the Federal Highway Administration. The National Highway Institute offers continuing education through short courses. These courses, although popular for continuing education, still require considerable investments in company money and employee time and travel.

Local opportunities for continuing education include local seminars, collaboration with industry, in-house expertise, and technology transfer centers.

## Cooperative Education

Through organizations such as educational consortiums, education institutions are proving that cost efficient, highly specialized programs can be offered by sharing resources and costs.

### *Existing Opportunities*

Traditional university distance courses can be taken only by correspondence. Even major universities within each Region VIII state may not have comprehensive transportation faculty or courses.

Lack of comprehensive graduate programs in transportation was a primary reason that the Mountain-Plains Consortium (MPC) proposed this project.

State transportation departments would benefit from cooperation with universities for many reasons. The specialties possessed by university faculty are necessary for many transportation projects to be successful. Transportation departments, through cooperation with universities, could have access to up-to-date materials and an ample employee pool whenever needed. University lab facilities may be used for training and research projects. Transportation department facilities may be useful to universities for the same reasons. Transportation department employees would have access to student support services and the prestige of a college-associated program. Shared resources will save money and provide for sound academic communication.

Cooperation of universities and transportation departments in providing continuing education is an agreeable situation if technological and institutional barriers can be overcome.

## Survey of Educational Needs

Overcoming technological and institutional barriers is a prerequisite to cooperative education in region VIII. A related but important process is the identification of educational needs at state transportation departments. A regional cooperative educational strategy must consider not only the types of educational services desired (e.g. graduate studies, continuing education, or other short courses) but also the subject areas demanded.

Some aspects of educational demand are apparent from historical enrollment in NHI, $T^2$, or university courses. However, it cannot be assumed that historical demand encompasses all of the subject areas or degree courses desired by state transportation department personnel. Nationwide, increased emphasis is being placed on interdisciplinary, multimodal educational needs; many of which are not covered by existing course offerings.

A prototype survey was developed and administered to the NDDOT home office at Bismarck. In addition to this questionnaire, the NDDOT training officer scheduled two open meetings for employees interested in university courses.

The NDDOT survey served three major purposes: (1) to ascertain what educational products (e.g. graduate study, continuing education, etc.) are needed; (2) to identify the major subject areas demanded; and (3) to refine a survey instrument for future region-wide use. The survey was designed to allow respondents to describe their educational objectives and desired subject areas without being constrained to existing course offerings.

Sample lists of course descriptions or subject areas were included for some questions, particularly regarding non-traditional, interdisciplinary topics that may not have been previously advertised. However, respondents were asked to go beyond the standard list and define their own educational subjects and courses.

With respect to continuing education, survey participants were asked to describe topics in their own words. These descriptions are useful in identifying subjects not currently provided through NHI, $T^2$, or university programs. Furthermore, these descriptions will be useful in compiling a topics list for use in future region-wide surveys.

Overall, forty complete surveys were returned. The major findings are highlighted in the next section. Details are presented in the appendix.

### *Highlights of Prototype Survey*

As a group, the survey respondents have substantial job experience. On the average, they have been employed at the North Dakota DOT for approximately six years and have over seven and one-half years of transportation experience. Twenty-eight of the respondents hold a baccalaureate degree, one holds a masters degree, and five hold an AA degree.

Twenty-nine of the survey respondents expressed interest in a graduate degree program. Of those 29 persons, 15 are interested in a masters degree in civil engineering with a transportation emphasis or option. The remaining fourteen are interested in non-engineering graduate degrees. Of this latter group, seven persons are interested in a general transportation degree rather in than a particular discipline.

The survey participants selected or described a wide range of topics which they would like to see included in a transportation program. Their responses generally fell into six categories:

- Management and agency administration
- Transportation economics and finance
- Logistics and distribution
- Transportation planning
- Analytic techniques
- Pavement or geotechnical engineering

Transportation administration and management was the most frequently requested subject area. Twenty persons requested courses in *management principles and techniques* and 17 requested courses in *transportation agency and program administration.*

Altogether, eighteen respondents requested courses in transportation economics or finance. Fourteen of these requests were for *transportation investment analysis,* twelve were for *transportation price and cost analysis*, and eight related to *transportation demand analysis.*

Altogether, sixteen people requested graduate courses in transportation planning. Within this group, thirteen respondents requested courses in *data management or information systems* while eleven persons identified topics in *transportation impact assessment.*

Applied analytic techniques is another a major area of interest at the NDDOT. Eighteen of these requests related to topics in *systems analysis* or *operations research*. Ten requests also named *statistics or econometrics* as a study area.

The remaining subjects named by respondents were more widely dispersed. Nine requests encompassed topics in *pavement or structural design* while five of the requests related to *geotechnical engineering*. Other topics included: land-use forecasting, professional communications, computer science, and safety.

The most frequently cited continuing educational topics were: management (6); pavement design (4); other transportation engineering (6); transportation economics and finance (5); transportation planning (3); and geotechnical engineering (2). Detailed topic descriptions and response frequencies are presented in the appendix.

***General Implications for Cooperative and Continuing Education***

Overall, the results of this first survey indicate a strong demand among practicing transportation engineers and specialists for both continuing education and graduate courses. The requested graduate topics encompass a wide range of subjects and disciplines including general transportation, pavement and geotechnical engineering; management and administration; economics and finance; and planning. Continuing education requests also cover a wide range of topics and disciplines, and are quite similar to the requests for graduate courses[2]. The course topics identified in the survey will be useful in the development of a refined questionnaire for future use.

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[2]It is important to note that employees working in district or local offices were not included in the survey; only employees at the home office. Employees located at district offices may have different perspectives regarding the scope of functionality of topics.

Many of the course topics identified through the questionnaire were also discussed at the two open meetings. The meetings also highlighted some of the departmental and institutional issues discussed elsewhere in this report. In particular, several participants noted that the NDDOT does not officially recognize a graduate degree as an indication of advanced job-related skills. Moreover, the NDDOT does not explicitly consider graduate degrees in job allocation, promotion or salary determinations.

Several participants suggested that greater educational interest exists within the NDDOT beyond that indicated by the survey participation rate. However, without some explicit recognition of a graduate degree, these people cannot justify the time and effort required to take graduate courses.

## DISTANCE EDUCATION DELIVERY SYSTEMS

Traditional systems used to deliver continuing education to professionals include any systems that have been used to transport teachers and/or learning materials to the student. The systems used do not affect the teaching style of the instructor or the student's learning style unless the medium in some way interferes with communication.

Correspondence study was the first form of distance education, transferring printed materials through the mail or other delivery systems. New technologies such as the facsimile and the computer have made the transfer of printed or electronically generated print faster and easier.

Systems for delivering distance education are: traveling teachers, correspondence courses, audiocassettes, audio teleconferences, audiographics, videocassettes, computer-aided instruction, interactive videodiscs, video teleconferencing, and combinations of systems.

### Criteria

Delivery systems are judged by their effectiveness in meeting the needs of state transportation departments and the MPC. The factors most important are cost effectiveness and educational effectiveness. The system, if also used for communication within transportation offices, must be cost

effective and facilitate quality communication. Effectiveness is the degree to which the system fulfills its users' goals. Effectiveness includes many of the factors considered important by educational specialists in the literature reviewed and by interviews with electronic distance delivery system users.

Several authors have presented methods for evaluating distance learning systems based on user needs and relative costs. Schmidt and Faulkner (1989) developed the information shown in Table 2. The information shown in Table 2 was obtained from its authors' review of literature, personal interviews and tours to sites employing distance education delivery systems.

**TABLE 2. Characteristics of Distance Education Delivery Modes[a]**

| | Delivery Modes | | | |
|---|---|---|---|---|
| Characteristics | Correspond-ence (Mail) | Radio | Computer Conference | Audiotex |
| Cost | Low | Medium | High | Medium |
| Complexity of Delivery | Low | Some | Medium | Medium |
| Speed of Delivery | Low | High | High | High |
| Delivery Time Flexibility | High | Some | Medium | High |
| Participant Trainer Interaction | Low | Low | Some | Some |
| Special Equipment Needed by Trainer | None | Low | High | High |
| Special Equipment Needed by Participant | None | Low | High | Medium |
| Trainer Travel | None | Low | Low | Low |
| Participant Travel | None | None | Low | None |
| Geographic Range of Delivery | Extensive | Medium | High | High |
| Acceptability for Delivery to Remote Locations | High | Medium | Medium | Medium |

| Characteristics | Delivery Modes: Television: Inter-active | Television: Pre-produced | Teleconference: Audio | Teleconference: Audio-graphic | Teleconference: Video |
|---|---|---|---|---|---|
| Cost | Extensive | High | Low | Medium | High |
| Complexity of Delivery | High | Medium | Medium | High | High |
| Speed of Delivery | High | Medium | High | High | High |
| Delivery Time Flexibility | Low | High | Low | Low | Low |
| Participant Trainer Interaction | High | Low | Medium | Medium | Medium |
| Special Equipment Needed by Trainer | Extensive | High | Some | High | High |
| Special Equipment Needed by Participant | Extensive | Low | Some | Medium | High |
| Trainer Travel | Low | Low | Low | Low | Low |
| Participant Travel | Low | None | Low | Low | Low |
| Geographic Range of Delivery | High | High | High | Medium | Medium |
| Adaptability for Delivery to Remote Locations | Medium | High | High | Medium | Medium |

[a]Rating categories of low (none), medium (some), high (extensive) are assigned on a relative basis.

SOURCE: Schmidt and Faulkner, 1989

Stubbs and Burnham (1990) created an instrument for evaluating the potential effectiveness of electronic distance education systems called the Potential Effectiveness Inventory (PEI). The PEI was developed from media-related studies and the authors' experiences. The factors valued by the PEI model are time and place independence, realism, number of communication paths, ease of use, and immediacy. In summary, their ideal electronic distance education delivery system would allow the student to experience interactive education any time and any place. That education system would also be capable of

transmitting concrete and abstract media through many communication paths; it would be easy to use and information would be transmitted instantaneously. The inventory assigns points to varying levels of the factors and multiplies them by a mean rank score. The mean rank score was obtained by surveying electronic distance education experts. (See Table 3).

**TABLE 3. Points, Means, and Weighted Values by Dimension**

| Dimension | Continuum Points | Survey's Mean Ranking | Weighted Values |
|---|---|---|---|
| **Communication Paths** | | | 10.1 |
| Multiple | 3.0 | | 8.4 |
| Duplex | 2.5 | X 3.37 = | 6.7 |
| Semi-duplex | 2.0 | | 5.1 |
| Pseudo-duplex | 1.5 | | 3.4 |
| Simplex | 1.0 | | |
| **Ease of Use** | | | 6.7 |
| Novice | 3.0 | X 2.24 = | 4.5 |
| Amateur | 2.0 | | 2.2 |
| Professional | 1.0 | | |
| **Realism** | | | 6.5 |
| Concrete | 3.0 | X 2.16 = | 4.3 |
| Representational | 2.0 | | 2.2 |
| Symbolic | 1.0 | | |
| **Time-Place Independence** | | | 4.6 |
| Independence | 3.0 | X 1.53 = | 3.1 |
| Semi-dependence | 2.0 | | 1.5 |
| Dependence | 1.0 | | |
| **Speed** | | | 2.1 |
| Instantaneous | 3.0 | | 1.8 |
| Seconds | 2.5 | X 0.71 = | 1.4 |
| Minutes | 2.0 | | 1.1 |
| Hours | 1.5 | | 0.7 |
| Days/weeks | 1.0 | | |

SOURCE: Stubbs and Burnham, 1990.

Both models presented for evaluation of electronic distance delivery systems are useful. In the educational technology business, as with other technologies, price structures may change as better technologies are introduced and prices drop.

### *Cost Effectiveness*

The cost effectiveness of a delivery system refers to the simple principle "to get what you are paying for." This implies that the system performs as you expected it to perform. Delivery systems are available in a wide range of prices and capabilities. Many features of educational delivery systems are optional, and their use depends on the users' needs.

In reviewing delivery systems, it was evident that exact costs are hard to determine. Student support, facility technicians, and facilities are necessary, but may be provided at low cost by schools already employing similar systems. Transmission paths are owned by different entities whose prices are variable.

After reviewing literature on distance education delivery systems, it was concluded that user interviews would be helpful in evaluating systems. For the interview information to be useful, the objectives of the organization using the system had to be similar to the interviewers' objectives.

### *Educational Effectiveness*

The educational effectiveness of distance delivery systems is a controversial question. Some would argue that educational effectiveness does not depend on the distance delivery system utilized (Hoko 1986; Chu and Schramm 1967; Clark 1963). Common sense dictates that any system that prevents the exercise of any factor which positively affects learning would be a restriction.

Educational effectiveness means the realistic opportunity exists for quality education. Although seminars and short courses are an integral component of continuing education, courses that are part of a degree program are necessary for comprehensive professional development.

Learning is the criterion by which most measure educational effectiveness. Learning can be measured in different ways. Most institutions measure learning through testing, which may be the best method because it is easy to use. Others argue that learning is not adequately represented through testing, and goes beyond the items that can be represented on a test.

Major factors that affect learning and are associated with distance education delivery systems are interaction, real-time transmission, and ease of use.

***Interaction***

Interaction is an important factor in education. Interaction between teacher and student can occur in different forms. "The literature of learning and instructional theory indicates that when students are active participants in the learning process they are likely to perform better and remember more." (Wagner 1991)

There are three kinds of interaction in an educational exchange: teacher-student, student-material, and student-other students. The more kinds of communication a delivery system allows, the greater its potential to deliver high quality education (Stubbs and Burnham 1990). It is important to note that interaction is only facilitated by delivery systems. The actual effectiveness of interaction is determined by the persons using the systems.

In addition to the kinds of interaction a student experiences, he/she also experiences different qualities of interaction. Although letters sent through the mail may facilitate communication, human interaction is "the next best thing to being there." Many educators use nonverbal cues from their students as a measure of how well students are grasping lecture material. Students rely on instructors to interpret class material to some degree. This interpretation is commonly given by facial expressions, verbal intonations, and body movements.

Many educational researchers stress the importance of adapting distance education delivery systems to individual learner styles. Sewart (1978) concluded that distance education systems can only adapt to infinite individual needs through the introduction of the human element.

***Real-Time Presentation***

An educational exchange, especially in technical fields, must be timely. A videocassette produced on Intelligent Vehicle Highway Systems (IVHS) in 1987 will not include the important developments in that field from 1987 to the present.

Real-time presentations are important to quality interaction. Feedback provided in real time allows the student to react immediately. The student may wish to question or further explore a problem. If a delivery system could not facilitate this real-time interaction, such as correspondence by mail, the student would lose interest even if he/she pursued the topic.

***Ease of Use***

Another factor that affects communication over distance education delivery systems is their ease of use. Since many users will be exposed to the system, frequent problems with technology must be avoided. A user-friendly system will speed system setup and utilization, as well as creating a comfortable environment for its user.

***Ease of Communication***

A system linking the departments of transportation, the Region VIII office, and the universities will be cost effective only if it supports quality communication. Meetings over the delivery systems would promote effective collaboration between organizations. It is important, however, to give priority to educational programs when mixing education and business communications.

A system that utilizes digital transmission systems (e.g. radio, telephone lines, satellite) may accommodate data transfer. Compatibility with other systems, such as Global Information Systems and

Global Positioning Systems would make an educational system especially useful. Data could be transferred during off hours.

To be useful, distance delivery systems would have to be expandable. Capacity can be added inexpensively and easily to some systems; other systems must be completely replaced. A communication system must be reliable. Each system's modes of failure are discussed in the evaluation.

Educational delivery systems are available with many value-added features. Value-added features such as data transfer may make a system more useful, but they will generally cost more.

## Evaluation

The following section presents a system-by-system review of commonly used distance education delivery systems.

### *Traveling Teacher*

The traveling teacher method of delivering distance education may be cost effective and educationally effective for delivery of continuing education seminars. The presence of a teacher in class provides real-time, simple, fully interactive communication. These benefits are important, but the negative impacts often outweigh the benefits. Graduate courses are not usually offered by traveling teachers. Highly trained teachers are scarce and reject traveling so much while teaching other classes on campus. Not many graduate-level professionals can gather at one location without travel, so the cost per student is often high.

Other communication systems, such as the telephone, are necessary for communication outside class and for student support services. Daily business communications between state transportation departments are not possible, since the traveling teacher is for continuing education purposes.

A traveling teacher is generally used to deliver only seminar courses. All forms of interaction are accommodated for a short time. Bringing the teacher to the student is expensive, inconvenient, and not warranted if there are few students.

***Correspondence Study***

Correspondence study has been the traditional method for distance delivery of graduate and continuing education courses throughout the United States. Some courses are still available by correspondence for academic credit.

The advantages of correspondence study as a distance delivery medium are that material is delivered uniformly, courses have virtually unlimited enrollment, correspondence study is low cost, and students can receive academic credit (Williams and Haas 1988).

Traditional correspondence study limitations are primarily related to the interactivity criterion. Two-way communication through the mail has proven too slow and inadequate for many applications. The lack of real-time interaction has led to a loss of student-student interaction, a loss of motivation, and reduced quality in teacher-student interaction.

Most professional study programs accept limited or no correspondence study academic credit. Since education through correspondence study does not end in degrees, its use is limited. No advantages are gained by the departments of transportation by choosing correspondence over any other delivery system, except that employees would probably not be away from their jobs.

***Audiocassette***

Audiocassettes are an inexpensive delivery system with little specialized equipment and many disadvantages. Primarily, audiocassettes do not provide real-time presentations and there is no student-teacher or student-student interaction. Audiocassettes are not used to deliver graduate degree programs.

Their delivery depends on the mail, so they are like correspondence study. Audiocassettes may be useful as a supplement to other delivery systems.

### *Audio Teleconferencing*

Audio teleconferencing refers to the traditional telephone "party line." Teleconferencing using phone lines provides for student-teacher and student-student interaction. Since no graphics can be presented and there is no visual contact, its use is limited. No provisions can be made for data or material transfer unless units such as computers or fax machines are added.

Audio teleconferencing would be a good addition to any distance delivery system. The use of telephone lines is discussed in the "Transmission Media" section.

### *Audiographic Delivery Systems*

Audiographics refers to a combination of systems consisting of microphones and computers. Microphones allow students and teachers to talk to each other freely. Computers are used to transmit graphics, tests, and class materials, and may also be used interactively. The system is moderately expensive and is justified for use with small classes.

The audio and computer data are transmitted over telephone lines. Both student-teacher and student-student audio interactions are facilitated, but no participants can see each other. Material is presented in real time.

Audiographics systems can be moderately to highly difficult to use. The disadvantages of using an audiographic delivery system are mostly due to the inability of the teachers and students to see each other and the disadvantages of using telephone transmission lines (see transmission media). The use of audiographics to teach requires a great deal of course adaptation and adjustments in presentation style.

*Videocassette*

Videocassettes can be distributed easily and require limited equipment at the student site. Video production costs are variable. Educationally, videocassettes are useful for transmitting information, but the lack of real-time and interactive presentations reduces their effectiveness. Distribution of materials by mail may become expensive and is subject to the same delays inherent in correspondence study.

The videocassette delivery system would offer no useful features to accommodate communication between universities and state transportation departments.

*Computer-Aided Instruction*

Computer-aided instruction may facilitate communication through computer conferences. Costs are not high since most companies already have most of the equipment. The problem with using computer-aided instruction is that other forms of communication would be necessary to accomplish many educational objectives. Tests and class materials could be sent over computer transmission lines, but extra time would be required to adapt class materials to computer use. Computer-aided instruction is not generally used for any type of graduate study due to its complex nature. The quality of interaction is poor since conversation must be entered through an input device. Computer-aided instruction would be dependent on telephone lines, so it is subject to the advantages and disadvantages of that medium.

*Interactive Compact Discs and Videodiscs*

Interactive compact discs and videodiscs are mostly used for primary and secondary education. The equipment necessary to produce and play back videodiscs is very expensive although prices are dropping. Materials presented on interactive videodiscs might be good for training or engineering simulations, but certainly not for graduate-level degree requirements. Interactive compact discs (CD-I) are a rapidly emerging technology. CD-Is require a dedicated computer whose operating system is different

from traditional personal computers. The hardware needed to run CD-I is low cost and should be dropping in price (National Transit Institute 1993).

### *Broadcast Television*

Broadcast television is a delivery system that would not be useful for graduate-level education due to its prevention of student-teacher and student-student interaction (assuming students do not meet in a central location).

Broadcast television is expensive and requires a lot of specialized production equipment. No provision is made for the two-way transfer of class materials and tests. Broadcast television is an option to consider when broadcasting to hundreds of sites. A large number of sites would make interaction virtually impossible. New and smaller two-way video systems exist that allow two-way interaction for a number of sites at a fraction of the cost of normal broadcast television.

### *Video Teleconferencing*

Different system combinations exist for video teleconferencing. Video teleconferences can be transmitted over microwave radio, telephone lines, and satellite. Students may view the teacher and/or other students on television screens. Some systems require students to call the teacher on separate telephone lines to ask questions. Other systems allow the students to talk freely over microphones, allowing more spontaneous communication.

Traditional video was broadcast in analog form, using varying voltages to represent video pictures. In addition to expensive equipment, the space required by an analog video signal makes it extremely expensive to transmit. Analog video is full motion and requires about 1000 times the bandwidth (transmission space) of a traditional phone call. Although interactive video has been recognized as a good educational delivery system, its expense has restricted its use to large institutions.

Video may also be transmitted in digital form, the same way that computers transmit information. New digital compression technologies allow video to be transmitted in much smaller bandwidths than analog video. Compression refers to the equipment and a set of algorithms that remove unnecessary information from the video signal. The basic difference presented to the viewer is that the frames of a compressed digital video program are not refreshed as frequently as full-motion video. Noticeable effects of digital compression are that quick movements appear "smeared" across the screen.

Video teleconferencing systems may be chosen with a number of value-added features. Fax transmittal, data transfer and remote VCR control are some of the features available. Although value-added features cost more at the outset, they may save money in the long run.

Video teleconferencing is a good education delivery system due to its real-time, fully interactive setup. Since it models a traditional classroom setting, most educators feel it is the best system. The quality of the delivery is primarily dependent on the instructor.

Video teleconferencing would add a new spectrum to communication in Region VIII. State transportation officials could have face-to-face meetings without travel. More frequent meetings with no required travel would allow more employees to participate in meetings and become more involved in their jobs.

Video teleconferencing systems using digital compression have utilized telephone lines for some time so costs may be estimated. Systems using satellites as a transmission system, however, are very new. Since the video teleconferencing market is unstable, costs are hard to determine.

## Transmission Media

### *Microwave Radio*

Microwave radio is a land transmission system that requires antennas spaced so that microwaves can be relayed from one antenna to the next. As a land-based system, antennas need terrestrial support. Repeater spacings of 100 miles are possible, but the path must be flat and have no obstructions.

Land-based microwave systems are unreliable because they are susceptible to atmospheric disturbances, interference from other signals, and multipath fading. Multipath fading occurs when out-of-phase energy encounters in-phase energy and they cancel each other.

Microwave radio can be an inexpensive transmission system for short distances. Region VIII is much too large and mountainous to justify using a microwave system in place of any other transmission system. Bandwidth available on microwave systems is also limited.

### *Telephone Lines*

Telephone lines are land-based systems and come as either traditional twisted-pair copper wires or glass fibers. Fiber optic (glass fiber) lines transmit digital information. Since digital information is "reassembled" at the receive site, fiber optic cables provide a higher quality signal than twisted-pair copper wires. While fiber optic lines are becoming more prevalent, they still do not reach all areas of the United States.

Telephone lines are land based and they are generally owned and managed by telephone companies. The lines are already placed and available for use. Fees for transmission time are determined by telephone companies and may vary. Dedicated lines (for the system's use only) are very expensive and costs would be justified only for a large system.

Telephone lines are subject to failure through excessive noise or breaches in the line. The advantages of using telephone lines are that they have wide geographical coverage and are generally maintained by the phone company.

The disadvantages of using telephone lines are that they are usually owned by separate entities, so telephone costs may be high and may vary. Telephone lines placed for company use are very expensive and require maintenance and acquisition of rights of way.

***Satellite***

Satellite transmission of analog video signals used to be prohibitively expensive for most uses. Since the development of digital compression technologies, the transmission space required by a traditional analog video signal has been reduced by a factor of six. Satellites have also improved tremendously in the past few years. Since satellites communicate with radio waves, a higher-powered satellite means ground antennas may be smaller. Even home entertainment receive-only satellite users will see a decrease in both cost and size. The combination of better technology and more users is causing prices to drop substantially.

The advantages of using a satellite to transmit educational programs are that land areas covered are very large and satellites have many potential capabilities. Soon satellites will transmit directly to each other, making coverage virtually worldwide. Digital transmission would allow data and video to be transmitted almost instantaneously.

A system using either fiber optic telephone lines or satellite transmission systems would require little technological support. Both systems can handle data, graphic, video, and audio transfer.

Satellite transmission may fail due to interference. A phenomenon called "rain attenuation" occurs when radio signals are blocked by rain. On analog signals, rain attenuation appears as "snowiness." Rain attenuation, if severe enough, does not decrease the quality of a digital transmission, but the signal will disappear for a short time. Ice and snow in a satellite dish may also cause signal interference.

Telephone lines and satellite transmission systems are virtually equivalent in their capabilities. The features that may be used to compare them are:

1) Fiber optic telephone lines do not reach all areas of the country. Interconnecting and networking remote regions across state boundaries is easy using satellite-based systems.

2) To add capacity to a full fiber optic line, a new parallel line must be laid. To add space to a full satellite, the user needs only to switch to a different transponder on the same satellite. While both systems have a theoretical space limit, the satellite has more available space.

3) Both systems have potential failure modes. Telephone lines may be broken and satellites may experience adverse weather interference.

4) Both systems may be operated by outside entities. Transmission costs are not certain. Satellite transmission costs are dropping since less space is required for digitally compressed video.

5) The digital compressed video market is rapidly changing, so exact costs are hard to determine.

Since costs of distance education delivery systems are hard to determine, a demonstration of the system would be useful. A scaled-down version of the delivery system would allow the user to further define its uses and benefits.

## BARRIERS TO DELIVERY OF EDUCATION

Combining institutions to improve the quality and accessibility of higher education presents questions concerning the barriers that might be encountered. The barriers may be classified as (1) technological barriers due to the delivery system employed and (2) institutional barriers caused by the delivery of inter-institutional and interstate education.

## Technological Barriers

Some degree of technological interference will be experienced in any distance delivery system. Whether a student and teacher require only three sessions to become accustomed to a delivery system or if that system prevents full student-teacher, student-student, or student-material interaction, some degree of interference is encountered. The technological barriers are discussed in the evaluation section of this report.

## Institutional Barriers

Institutional barriers are those potential problems caused by mixing intrastate and interstate institutions. It is important that participating institutions review their mission statements and resolve possible conflicts before becoming partners in regional educational service delivery. Institutional barriers may be broken into administrative, student, and faculty issues.

### *Administrative Issues*

Possible administrative barriers to educational service delivery in Region VIII include academic standards, academic evaluations, residency, fee collection, allocation of instructional resources, institutional commitment and copyright and royalty issues.

Delivery of graduate programs through a distance education delivery system may constitute a "substantive change" in an institution. If the change was determined to be substantive, the accrediting agency would have to review the program. The program would also have to be approved by the issuing institution. It should be noted, however, that advanced degree accreditation is not a problem in all areas of study; civil engineering, for example.

Academic policies of all participating institutions would have to be reviewed. The interstate nature of the participating institutions subjects the system to many regulatory boards. Institutions have handled the accreditation question in different ways. California State University at Chico delivered classes

out-of-state to Hewlett Packard employees. All receive sites were located at businesses. When another state wanted to review the Chico operation, Chico responded that it considered the receive site an extension of its classes, which were accredited. The National Technological University (NTU), on the other hand, responds directly to the regulatory agencies when asked. The requirements in each state are met by NTU. NTU has had no significant problems with any education regulatory board (Olcott 1991).

To be successful, any program needs to be evaluated on a regular basis. Evaluation of the faculty and program may be a problem for an interstate program. The responsibility for evaluation would have to come from a designated institution or office, a private contractor, or perhaps each institution could provide their own evaluations. An appeals process may be necessary to give other member institutions some control over the system's academic quality.

An important issue that affects the character of the distance education delivery system is residency. How many credit hours must a student complete on campus? Many educators feel that on-campus education is more complete because the student has ready access to resources such as a library, extracurricular activities, and student services. Each institution's residency requirements will affect the system's success.

Other topics relating to residency are the status of the student and the awarding of academic credit. Will a student have to be admitted to each institution from which a course originates? Will academic credit be awarded from the originating school and then transferred to the student's degree program? One way to avoid interinstitutional barriers is to grant degrees specifically administered by the program. A separate degree-granting institution would only be feasible if the program was very large, however.

Questions about credit transfer and acceptance lead to questions about fee reimbursement. Different institutions require different fees for classes. Fees for classes delivered through a distance education delivery system may differ from regular on-campus classes. Distance students are not using many student services on campus, although the delivery system will probably cost more. Participants in

distance education have to decide whether the program will be self-supporting or subsidized. A self-supporting system may drive fees so high that few will participate, and the user's goals will not be met.

The institutions participating in a joint venture may encounter problems of support from their own institution. The member institutions must get support from the university in the form of money, planning, and allocation of instructional resources.

The role of other institutions in the partnership should be defined at the outset. What will be the contributions of each institution? What course of action should be taken if a member institution does not participate as expected? Do the missions of the members conflict? Perhaps a joint mission statement would be a good idea to resolve potential problems.

The use of a distance education delivery system may raise questions about copyrights and royalties regarding the use of material over the transmission media, as well as the use of recorded classes. These are important structural issues which must be addressed.

***Student Issues***

Students from the state transportation departments and the member universities will be taking classes over the distance delivery system. Some students will have access to library facilities and student support services. Student services, such as advising, admissions, counseling, computers, office hours, and special help sessions, are an important part of a student's education. Provisions will have to be made to provide support to off-campus students. As technology advances, libraries and other services are becoming increasingly available to off-campus students, but some barriers still exist.

Students from transportation departments may need extra incentives to participate in educational programs. Financial reimbursements, time allowances, and recognition of educational advancements seem the best way to encourage participation.

***Faculty Issues***

The faculty issues that are the most prominent barriers to successful faculty participation are classification of courses, faculty compensation, release time, and promotion and tenure. Most faculty problems would arise if the institution offers inadequate support to the system.

The courses to be taught over the distance delivery system may be classified differently from regular on-campus courses. If courses are classified as overload rather than inload, faculty might be more reluctant to participate. Faculty must be adequately compensated for courses. Some additional incentives for faculty to participate include the classification of courses as counting toward promotion and tenure. Teaching over distance education delivery systems usually requires extra time to adapt class materials to the medium.

Some faculty members may resist teaching over distance education delivery systems for a variety of reasons. Some faculty members may fear being replaced by teachers at different institutions. Faculty members may not want to take the time to adapt class materials to the delivery medium. A system that more closely resembles a traditional classroom setting will be more readily accepted.

## CONCLUSION

Human resource development strategies are key to the future success of large agencies such as state transportation departments. Continuing education and graduate studies are two important elements of a human resource plan, and are of particular importance to state transportation agencies in federal region VIII.

A survey of the NDDOT indicates strong demand for both continuing and graduate education. Other state transportation departments in region VIII probably exhibit similar needs. However, there are barriers to the delivery of educational services to state agencies in this region.

In each state, the transportation agency and the state university are located in different cities. This distance barrier is exacerbated by climate and a limited pool of transportation faculty at MPC universities.

Traditional methods of distance education — such as the traveling teacher, correspondence study, or student travel to campus sites — are inefficient and impractical. Fortunately, recent advances in the technology and methods of distance-learning can improve the quality of off-campus educational services *and* more efficiently utilize scarce faculty.

Computer-aided instruction is now feasible on a broad scale. In this mode, educational materials are presented to students in real time environment. However, communication is limited by the input device and the absence of face-to-face conversation.

Several other distance-learning technologies have been experimented with or used in a specialized manner in the United States (including audiocassettes, videocassettes, and broadcast media). These methods are useful for limited purposes. However, they lack real-time instruction and teacher-student interaction. Moreover, feedback is slow and spontaneous interaction is missing among students.

Of all the existing distance-learning techniques evaluated in this study, only interactive teleconferencing (which supports both video and audio interchange) offers classroom atmospherics and student-teacher interchange that are similar to the traditional classroom setting.

Teleconferencing is now possible via terrestrial or satellite systems. Land-based systems typically require interchange among telephone carriers. Satellite systems offer high reliability, limited down time, easy expansion of networks, and overall flexibility. The choice of transmission media depends upon the level of control desired and the relative costs.

Some institutional barriers must be overcome before regional cooperative and continuing educational strategies can be implemented. Cost-sharing, academic credit and faculty issues between universities are three of the most apparent problems. However, local access to student support services is also an issue.

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# APPENDIX A
# NORTH DAKOTA DOT EDUCATIONAL SURVEY RESULTS

The purpose of this appendix is to document the questions asked in the survey and the frequencies of responses. Each survey question is assigned a number (e.g. Q1). For each question, the possible responses are also numbered (e.g. - 1 -). The frequency of each response to a question is shown in parentheses (e.g. (18)).

## Q1: JOB TITLE OR DESCRIPTION
**(Frequency answered in parentheses)**

- 1 - Transportation Engineer (18)
- 2 - Traffic Operations Engineer (1)
- 3 - Pavement Management Engineer (1)
- 4 - Clerk (3)
- 5 - Engineer - Bridge Designer, Urban Planning (3)
- 6 - Rail/County Planning (1)
- 7 - Tech (1)
- 8 - Project Manager (1)
- 9 - Dealer Rep (1)
- 10 - Training Officer (1)
- 11 - Administrative Assistant (3)
- 12 - Computer Technical Support Manager (1)
- 13 - Driver Licensing Hearing Officer (1)
- 14 - Supervisor - Motor Carrier Section (1)
- 15 - Auditor (1)
- 16 - Management Director (1)

## Q2: JOB LOCATION
**(Frequency answered in parentheses)**

- 1 - Central Office / Highway Building / Bismarck (12)
- 2 - Design Division - Urban (6)
- 3 - Materials and Research (6)
- 4 - Program and Project Development (3)
- 5 - Planning Division (5)
- 6 - Motor Vehicles (3)
- 7 - Bridge Division (1)
- 8 - Human Resources (1)
- 9 - Legal Division (1)
- 10 - Driver Licensing and Traffic Safety (1)
- 11 - Construction Division (1)

**Q3: YEARS AT DOT**

- entered in months
- ranged from 3 up to 360 months (1/4 year to 30 years) with a mean of 71.42 months (approximately 6 years)

**Q4: TOTAL YEARS OF TRANSPORTATION WORK EXPERIENCE**

- entered in months
- ranged from 6 up to 360 months (1/2 year to 30 years) with a mean of 89.89 months (approximately 7 and 1/2 years)

**Q5: YEARS OF SCHOOL COMPLETED**
**(Frequency answered in parentheses, mean was 4.45)**

- 1 - HS/GED (2)
- 2 - 1 year of college (0)
- 3 - 2 years of college (7)
- 4 - 3 years of college (1)
- 5 - 4 years of college (29)
- 6 - Masters (1)

**Q6: HIGHEST COLLEGE DEGREE EARNED**
**(Frequency answered in parentheses, mean was 2.74)**

- 1 - AA (5)
- 2 - BA (1)
- 3 - BS (27)
- 4 - MA (0)
- 5 - MS (1)

**Q7: MAJOR AREAS OF STUDY**
**(Frequency answered in parentheses, could answer more than one)**

- 1 - Construction Management (6)
- 2 - Civil Engineering / Technology (17)
- 3 - Transportation Engineering (2)
- 4 - Business Administration / Management (9)
- 5 - History (1)
- 6 - Geography / Urban and Regional Planning (1)
- 7 - Science (1)
- 8 - Psychology (2)
- 9 - Liberal Arts (1)
- 10 - Accounting (2)
- 11 - Sociology (1)
- 12 - Education / Educational Administration (2)
- 13 - English (1)
- 14 - Secretarial (3)

**Q8: ARE YOU INTERESTED IN**
**(Frequency answered in parentheses, could answer more than one)**

- 1 - Undergraduate Degree Program (14)
- 2 - Graduate Degree Program (29)
- 3 - University Courses (12)
- 4 - Continuing Education Courses (15)
- 5 - Other Education
  - a few people listed specific courses here, but then repeated them again later

**Q9: WHICH UNDERGRADUATE MAJORS OR SUBJECTS ARE YOU INTERESTED IN**
**(Frequency answered in parentheses, could answer more than one)**

- 1 - Agricultural Economics (1)
- 2 - Business Administration (11)
- 3 - Economics (5)
- 4 - Public Administration (8)
- 5 - Engineering (Please Specify) (16)
  - Civil (9)
  - Transportation (8)
  - Management (3)
  - Geotechnical
  - Industrial, with courses in cost accounting
  - Soils
  - Structural
  - Environmental
- 6 - Other (Please Specify) (6)
  - Urban Planning
  - Human Resource Management
  - Computer Science
  - Management
  - Accounting
  - Computers
  - Computer Information Systems

**Q10: ARE YOU INTERESTED IN ONE OF THE FOLLOWING GRADUATE TRANSPORTATION PROGRAMS**
**(Frequency answered in parentheses, could answer more than one)**

- 1 - Masters in Agricultural Economics (with Transportation Option) (3)
- 2 - Masters in Civil Engineering (with Transportation Option) (15)
- 3 - Masters in Transportation (7)
- 4 - Other (6)

**Q11: PLEASE DESCRIBE ANY SUBJECTS OR COURSES THAT YOU WOULD LIKE TO SEE IN A GRADUATE PROGRAM**
**(Frequency answered in parentheses, could answer more than one)**

- 1 - Logistics and Distribution (3)
- 2 - Transportation Economics and Finance (18)
- 3 - State and Regional Transportation Planning (16)
- 4 - Analytic Techniques and Skills (4)
- 5 - Demand Analysis (8)
- 6 - Investment Analysis Techniques (14)
- 7 - Applied Operations Research Techniques (9)
- 8 - Statistical or Econometric Analysis (10)
- 9 - Systems Analysis Techniques (9)
- 10 - Transportation Price and Cost Analysis (12)
- 11 - Transportation Impact Analysis (11)
- 12 - Data Management and Analysis Procedures (13)
- 13 - Pavement or Structural Design (9)
- 14 - Geotechnical (5)
- 14 - Management Principles and Techniques (20)
- 15 - Transportation Agency and Program Administration (17)
- 16 - Other)
    - Engineering (General)
    - Mathematics
    - Computers (2)
    - Civil Engineering (General)
    - Non-Destructive Testing
    - Metallurgy studies
    - Welding
    - Professional Communication - Writing and Public Speaking
    - Pedestrian Considerations and Safety Aspects
    - Land Use Forecasting
    - MBA courses

**Q12: PLEASE DESCRIBE IN YOUR OWN WORDS THE TRANSPORTATION TOPICS YOU WOULD LIKE TO SEE OFFERED AS CONTINUING EDUCATION COURSES AND GIVE A PRIORITY RATING (HIGH, MEDIUM, OR LOW) FOR THAT SUBJECT**

**Topic:** Civil Engineering
**Description:** Transportation related
**Rating:** High

**Topic:** Civil Engineering
**Description:** Courses in Civil Engineering towards Transportation
**Rating:** Medium

**Topic:** Computers
**Description:** Systems that aid in engineering and drafting
**Rating:** Medium

**Topic:** Computers
**Description:**
**Rating:**

**Topic:** Computers
**Description:** Computer classes in the advanced area which emphasize math/engineering applications rather than business/accounting applications
**Rating:** Medium

**Topic:** Computer Aided Design (CAD)
**Description:** I would like some intensive training on CAD software, we have quite a bit of horsepower and investment in a CAD system that few can use, we need more training
**Rating:** Medium

**Topic:** Pavement Design
**Description:** Principles of pavement design. For example, design principles need for both Concrete and asphalt pavements
**Rating:** Medium

**Topic:** Pavement Design
**Description:** Course would include strategies and philosophies for designing asphalt and concrete pavements
**Rating:** High

**Topic:** Pavement Design
**Description:** Understanding the basic concepts and principles of the mix design process - for example, how does thickness, asphalt content, and aggregate size interrelate or how does sub-base material thickness and quality come into play in the mix design process
**Rating:** Medium

**Topic:** Pavement Design - Pavement Reliability
**Description:** Would like to stay abreast of new pavement design processes as they become available, AASHTO is in the process of developing new design software, I would like to attend a training seminar on this
**Rating:** High

**Topic:** Hydraulic Design
**Description:** A course providing up-to-date information on the concepts and theories used in hydraulic calculations
**Rating:** High

**Topic:** Upper Level Management
**Description:** A course which introduces concepts with examples on how to mange effectively
**Rating:** High

**Topic:** Transportation Economics
**Description:** Intense study of Economics with major focus on Transportation
**Rating:** High

**Topic:** Transportation Economics
**Description:** Economics with major emphasis on Transportation
**Rating:** High

**Topic:** Transportation Financing
**Description:** Revenue generating technique to aid local municipalities finance projects through bonds, mill-levies, grants, and loans
**Rating:** High

**Topic:** Transportation Economics and Finance
**Description:**
**Rating:** High

**Topic:** Transportation Economics and Finance
**Description:** A comprehensive course in how to efficiently utilize available funding and how best to plan for future economic impact financing with emphasis on public relations
**Rating:** High

**Topic:** Transportation Planning
**Description:**
**Rating:** High

**Topic:** Statewide Transportation Planning
**Description:** Developing a strategic plan for identifying, maintaining, and enhancing the various transportation modes and facilities within any given state
**Rating:** High

**Topic:** Strategic Planning
**Description:** The how-to's and benefits of a statewide (state, counties, cities) intermodal system
**Rating:**

**Topic:** Non-Destructive Testing (NDT)
**Description:** Course would include NDT techniques for topics such as steel, bolts, and concrete
**Rating:** Medium

**Topic:** Non-Destructive Testing (NDT)
**Description:** Processes and methods of weld testing
**Rating:** High

**Topic:** European Road Design and Construction
**Description:** Course would cover common European practices and philosophy for road design and construction
**Rating:** High

**Topic:** Structural Design
**Description:** Bridge design - foreign or national
**Rating:** High

**Topic:** Welding
**Description:** Welding process - methods and chemical analysis of welds
**Rating:** High

**Topic:** Transportation Technology's Impact on Society
**Description:** Outlines areas, both social and environmental, that are effected by improvements to roadways and modes of transportation, looks at effects of mass transit, waste disposal, and collection
**Rating:** High

**Topic:** Subsurface Geology
**Description:** Instructs engineers on considering what properties various soils have, considers impacts of construction or waste disposal on fresh water aquifers
**Rating:** Low

**Topic:** Geotechnical Engineering
**Description:** I would like to stay on top of soils engineering - new tests, results of studies, new methods to determine soil properties
**Rating:** High

**Topic:** Personnel Management
**Description:** None given
**Rating:** High

**Topic:** Management
**Description:**
**Rating:** High

**Topic:** Management Techniques
**Description:** A course in modern management techniques with a high degree of focus on total quality management in an attempt to formulate an overall management scheme, top to bottom - require top and middle level managers to participate and set up workshops for lower level managers
**Rating:** High

**Topic:** Total Quality Management (TQM)
**Description:** The how-to and practical implementation of TQM into DOT and requiring it of contractors and other suppliers
**Rating:** High

**Topic:** Management of Low Volume Road Networks
**Description:** Financial, manpower, and inventory management concepts for administering a county highway system
**Rating:**

**Topic:** Transportation Engineering
**Description:** Basics to advanced math, engineering, and computer classes
**Rating:** High

**Topic:** Study Sessions for P.E. Test
**Description:**
**Rating:** High

**Topic:** Engineer-in-Training Exam Review Class
**Description:**
**Rating:** High

**Topic:** Investment Analysis Techniques
**Description:**
**Rating:** Medium

**Topic:** Data Management and Analysis
**Description:** A workable GIS system which has a direct correlation with an existing database (i.e., RIMS) in which each division can be linked electronically with mandatory training and participation
**Rating:** High

**Topic:** Citizen Participation in Transportation Planning
**Description:** Methods of citizen involvement in transportation planning - both the successes and the failures
**Rating:** Medium

**Topic:** Contracts/Legal
**Description:** How to read and interpret legal contracts
**Rating:** Medium

**Topic:** State and Local Government and Private Sector
**Description:** How the three work, how they differ and how they are the same
**Rating:** Medium

**Topic:** Administrative Ethics
**Description:** An overview of ethical problems in public bureaucracy and sensitivity training in dealing with ethical questions
**Rating:** High

**Topic:** Economics of the Trucking Industry
**Description:** Costs of trucking in relation to government regulations and taxes - fuel, license, authority, safety regulations, etc. - and the economic impact this has on consumer prices in relation to total transport costs - costs of trucking taxes etc. compared to auto taxes (licenses, fuel, etc.) in relation to weight differences and mileage driven annually
**Rating:**

**Topic:** Transportation Effects on the Highway System
**Description:** Costs for heavier road bases, toppings, etc. which are needed for trucking as compared to automobiles - wear factors of various axle combinations on the roads - compare road life between heavy and light vehicles
**Rating:**

**Topic:** Automation in the Transportation Industry
**Description:** A course that would focus on the administrative side of DOT's and how automation can be used to make this function more efficient and effective
**Rating:** High

**Topic:** Auditing in the Transportation Industry
**Description:** A course that would focus on auditing those hard to audit areas - engineering, research, project development
**Rating:** Medium

**Topic:** Route Surveying
**Description:** Survey methods of the new total stations as they relate to topography and earth computations
**Rating:** High

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16. Abstract

The purposes of the MPC cooperative and continuing transportation education program are to describe the continuing educational needs of Region VIII state departments of transportation, to identify alternative methods of educational delivery, and to identify and overcome institutional and technological barriers.

This project is a joint effort by North Dakota State University and the University of Wyoming. This report is the first in a series and includes a review of educational and technical literature, and reviews of existing distance education delivery systems and methods.

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