The Diffusion of IT-Based Shareable Learning Resources (SLR) in the Practice of Engineering Education

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Executive Summary

Purpose

The purpose of the proposed research is to contribute to knowledge about a nationally important educational issue, the diffusion of IT-based educational materials into science, technology, engineering and mathematics (STEM) teaching and learning. These resources can range from a simple activity to illustrate a single concept, to a video demonstration, simulation or animation, to a case study, or to an entire course in a specific subject area. The study was designed to identify the factors that influence, both positively and negatively, the diffusion of the web-based or IT-based sharable learning resources (SLR) that have been developed by the Greenfield Coalition and others.

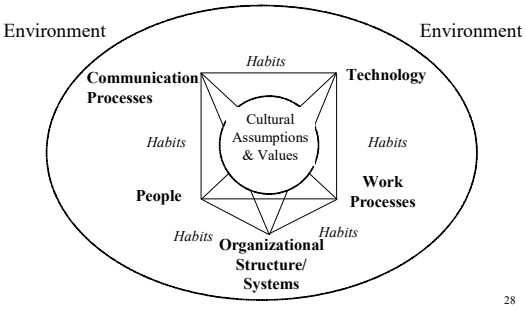
Methods

This study of the diffusion of the Greenfield SLR materials was designed as a qualitative examination of the factors that helped and hindered in the dissemination process. The research team employed three types of qualitative methods, interviewing, observation, and secondary data analysis to achieve as complete a picture as possible and to triangulate findings from interviews with findings from observations and secondary data analysis.

Findings

The study findings reflect the understanding we gained as a research team about the diffusion of IT-based shareable learning resources within the context of the system of higher education in the United States, particularly with regard to education in the engineering community. Fundamentally, the diffusion of SLRs is part of a dynamic system in which multiple factors interact to either promote or inhibit the adoption and use of the materials. The findings are organized according to seven elements of a socio-cultural and technical systems framework that helps clarify the systemic nature of the diffusion of SLRs and that serves to highlight the key factors related to diffusion and their interaction: 1) the environment, 2) technology, 3) cultural assumptions and values, 4) people, 5) organizational structures and systems, 6) work processes, and 7) communication processes.

Socio-Cultural Technical Systems Framework



1) Environment

The larger information technology environment is an enabler of IT-based shareable learning resources through the internet, and through the proliferation of sophisticated tools to create, and to share these resources. However, the information technology products and services that support SLRs are situated in an industry of rapid change and complexity that create instability and lack of standardization, which means that SLRs may not work as intended.

2) Technology

IT-based SLRs require, simply put, only a computer, an internet connection and a web link to access these materials. Conceptually, the technology is simple and straightforward. Practically, however, IT-based shareable learning resources can become technologically challenging. When the educational content requires that technological capabilities move beyond text to incorporate multimedia capability such as animation, simulation, and interactive, what-if scenarios based in real-world case studies the technical complexity can quickly increase the probability that the technology will not work without the imposition of standards in a controlled environment.

3) Cultural Assumptions and Values

There are cultural assumptions and values that underlie any educational system. We found that there is a conflict in the values and assumptions of the developers and early adopters of IT-based shareable learning resources with the traditional values of the engineering educational community in the United States.

The traditional *university values of higher education* in the United States are part of an educational culture of independent thought and practice, especially in the classroom, and a pedagogy that rewards individual initiative and achievement. In research universities, in particular, rewards for tenure and promotion demonstrate the value of research over teaching. Prestige and career advancement most often comes from demonstration of individual contribution to knowledge not from collaborating or using others' materials, especially in research institutions. Additionally, in the *engineering educational community*, faculty members have traditionally demonstrated in their teaching a value for theoretical knowledge over practical application and have adopted a normative teaching style that is primarily based on lecturing rather than interaction and practice. The use of IT-based SLRs requires a pedagogical shift. The shift is one from traditional lecture-based instruction in which the students are essentially passive learners and the educational infrastructure is basically blackboards, chalk, slides and note taking with limited interaction between the instructor and students, to one in which students are active learners and the learning is based on discovery and hands-on experience with the content.

4) People

Faculty who use IT-based shareable learning resources state most often that their reasons for use are because the materials fit their values for teaching, include good content that is relevant, promote student learning, and work for what they need in the classroom. The non-adoption of SLRs in general, according to the people in our study, reflects the limited marketing or advertising of the materials within the engineering

community, the value for independence and self-reliance among the faculty, the reluctance for faculty to spend a lot of time on teaching, and the difficulty of developing good, technically reliable materials.

5) Organizational Structures and Systems

There are three primary factors that emerged as important organizational structure and systems issues, in interviews, observations and data from secondary sources: the reward and recognition structure for faculty, the intellectual property rights concerning both the development and use of the materials, and the university-based leadership and technical support system for both faculty and students.

There is a wide continuum from negative rewards to positive rewards for developing and/or using IT-based shareable learning resources. One the negative side, respondents told us repeatedly, in no uncertain terms, that there were no tangible rewards for teaching in a research institution. On the positive side, adoption of IT-based shareable learning resources does provide rewards that are centered primarily on the personal satisfaction faculty members receive from teaching in new ways and affecting student learning experiences in a dramatic and positive way.

The academic endorsement and active support of campus leaders responsible for setting university-wide policy, as well as in colleges and departments, was viewed as critical for the diffusion of SLRs. The university is also responsible for providing technical leadership. Respondents said that the university had to provide a network system that works, that is reliable and field tested.

6) Work Processes

There are seven work process factors that emerged as facilitators or hindrances in the development of the IT-based shareable learning resources, primarily within Greenfield, but elsewhere as well: 1) an interdisciplinary team of skilled development staff, 2) access to industry experts, 3) positive faculty attitude, 4) a defined process for instructional development, 5) a supportive environment, and 6) money and tools.
In addition to the work process factors mentioned above, we found four other factors related to planning, monitoring managing and evaluating IT-based shareable learning resources: 1) an assessment process, 2) adequate technology, 3) a sharing process, 4) orientation to and trial of materials.

7) Communication Processes

Overall, the promotion of IT-based shareable learning resources takes place through six primary channels: 1) word of mouth, 2) publications, 3) websites, 4) demonstration and presentation events, and 5) awards. Once awareness is created via publications, word of mouth and demonstration events that allow for one-on-one personal contact, for observation and trial of the materials, and for referral or endorsement of materials by trusted sources are the most effective means for influencing adoption. Websites provide promotion and also reinforce adoption by highlighting awards for development and use of SLRs.

Conclusion and Recommendations

In conclusion, the study findings emphasize that to accelerate the diffusion of IT-based shareable learning resources in the engineering educational community these resources need to be understood as part of a system of education involving not just developers, faculty and students, but also the organizational structure and systems, including the academic and technological leadership and support systems, as well as the larger information technology environment. Use of IT-resources to support classroom teaching and learning requires a significant pedagogical shift which begins with a change in cultural assumptions and values in higher education that will take time to accomplish. It may be that SLRs will diffuse more quickly in industry than in academe because the infrastructure in industry is more standardized and stable, and because the decision to use SLRs can be an authoritative mandate for technical proficiency, rather than an optional decision made by individual faculty members for selected classes. It may also require the investment of commercial interests to provide the economic impetus to achieve the widespread diffusion of SLRs.

The following steps can be taken to foster the development, sharing and use of SLRs:

1) *Establish an assessment and evaluation initiative* that can be used commonly on a widespread basis to document the impact of SLRs on learning in the classroom in the near term and the impact of this learning on the job in industry in the long term.

2) Develop the commercial potential of SLRs. Attracting the attention of commercial publishers can provide the impetus to standardize and more easily distribute materials developed by the innovative community of practice that currently exists.

3) *Promote the use of SLRs* outside academic institutions to professional industry organizations, associations and in industry. There is a wider market for SLRs that has educational needs that could be well-suited as adopters of materials developed in academic institutions. Sales of materials to these audiences can also provide capital to support development in university settings.

4) *Identify a core of academic leaders and institutions* who have sufficient credibility, and trust in the academic community as opinion leaders to work together on changing the reward and recognition system for tenure and promotion to include the scholarship of teaching and the sharing of education materials, and to develop a standardized process for sharing of intellectual property and SLR resources.

5) Align shareable learning resources with the cultural assumptions and values of higher education by altering the reward and recognition system in the institutional context.

6) *Consider that community colleges and teaching universities* may be easier audiences to target for adoption because they do not have research as their highest priority.

7) *Target younger faculty members* who have grown up in the digital age as potential adopters.

8) *Increase the number of demonstrations* to provide observability and trialability of materials for faculty first-hand through one-on-one personal contact, allowing them to experience how SLRS can enhance teaching and learning in their own classrooms.

9) *Provide funding to universities* who wish to promote the use of SLRs to help defray their costs of experimentation and for technical support.

10) *Provide expeditious, reliable, and accessible technical support for faculty and student users of SLRs* in order to decrease the lack of adoption and lack of acceptance due to technical factors.

Statement of the Problem and Research Questions

Information technology (IT) is ubiquitous in our lives, in our work, and in the classroom. Recently, the National Academy of Engineering (NAE) established the Committee on Achieving Compatibility in IT-Based Educational Materials to develop strategies for the diffusion of IT-based educational materials into science, technology, engineering and mathematics (STEM) teaching and learning. These resources can range from a simple activity to illustrate a single concept, to a video demonstration, simulation or animation, to a case study, or to an entire course in a specific subject area. The formation of this Committee signals the strategic importance of IT diffusion as an issue in engineering education. There is recognition that little has been done to aid dissemination to others in the use of these materials beyond the local development sites. The purpose of the proposed research is to contribute to our knowledge about this nationally important educational issue by identifying the factors that influence, both positively and negatively, the diffusion of the web-based or IT-based sharable learning resources (SLR) that have been developed by the Greenfield Coalition and others.

The educational system in this country is decentralized at the state and local level and has a strong culture of autonomy and independence, which may not respond to traditional hierarchical or bureaucratic change management methods. Managing the diffusion of innovations in engineering education requires knowledge of both the content and the structure of the administrative, faculty and student communication networks. Existing research does not address directly a central problem faced by today's educational leaders, how best to diffuse new ideas, processes and technologies in STEM given its decentralized nature (National Academy of Engineering and the KAVLI Foundation and Institute 2002). A critical factor in our nation's competitiveness has become the speed at which education can adopt new learning materials to address the changing needs of students in a rapidly changing technological environment. While fostering good ideas and producing innovation is central to educational success, the speed and flexibility of educational delivery in today's economy has become a differentiating factor that provides competitive advantage through education and is far from assured (The Gartner Group 2003; Guimaraes & Armstrong 1998). While there have been many recent innovations in IT-based educational materials, the implementation of these materials in the engineering classroom is not as rapid as desired. Increasing awareness in the engineering educational community of the potential benefit of IT-based SLRs and achieving alignment of these materials with current educational practices can help accelerate the rate of diffusion. The study of the diffusion of the IT-based shareable learning resources developed by the Greenfield Coalition and others provides a unique opportunity to examine how this awareness and alignment can best be achieved in engineering education.

This study was designed to investigate five primary research questions about the diffusion of IT-based shareable learning resources based upon Rogers (2003) theory of the diffusion of innovations that considers the attributes of an innovation, how it is communicated over time among members of a social system and how these factors impact the rate of adoption. The five research questions and their associated propositions are as follows:

Research Question One: How do the perceived attributes of the sharable learning resources (SLR) affect their adoption?

Proposition 1a: The relative advantage of the SLR, as perceived by faculty and students, is positively related to the rate of adoption.

Proposition 1b: The compatibility of the SLR, as perceived by faculty and students, is positively related to the rate of adoption.

Proposition 1c: The complexity of an innovation, as perceived by faculty and students, is negatively related to the rate of adoption.

Research Question Two: How do perceptions of the faculty and students about the SLR decision affect the rate of adoption of an innovation?

Proposition 2a: The rate of adoption of decisions perceived by faculty and students as authoritative will be faster than those decisions perceived as optional.

Proposition 2b: The rate of collection adoption of SLRs is positively related to the degree of power concentration in the educational system.

Research Question Three: How do mass media communication channels (such as advertising and direct mailings) and interpersonal channels of communication impact the rate of adoption of an innovation?

Proposition 3a: Mass media channels are relatively more important at the knowledge function and interpersonal channels are relatively more important at the persuasion function in the decision to adopt SLR.

Proposition 3b: Mass media channels are relatively more important for early adopters of SLR than for later adopters.

Proposition 3c: Opinion leaders have greater exposure to mass media than followers.

Research Question Four: How does the nature of the social system (network communication patterns) impact the rate of adoption of an innovation?

*Proposition 4*a: The degree of communication integration among faculty is positively related to the rate of adoption of innovations.

Proposition 4b: Opinion leaders in the educational system have greater social participation than their followers.

Proposition 4c: Early adopters seek information about innovations more than later adopters.

Research Question Five: How does a change agent (e.g. an educator who demonstrates or teaches others about the SLR) impact the rate of adoption?

Proposition 5a: Change agent success is positively related to the extent he or she works through opinion leaders.

Proposition 5b: Change agent success is positively related to the extent of change agent effort in contacting potential users of the SLR.

We will return to these questions in the discussion section of this report, following the presentation of our findings. The next section of this report describes the study methodology.

Methodology

This study of the diffusion of the Greenfield SLR materials was designed as a qualitative examination of the factors that helped and hindered in the diffusion process. An important aim of the study was to develop an in-depth understanding of the issues as well as some insight about how to accelerate the diffusion of SLRs in the engineering educational community.

The research team was comprised of three people: one engineering faculty member, Dr. Kenneth Riopelle, one business and organizational anthropologist, Dr. Julia Gluesing, and one doctoral student in business and organizational anthropology, Tara Alcordo Eaton. Dr. Marietta Baba, Dean of Social Science at Michigan State University, and Dr. Diane Pawlowski, staff anthropologist at the Greenfield Coalition, served as consultants to the project. (Professional Biographies of the research team members are included in Appendix E.)

The research team employed three types of qualitative methods, interviewing, observation, and secondary data analysis to achieve as complete a picture as possible and to triangulate findings from interviews with findings from observations and secondary data analysis.

Interviews

Interviews were conducted with Greenfield Coalition staff, with the developers of the Greenfield materials, with faculty members who use the Greenfield materials and with potential faculty adopters of IT-based shareable learning resources. The research team also interviewed developers of non-Greenfield materials and faculty who use these IT-based shareable learning resources to gain insight from them about the development of the materials as well as their diffusion and use. The research team conducted a total of 24 in-depth interviews. The interviews were approximately 90 minutes long, were tape recorded and transcribed for qualitative analysis. All interviews were kept confidential and anonymous and are reported in this report in summary form only.

Workshop Observation and Evaluation

On June 4 – 5, 2004, the Greenfield Coalition and the Society for Manufacturing Engineers co-sponsored a workshop on IT-based shareable learning resources at the National Association for Manufacturing Research Conference (NAMRC) held in Charlotte, North Carolina. The research team attended the workshop and observed both the presentation of the materials and the audience reaction. The audience also completed a workshop evaluation form asking for their opinions about the workshop presentations and their likelihood of adopting the materials. The evaluation asked participants to offer their opinions about the factors that influence their use of or willingness to use materials like those presented in the workshop. A copy of the evaluation form is included in Appendix C. The team also had the opportunity to conduct informal interviews about IT-based SLRs with conference attendees on the days prior to the workshop which was conducted just after the formal closing of NAMRC.

Observation of Adoption Process

To understand how faculty members go about finding, adopting and using IT-based shareable learning resources, both those developed by the Greenfield Coalition and those developed by others, two members of the research team simulated the adoption process. One of the researchers, a faculty member himself, visited the Greenfield website and four other sites that offer SLRs to faculty to incorporate in their classroom teaching. The purpose of the simulation exercise was to observe and record first-hand the actual ease or difficulty of obtaining and using the resources, from a faculty member's perspective. One of the anthropologists on the team observed the simulated adoption process recording details about the technology and about the faculty member's reactions.

Secondary Data

The research team gathered secondary materials to supplement the primary data gathered in interviews and observations to both expand the team's understanding of already documented diffusion issues in published materials and to examine the promotional materials that are being used to disseminate IT-shareable learning resources. The team gathered published papers about IT-based shareable learning resources, reports prepared by NSF-sponsored workshops, and reports prepared by researchers and educators working on digital library initiatives. These resources are included in the list of references at the end of this report.

In summary, this report provides the findings of a qualitative study of the diffusion of IT-based shareable learning resources that used multiple methods to gather data about the adoption process itself as well as about the factors leading to and hindering the adoption of SLRs in engineering education.

Findings

The study findings presented in the following pages of this report reflect the understanding we gained as a research team about the diffusion of IT-based shareable learning resources within the context of the system of higher education in the United States, particularly with regard to education in the engineering community. Fundamentally, the diffusion of SLRs is part of a dynamic system in which multiple factors interact to either promote or inhibit the adoption and use of the materials.

The findings are organized according to a socio-cultural and technical systems framework that helps clarify the systemic nature of the diffusion of SLRs and that serves to highlight the key factors related to diffusion and their interaction. The framework provides a practical way to visualize and to talk about the dynamic interdependencies operating in the development, dissemination and use of IT-based shareable learning resources. It also helps to surface the actions that can be taken to foster and accelerate the diffusion of SLRs and that are included in the recommendations we put forth in our discussion of the findings.

In the following pages we first present and explain the socio-cultural and technical systems framework. Next, we discuss in detail the findings related to each of the system elements, with reference to other system elements where applicable. Finally, we include a discussion of the study findings and recommendations for accelerating the diffusion of IT-based shareable learning resources within the engineering educational community.

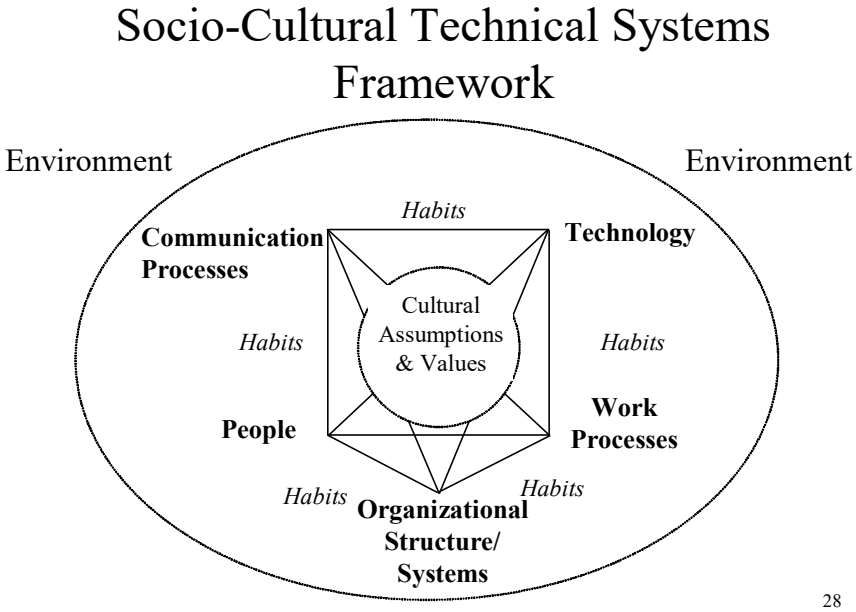
The quotations that illustrate our findings were taken from our interviews.

Socio-Cultural and Technical Systems Framework

In the reporting of the findings from our analysis of the study data gathered through interviews, observations and secondary sources, we have chosen to organize the findings by framing them according to a model that situates innovation within a socio-cultural and technical systems context. Van De Ven and Rogers (1988) stress the importance of considering innovation as a system, particularly with respect to the implementation or diffusion of an innovation within an organizational context:

> . . . although invention may be the province of a single individual, innovation inherently involves a collective achievement among many individuals and stakeholders (investors, management levels, customers, and vendors) in mutual interaction. Thus understanding the process of innovation implies appreciating micro-/macro-level dynamics and constraints.

The Socio-Cultural and Technical Systems Framework illustrated in Figure 1 below highlights seven interdependent system elements that both help and hinder the diffusion of IT-based shareable learning resources: 1) the environment, 2) technology, 3) cultural assumptions and values, 4) people, 5) organizational structures and systems, 6) work processes, and 7) communication processes. We provide here an explanation of each of these elements and how they relate to the diffusion of SLRs.



1) *Environment.* By environment we mean the larger information technology industry which has produced the inventions that enable the creation, distribution and use of IT-based shareable learning resources. We ask the question: What does the environment require or allow, and how does it shape the adoption patterns in the university or academic engineering community?

2) *Technology.* The technologies we are considering are the specific information technology tools and infrastructure required to create, share and use IT-based SLRs.

3) *Cultural Assumptions and Values*. The assumptions and values important to this study are those that are relevant to higher education in the United States in general and to the engineering academic community specifically.

4) *People.* We include in this element three basic groups of people who have major roles in the creation, sharing and use of SLRs, the administrators in university institutions, the university faculty and students, and those who provide information technology leadership, services and support.

5) *Organizational Structure and Systems.* This element includes the administrative systems and structures government tenure and promotion, rewards and recognition and technology infrastructure.

6) *Work Processes.* Work processes refer to the specific processes involved in the development of IT-based shareable learning resources as well as to the processes that support their use in the classroom.

7) *Communication Processes.* This system element categorizes the communication processes related to the promotion of shareable learning resources within the engineering educational system.

This framework provides a unifying mechanism for examining complex issues in a way that simplifies yet retains the systemic, holistic and interdependent nature of the adoption process. We now turn to our discussion of the specific and detailed findings related to each of these system elements.

1. Environment

IT-based shareable learning resources are part of the broader information technology environment that has affected the delivery of education in the classroom. There are three major conditions that characterize the context of information technology based higher education. First, the internet is ubiquitous on and off university campuses nationwide. The internet is available on networks that are both wired and wireless. The recent trend is to provide wireless access to the internet across the campus for both students and faculty. Second, the tools available to developers are increasingly sophisticated, easy to use and cost effective enabling faculty members themselves to produce quality IT-based educational materials for use in their own classrooms and to share with others. For example, developers can build instructional materials with dynamic video and audio components, 3-D simulation technologies and interactive gaming, to provide students with real-time and real-world examples to illustrate the application of abstract mathematical and engineering concepts in engineering design or on the shop floor. Third, universities have increased their investments in IT infrastructure to support the delivery of education in and out of the classroom. In an increasing number of universities, computers are a requirement for all students. Universities are also incorporating learning systems such as Blackboard to facilitate faculty-student communication and student-to-student interaction as well as for the teaching and dissemination of course materials.

While the rapid change in information technology capabilities and their extensive adoption in institutions of higher education have served to support and facilitate learning, these same advances have resulted in greater system complexity and incompatibilities that make it difficult for individual faculty members to manage the complexity of information technology in their classrooms. The instability of the information technology infrastructure results in a higher probability that IT-based shareable learning resources will not work properly, that they will need greater maintenance and someone to monitor upgrades, service patches, version control and basic system requirements. Given these

complexities it is difficult for faculty members to adopt shareable learning resources and be assured that they will work as planned in the classroom. One faculty meeting involved in the Greenfield Coalition stated that in 10 years, "we have been through three systems" and none of them stabilized long enough to work properly. Another faculty developer who was not part of the Greenfield Coalition summarized the issue this way:

> "One area is the outside forces that are now really coming to bear . . . on the forces to use electronic media. I tend to think that many of the outside forces will be a bigger issue."

The environment of constant and rapid change in e-learning technologies will continue to be a double-sided issue for the development, diffusion and use of shareable learning resources in the near future. On the one hand, there is increasing technical sophistication and capability in software and hardware as well as the proliferation of these technologies in mainstream computing. On the other hand, the enhanced capabilities also increase complexity and the need for technical support. Because computers are personal and customizable to individual needs, there will be problems of compatibility in the implementation of IT-based shareable learning resources and the likelihood of problems in implementation without standardization.

2. Technology

2.1 Technology Strategies. Central to the diffusion of shareable learning resources is the technology itself. At a high level, the technology is composed of three things: students and faculty with computers, internet availability, and a link or URL to access and make use of the educational content. Conceptually, the technology is simple and straightforward. Practically, however, IT-based shareable learning resources can become technologically challenging. When the educational content requires that technological capabilities move beyond text to incorporate multimedia capability such as animation, simulation, and interactive, what-if scenarios based in real-world case studies the technical complexity can quickly increase the probability that the technology will not work without the imposition of standards in a controlled environment.

Based upon both interviews and direct observation, we found that developers made trade-offs to manage this situation. There were basically two strategies for increasing diffusion and use of IT-based SLRs. One strategy involves the reduction of computer system requirements to a minimal level, requiring no more than two browser plug-ins and simple internet access only. The second strategy increases the system requirements to as many as eight plug-ins to take advantage of multimedia in more sophisticated ways. This second strategy requires that students verify their computer system configurations using a script to check their system to ensure it will support the materials, and to download additional plug-ins if necessary. In addition, this strategy, especially in the case of the Greenfield Coalition, computers were pre-configured, pre-tested and then fully supported in the classroom by on-site staff, ensuring that the technology worked as planned.

The two strategies produce different diffusion results. The first strategy enables ease of adoption and use in the classroom with few possibilities that the technology will fail. However, there is a trade-off in flexibility, sophistication and customization for specific classroom activities or educational objectives. The second strategy provides the instructor with rich capabilities and an increased feature set for customizing educational content but also means that it takes much more time and effort to adopt the materials and the chance of failure increases. For example, one of our respondents said, "One of the downloads took me 3 weeks to get the right download to work on my computer. If that happens to a student or faculty member, and I go to a link that doesn't work, I'm not using the materials. There's only so much time that a person has." The increased capabilities require that there be a technology infrastructure to support them. Without this infrastructure, both students and faculty can easily become frustrated and discouraged and will be likely to discontinue use of the SLRs.

2.2 Developers' Objectives. The increased availability and capabilities of information technology to support learning in the classroom make the technology an enabler for a shift in the paradigm for engineering education. The shift is one from traditional lecture-based instruction in which the students are essentially passive learners and the educational infrastructure is basically blackboards, chalk, slides and note taking with limited interaction between the instructor and students, to one in which students are active learners and the learning is based on discovery and hands-on experience with the content. The information technology capabilities have provided the faculty with a way to bring the shop floor and real-world industry experience in problem-solving into the traditional classroom. As one respondent said, "I boil it down to people learn most effectively when they do things, when it's experiential, hands-on, applied, when there's meaning to some goal that they're trying to achieve. Learning has to be practical, hands on, repeated, and assessed." When using SLRs, students can see and work with machinery, real-time data and scenarios as though they were in the manufacturing plant. Students can also access analytical tools, perform what-if computation and receive immediate feedback in a practical way. The technology is most often used to do dynamic demonstration in a practical way of abstract concepts. The objectives of the developers are to provide an experiential curriculum that conveys the practical implications of engineering content.

When asked about their objectives, developers are quick to point out that they are trying to create a new pedagogy that stresses the following teaching concepts and practices:

- Learner-centered materials, in which faculty members are more facilitators than lecturers
- Discovery or exploratory learning
- Transferring knowledge more efficiently and permanently
- Blending knowledge and skills for technical mastery
- Teaching cognitive skills in a way that allows for multiple learning paths and styles

- Convenience and enhancement of learning outside the classroom, with self-paced computerized materials
- Instructional design in which pedagogy is embedded in the multimedia instructional materials
- A structured framework for learning
- Instructionally sound materials to support the engineering curriculum
- Interdisciplinary engineering programs through groupware and collaborative tools
- Providing a blend of engineering and business
- Hands-on real-world content, in which students work on case studies, learn from practical examples and from the experiences of industry
- Solutions to problems that are not black and white
- Dissection of activities, or reverse engineering
- Demonstration without the laboratory
- Bringing in the social context
- Making teaching and learning fun
- Making teaching and learning resources shareable with the ability to transfer materials to other faculty members and educational institutions, and to sell to industry

In sum, the evolving technology capabilities have given willing faculty members the ability to transform the way they teach and the way students learn.

2.3 Technology Infrastructure Requirements. Our research revealed that the achievement of developers' objectives requires a system infrastructure, both human and technological at the university, the faculty and the student levels.

First, at the *university level* we learned in our interviews that the following support is necessary:

- A computer host system that is reliable, first and foremost
- A sufficient number of software licenses to match student enrollment
- Technical staff to do regular server maintenance to keep up with software upgrades and service patches, and website changes
- Technical staff to manage a database
- The capability to use both non-proprietary and proprietary software
- A learning system to support and track the use of materials as well as student progress and achievement
- Classrooms that are equipped and maintained
- A faculty software interface to allow authoring and customization of materials
- Online support documentation and help

Second, at the *faculty level*, in addition to the above infrastructure requirements, the following capabilities are cited as most important to support the new pedagogy:

- Authoring software to develop course materials
- Sufficient time to learn and test IT-based shareable learning resources
- Protection of intellectual property

Third, at both the *student and faculty level*, these requirements are also essential:

- Computer literacy
- A computer, preferably a laptop, with the minimum set of system requirements to enable access and use of the selected SLRs:
    - Internet access, preferably high speed and wireless
    - An up-to-date browser
    - Installed and functioning plug-ins, including special viewers if appropriate
    - Web pages that are easy to access and navigate
- Access to technical support, online, onsite and in real time.

What appears at face value to be the simple application of internet and multimedia capabilities to the traditional classroom is in fact a transformation of pedagogical approach to engineering education that requires a significant investment in time, effort and resources to achieve. As one respondent said, "Just like how with the students, the concept of web-based learning is excellent. It's very standardized, which is very good, but it is a change from the conventional way of learning. That's one of the barriers." For a faculty member to discover a shareable learning resource and actually adopt it and use it in the classroom there may be a significant technological hurdle to overcome given the heterogeneity and personalization of personal computers. A faculty member and students must also become comfortable with a new way of teaching and learning that requires a fundamental shift in cultural assumptions and values.

3. Cultural Assumptions and Values

There are cultural assumptions and values that underlie any educational system. We found that there is a conflict in the values and assumptions of the developers, and early adopters of IT-based shareable learning resources with the traditional values of the engineering educational community in the United States.

The traditional *university values of higher education* in the United States are part of an educational culture of independent thought and practice, especially in the classroom, and a pedagogy that rewards individual initiative and achievement. In research universities, in particular, rewards for tenure and promotion demonstrate the value of research over teaching. Prestige and career advancement most often comes from demonstration of individual contribution to knowledge, not from collaborating or using others' materials, especially in research institutions. Additionally, in the *engineering educational community*, faculty members have traditionally demonstrated in their teaching a value for theoretical knowledge over practical application and have adopted a normative teaching style that is primarily based on lecturing rather than interaction and practice. Moreover, our respondents articulated that a sizeable percentage of the faculty members (approximately 90%) have never worked in industry and do not have real-

world, on the job experience in applying many of the concepts they teach. Granted that many engineering professors have served as consultants to industry; however, they do not have the real-world experience base to draw upon to enhance their teaching with practical demonstration. Consequently, engineering faculty has the normative practice in their teaching of relying on black and white, single answer, textbook responses to engineering problems. The *knowledge assumptions* that underlie this traditional approach to engineering education assume that the role of the instructor is to impart theoretical knowledge and the role of the student is to receive it. Teaching materials are developed that reinforce the value of the theoretical and the one-way learning model in which the engineering faculty lecture and students take notes and hopefully learn the right answers well enough to answer test questions.

In contrast, we found that many of the developers and users of SLRs are those that espouse a different set of values and beliefs about knowledge, how it is created and transferred. As previously discussed, the developers are embedding a new pedagogical approach in the content and delivery of SLRs, taking advantage of the multi-media capabilities to create an alternative teaching and learning environment. As one respondent commented:

> I think we tried to get rid of old assumptions that learning is passive. We worked from the assumption that active learning is better. When students are individually exploring a problem space, they can grasp the problem better. By giving them an excel spreadsheet, where they can move spinner knobs and change a compounding rate and see how the value changes, they are actively engaged in the learning process and see the "ah hahs" - they are creating their own inductive learning. Another assumption was that the learning would be better if there is a better real-world scaffolding to hang the knowledge on. The learning is more a transfer and a transformation of knowledge rather than stuffing a bunch of brand new stuff into what is supposedly an empty hole."

Users as well as developers are faculty members who buy-in to the value of experiential learning in which knowledge and fundamental engineering concepts are captured in activities that students perform. Our respondents who had adopted SLRs expressed a value for entertainment as well as learning and for common sense and optimized solutions rather than general theoretical problems with a correct answer.

Assumptions about faculty-student interaction and roles also contrast with the traditional approach. We found that faculty and students preferred discovery over having the content delivered through lecture. One respondent told us, "To the individual student, we believe that transferring abilities that are based upon knowledge is not done at an intellectual framework. It is strongly influenced if it can come from the worker's own experience. Tend not to tell them why something works, but let them discover. In some sense there's some sort of a balance between telling and discovering." There is also an assumption built into many of the SLR materials we investigated that students come to

classroom with some knowledge and expertise that they have acquired through experience, even if that experience comes only from day-to-day living.

Since IT-based SLRS require a significant amount of faculty time to learn and use, faculty members who adopt these resources and materials have a value for teaching that generally exceeds that of the typical engineering faculty member. The developers and early adopters of SLRs will often spend extra time in classroom preparation sometimes sacrificing time they could be spending on research. These faculty members are also taking a risk in experimenting with these materials since student evaluations may be unfavorable as both faculty and students learn how to use the materials to their advantage. Faculty members who adopt SLRs generally have a higher tolerance for risk-taking in their careers than those who do not adopt the materials.

For engineering faculty the SLRS mean four things that require a paradigm shift:

- A change in role from lecturer to facilitator
- Increased classroom discussion and vulnerability to student challenges
- Increased uncertainty in delivery of content both because the technology may fail and because they may fail to transfer knowledge
- Increased risk because faculty members have to demonstrate application in areas where they may not have much experience and because there is no black and white solution

The engineering faculty members who have made the pedagogical shift and are comfortable with the technology resources are strong supporters and believers in the new paradigm. They are confident and are good spokespeople for the benefits of adoption. They have seen results that exceed the traditional methods of teaching, such as student engagement and enthusiasm, students who grasp fully the concepts they are trying to get across, and both cognitive and skill mastery. Everyone we spoke with who had adopted the materials stated that they would never go back to the old way of teaching.

For the diffusion of IT-based shareable learning resources the paradigm shift and conflict in values means that adoption will be slow because it requires a system-wide paradigm shift in the system of engineering education at the university level. At present, only the faculty members who are predisposed in terms of their value for teaching and their tolerance for risk and uncertainty are likely adopters. The faculty members at research institutions have a built-in value conflict between research and teaching which we will discuss further in the following two sections of the report when we present specific findings about people and organizational structure and systems.

4. People

In this section of the report we describe the population we interviewed and observed, respondents' opinions about why they and others use and don't IT-based shareable learning resources, and their opinions about the developers of these resources.

4.1 Study Population. The people in our study population fall into three broad categories related to SLR development and use: engineering faculty, development staff, and administration and other positions including industry. The engineering faculty represented engineering technology, manufacturing engineering, materials engineering, mechanical engineering, metal forming technology, product development systems and pure research. The development staff represented instructional design, information systems support and graphics design and multimedia development technicians. Those respondents involved in the development of SLRs played varied roles including instructor, content expert, course developer, media production, computer development and support, and program administration.

4.2 Adoption of SLRs. When we asked respondents why they use or think others would use IT-based shareable learning resources, they responded that they use these resources primarily because:

- They developed the course themselves
- The course repackaged existing materials
- The course teaches students how to use specific tools
- They were able to use only parts of the course
- Already developed courses save time because faculty don't have to recreate or develop the materials on their own
- The content is relevant, good, or what they need
- The materials are free of charge or affordable
- Materials are readily available
- Students like the materials
- The materials promote learning
- The materials align with their own paradigm shift in teaching and learning
- Interactivity and spontaneity keeps teaching fresh
- The content supports student learning by:
    - Providing good examples
    - Including case studies they can use to get across specific points
    - Making learning fun through games
    - Offering leading-edge computer simulations for demonstration, to show the real thing in a university environment
    - Fostering the transfer of knowledge, making teaching more effective and helping students learn

Respondents mentioned that others outside the engineering faculty have also adopted IT-based shareable learning resources. These adopters include:

- Trainers who work with practitioners
- Industry practitioners themselves
- Business schools
- Professional societies such as the Society of Manufacturing Engineers (SME)

Faculty members stated that they use the following types of IT-based shareable learning resources, which exhibit the full range of what is currently available in the information technology environment:

- Websites
- Videotapes and web-based video
- Animations
- Simulations
- Textbook DVDs and CDs
- Specific software to demonstrate principles, such as quality control
- Materials ranging from fully developed courses, to specific modules and activities, to simply video or audio segments

Faculty who use IT-based shareable learning resources state most often that their reasons for use are because the materials fit their values for teaching, include good content that is relevant, promote student learning, and they work for what they need in the classroom.

4.3 Non-Adoption of SLRs.

Among our study respondents, the faculty members who told us they did not use IT-based shareable learning resources said first and foremost that they were not aware these resources were available to them. One faculty member said, "Anything I am aware of like that (SLR), I have run across it by accident and just took it. There are no shareable learning resources out there that I know of." Other reasons for not adopting the materials developed by others include:

- Faculty prefer to develop their own materials
- Faculty do not like using what others have developed
- Materials might violate copyright
- Materials are not suited to their needs
- Materials don't work the way they should
- Materials are not of good quality:
    - Errors in content
    - Lack of completeness
    - Lack of technical support
    - Lack of reliability
    - Lack of flexibility
    - No real-world relevance
- It takes more faculty time to use the materials
- The materials are used or taught in another way
- The faculty member does not teach at all, or does not teach courses for which materials have been developed

The non-adoption of SLRs in general, according to the people in our study, reflects the limited marketing or advertising of the materials within the engineering

community, the value for independence and self-reliance among the faculty, the reluctance for faculty to spend a lot of time on teaching, and the difficulty of developing good, technically reliable materials.

4.4 Opinions about Originators of SLRs. The opinions of faculty members and others about the people who develop or originate the IT-based shareable learning resources influence others' willingness to adopt the materials. When asked about their perceptions, respondents stated that brand recognition and a good brand name means or would mean a lot in their decision to adopt. The perception of the institution at which the materials are developed is important. People stated they would be more reluctant to adopt materials developed at second tier universities. They also stated that personal name recognition counted as well in their decision to adopt. If faculty members recognize a specific developer as a known expert with experience in the content area, they are more likely to adopt materials than if the developer is unknown to them, no matter how good the content may be. Respondents also stated that if the development of the materials has been supported by the National Science Foundation, the materials are likely to receive more respect. One person said, "I think one of selling points is the fact that this project was funded by NSF - Greenfield doesn't mean anything to most people, but NSF support and funding gives it credibility. A lot of people never hear the word Greenfield and don't know what it stands for." In addition, industry involvement or support of materials was viewed as an endorsement and as a means to speed diffusion. Some respondents believed that smaller universities are more likely to foster innovative teaching methods and materials because collaboration is easier. Again, we heard from respondents that real-world, case-based, quality content enhances the reputation of both the source and the materials themselves. However, there is a downside to industry-specific cases because they may not be transferable to students in universities or in environments beyond the local ones in which they were developed.

5. Organizational Structure and Systems

There are three primary factors that emerged as important organizational structure and systems issues, in interviews, observations and data from secondary sources: the reward and recognition structure for faculty, the intellectual property rights concerning both the development and use of the materials, and the university-based leadership and technical support system for both faculty and students.

5.1 Rewards and Recognition. There is a wide continuum from negative rewards to positive rewards for developing and/or using IT-based shareable learning resources. One the negative side, respondents told us repeatedly, in no uncertain terms, that there were no tangible rewards for teaching in a research institution. They stated at best that at research universities, lip service is paid to rewards for teaching and rewards that do exist for teaching are of questionable value in decisions about tenure and promotion. The respondents stated that there is no reward for putting extra time into teaching, nor is there a visible reward or positive recognition if faculty members use SLRs developed by others. In one respondent's words, "Faculty doesn't get any rewards or anything based on using their own material or anyone else's material." In fact, people told us that putting time and energy into teaching is tantamount to risking tenure and

promotion because efforts are not concentrated on grant writing, research and publications. For example, we heard, "If you do work in this area, it can be satisfied personally, but you will be penalized basically in a university environment. They won't treat this as your research; this is treated as part of the education. This won't help with research and working in the area that will get you tenure." Faculty members also said that using SLRs was risky because it might adversely affect student evaluations of teaching while instructors work out how best to incorporate the new learning paradigm, the educational materials themselves, and the technological glitches that inevitably occur. Another downside is the lack of benchmarking of student learning outcomes both pre- and post-use of SLRs. What is lacking is an experimental design to measure comparative learning of traditional teaching and learning methods and methods that use SLRs.

On the positive side, at the *faculty level*, adoption of IT-based shareable learning resources do provide rewards that are centered primarily on the personal satisfaction faculty members receive from teaching in new ways and affecting student learning experiences in a dramatic and positive way. Faculty members state they are inclined to use the materials simply because it is the "right thing to do." They say that it is an incentive for them to use SLRs when the content or topic they are teaching undergoes some fundamental change, and because the materials, especially if they include relevant case studies, make explanation easier. In this case the SLRs help them get up to speed quickly and provide good examples to illustrate otherwise abstract concepts. Faculty members also say that they are rewarded by reduced preparation time for teaching (freeing time for important research activities) if the materials are high quality and reliable. They also say they save time if they can reuse materials. Rewards also come from the ability to maximize time spent in the classroom, especially when time can be used to interact more with students and explain difficult material. At the *student level*, our respondents told us rewards are associated with enhanced learning for students, when students are actively engaged in learning. SLRs can provide students the opportunity to interact more with faculty members. Faculty members say they are rewarded with positive feedback from students and positive student evaluations when SLRs work for them. At the *university level* faculty members reported that the rewards come from changes in higher education that supports a more interactive learning style and reward for the scholarship of teaching.

5.2 Intellectual Property. Ownership of content and copyright is an important structural issue at both the faculty level and the university level, and directly affects the diffusion of IT-based shareable learning resources. There are two primary groups of responses to this issue that emerged from our data: clear ownership and unclear ownership. When intellectual property ownership is clear, the issue is discussed openly and copyright ownership is spelled out explicitly for developers. In general, intellectual property rights are handled in four primary ways: 1) an institution can own the copyright, 2) faculty members themselves retain the copyright on the materials they develop, 3) copyright is embedded in the information technology learning resources themselves, or 4) copyright is negotiated and often transferred from faculty members to publishers.

1) *Institutional ownership.* In the case of institutional ownership, the intellectual property arrangements are varied. Each university at which materials are developed can have its own intellectual property agreement. A funding agency can also own the copyright. In the case of Coalitions that develop IT-based shareable learning resources, the copyright is negotiated among the participating institutions. In some cases the university owns the copyright with an agreement that faculty can use the materials. In other cases a publisher owns the copyright entirely. This is often the situation when DVDs and CDs are provided with textbooks as supplemental course material.

2) *Faculty ownership*. When faculty members own the copyright, the arrangement is generally negotiated up front prior to development between the faculty member and the university. There is often an official agreement with copyright assignment and release. In other cases there is no official copyright agreement, however, the developers or originators of the materials are given authorship credit just as in most academic publications.

3) *Embedded copyright.* Unique to the Greenfield Coalition materials, the design of the information technology infrastructure embedded the intellectual property credits directly in the shareable learning resources themselves. The important point to make here is that the content in the Greenfield materials is dynamically rendered at the time of use and is never downloaded to anyone's computer, ensuring that materials cannot be copied, edited and resold or reused under another name.

4) *Negotiated copyright.* When copyright is negotiated between a faculty member and publishers it can be handled in different ways. In some cases, copyright is retained by the author, in other cases it is negotiated up front as retained by the publisher exclusively. Copyright can also be retained by both parties in certain cases. For example, in the NEEDS Coalition, the original materials in the NEEDS database are retained by the author and available as freeware for other faculty to use. However, in some cases, these materials have been commercialized and publishers have enhanced and altered the materials in significant ways, with the agreement of the originator, and hold the publisher holds the copyright for these commercialized materials that are sold.

When respondents told us that *copyright was unclear*, it was often the case that our asking the question about intellectual property was the first time the issue had been raised or respondents had thought about it at all. The most frequent response to this question was "I don't know." The copyright or intellectual property issue is unclear, has not been addressed, is not an issue or is characterized as a moving target. In some cases, the copyright ownership was characterized as ambiguous. In these situations, the issue of trust and fairness was raised, in which faculty members were supposed to exhibit responsibility and integrity in the use of others' materials, or faculty were expected to negotiate individual agreements among themselves on a case by case basis. We also heard from respondents that practicality dominates the legal aspects in these situations.

5.3 Academic and Technical Leadership. The university-based technical support system for both faculty and students is a central and essential element in the

development, adoption and use of IT-based shareable learning resources. One person offered this suggestion about how to achieve wider use of SLRs, "There needs to be departmental reform. There needs to be the blessings from the chain of command. There has to be involvement from the faculty." Just as a university provides the physical infrastructure of classrooms, blackboards, offices, and provides talented faculty, and as well as other support for education to take place effectively, we were told the university has a critical role in supplying an *academic and information technology infrastructure* to support the development and use of SLRs. Specifically, our respondents cited the need for leadership, both academically and technically

Academic leadership. The academic endorsement and active support of campus leaders responsible for setting policy university-wide, as well as in colleges and departments, was viewed as critical for the diffusion of SLRs. Without the consideration and reward for innovative teaching and the scholarship of teaching, including use of others' materials as legitimate criteria for the evaluation of faculty in their tenure and promotion, respondents told us it would be difficult to increase the rate of adoption beyond those faculty members who expressed intrinsic motivation to use the SLRs. Another aspect of academic support is the establishment of an environment that fosters a community of practice for faculty to create and share resources that foster innovation in teaching. Part of the need for this community is related to the fundamental value of faculty independence and freedom. To increase the rate of adoption for an innovation like SLRs, faculty members need to be pushed and challenged by their peers. It is not enough to create policy. Reward comes from prestige in an academic community of peers.

Technical leadership. The university is also responsible for providing technical leadership. Respondents said that the university had to provide a network system that works, that is reliable and field tested. In addition, there is a need for technical support for faculty interested in developing SLRs as well as for those who want to use materials developed by others. To sustain the use of SLRs, technicians who can troubleshoot, answer questions, be on-site in the classroom, and offer help virtually, online, and who are on call full time are necessary. We also learned from the interviews that there needs to be a set protocol or process for answering technical support problems that is reliable and expeditious, so that faculty and students are not discouraged from using SLRs or from approaching technical support staff when problems do arise. Respondents said, in short, that an adequate staff of technically competent people is required to keep up with the complexity of technology and technological change.

The technical infrastructure support from the university also extends to providing faculty with training in the use of SLRs including new teaching methods to support the paradigm shift as well as in basic computer literacy. Respondents said that the need for bringing computer literacy up to speed will be reduced with the upcoming generation of new faculty who has grown up with information technology. However, for many of the existing faculty members, especially those who have long-established methods of teaching without information technology resources, training as well as incentives to reward change will be required. Some despaired that this type of change among the older

generation of faculty would be possible. Many said that the best strategy would be to wait for a generational change and the problem would take care of itself.

Technical support for students as well as faculty was mentioned as an important condition for the diffusion of IT-based shareable learning resources. Students also need the same level of computer literacy and training in the use of SLRs as do faculty members. A technical support staff needs to be available to provide on-site, online, and on-call answers to questions and troubleshooting. For students, the faculty often serve as the technical support specialists, emphasizing the need for faculty members to be technologically proficient. Students also receive support from peers, and respondents mentioned that a problem-resolution process and forum for resolving problems is a help in reducing the university and faculty resource needs.

An important consequence of adopting SLRs is that there is almost always an initial learning curve which takes more time and energy at all levels. Classroom policies and procedures should take the increased time commitment into account. Even when IT-base SLRS are easy to use and when they require little technological support, learning how to use them efficiently in teaching and learning takes some time. One final caveat is that the technological reliability and the quality of the content in SLRs is necessary for diffusion to take place. If the material is quality, is field-tested and stress-tested, and is piloted before being diffused to a wider audience, the SLRs are more likely to be adopted in the classroom. There is less chance that things can go wrong that will discourage faculty or students from using the materials, and there will be less reliance on technical support. Both academic and technical leadership are necessary for the successful diffusion of IT-based shareable learning resources.

6. Work Processes

In our interviews and observations we investigated one of the essential elements of the socio-cultural technical system within which IT-shareable learning resources are embedded -- the work processes involved in teaching in the university setting and in developing the shareable learning resources. We asked respondents about the factors that helped or hindered in the development of the resources and what they would need to plan, monitor, manage and evaluate SLRs, and we observed adoption processes in action. Most of our direct observations and examples come from the research we conducted of the Greenfield Coalition materials. However, we supplemented this data with interviews with other developers outside the coalition and in our observations of the adoption processes involved in using other materials as well as in our secondary data analysis.

6.1 Factors that Help or Hinder Development. There are seven work process factors that emerged as facilitators or hindrances in the development of the IT-based shareable learning resources, primarily within Greenfield, but elsewhere as well: 1) an interdisciplinary team of skilled development staff, 2) access to industry experts, 3) positive faculty attitude, 4) a defined process for instructional development, 5) a supportive environment, and 6) money and tools.

1) *Interdisciplinary team of skilled development staff*. Faculty members in most cases do not work alone in the development of SLRs. Greenfield took a team approach to development, in which a faculty member work in concert with instructional designers, computer programmers and graphic designers, all of whom had experience working in a university environment, working in interdisciplinary teams, and who were credential in their area of expertise. The faculty developers said the teamwork involved in developing SLRs was for most of them a new experience, and one that was gratifying and in which they learned a great deal. Working with the instructional designers gave them insights about the learning process itself, and working with the technical staff taught them about how to package materials to make them for efficient and effective and provide students with a more pleasurable learning experience. Nevertheless, faculty members were quick to point out that this experience was unique and rare in the university careers and that they normally work alone without the resources and support Greenfield provided to them.

2) *Industry expertise.* In all cases, developers told us that they sought and used industry experts as consultants and as subject matter experts, and as active voices in the materials themselves. The reasons for the importance of industry experts to development included to have confidence that the material would be relevant, that it would accurately demonstrate concepts in a practical way, and that it would be anchored in real-world experience. In some cases, industry experts were included in video segments, adding credibility and authenticity to the content. Using industry experts also provided shop floor or industry laboratory access for filming video segments that were critical to demonstrating concepts in real-world applications.

3) *Positive faculty attitude.* Faculty members had an openness and flexibility in adapting to the new work process. Without this, respondents told us faculty dropped out of development work. If faculty developers had trouble adapting to a new pedagogical paradigm, both in Greenfield and in other coalitions or development sites, they often could not take ownership of the materials and would not use the materials in their own teaching. Faculty developers told us that the university structure was partly to blame because it rewarded faculty for maintaining the status quo rather than trying out new methods and materials for enhancing teaching and learning, reinforcing the need for university leadership, structure and systems to support development and diffusion of SLRs.

4) *Defined process for instructional development.* At the Greenfield Coalition, faculty developers stated unequivocally that the instructional designers who followed Gagne's principles for instructional design provided a template for development that enhanced student learning in the classroom. These principles include events of instruction, types of learning and learning hierarchies[1]. They are:

[1] See Gagne, R. 1985. *The conditions of learning* (4th ed.) New York: Rinehart and Winston, or also Gagne, R., Briggs, L. & Wagner W. 1988. *Principles of Instructional Design.* New York: Rinehart and Winston)

Gagne's events of instruction:

1. Gaining attention
2. Informing the learner of the objective
3. Stimulating recall of prerequisite learning
4. Presenting new material
5. Providing learning guidance
6. Eliciting performance
7. Providing feedback about correctness
8. Assessing performance
9. Enhancing retention and recall

Gagne's types of learning:

1. Intellectual skills
2. Cognitive strategies
3. Verbal information
4. Motor skills
5. Attitudes

Gagne's learning hierarchies:

Gagne called a specified list of building blocks a *learning hierarchy*. Learning in the form of a building process is required to develop *intellectual skills.* Lower-level skills provide a necessary foundation for higher-level ones. To teach a specific skill, a teacher must first identify its prerequisite skills and make sure the student possesses them.

Even in cases where there was not such a pedagogically derived structure, a template and articulated process for development was cited by respondents as a significant help in developing SLRs. For the most part, while engineering faculty are theoretically and technically proficient and competent in their subject matter expertise, they have not been trained to develop instructional materials using adult learning principles.

Respondents mentioned several additional important aspects of the instructional development process. First, administratively, the developers had regularly scheduled interdisciplinary team meetings. Second, members of the development team had an overall understanding of the curriculum design. Third, early piloting of materials with students, particularly cases, helped get the bugs out before implementation in the classroom.

In cases where the development process was not very well defined, faculty cited difficulties related to lack of clearly defined roles and responsibilities in development, trying to do too much in one course, not enough time to complete the development process and lack of collaboration or cooperation among team members. Faculty developers cited the steep learning curve as a difficult hurdle to overcome. One respondent put it this way, “The blended environment with shareable learning is more technically challenging to develop compared with once the content is developed and you want to make it accessible.” They also mentioned that they had difficulty balancing web

resources versus classroom instruction in the design process and in translating their knowledge into useable case studies.

5) *Supportive environment.* The faculty developers we interviewed mentioned the academic leadership support and peer support as most important to the development of the SLRs. Support from the college and university, from deans, department chairs and the university administration in general, meant that engaging in development of SLRs was a worthwhile expenditure of faculty members' time and energy. When academic support was not present, or when faculty members were discouraged from engaging in the development of SLRs, they had trouble meeting development goals. In these cases, their own interests in working on the development of SLRs were in direct conflict with values in their departments and colleges. Interestingly, technological support was not mentioned except in cases where lack of support detracted from the development process. Specifically, the rapid pace of technology change was cited as a hindrance, as was the lack of resources such as computers in the classroom.

6) *Money and tools.* In our interviews, faculty developers told us that resources in the form of money and tools to support development were critical. For example, in the words of one respondent, "It would be difficult to come up with this type of material without good financial backing because this is not research. Unless you get some type of NSF-type grant, it is next to impossible to come up with what we have developed." Without National Science Foundation funding, endowed chairs that allowed for dedicated faculty time and the help of graduate assistants, or industry funding for web-based media production or laboratory facilities providing hardware and software to create and deploy materials, faculty would not have been able to develop the SLRs. In many cases, faculty developers were commissioned and paid to create SLRs. In some cases, faculty members were altruistic in their motivation to create SLRs because they believed so strongly in them. However, even these faculty members were able to recoup some of their investment through later sales of materials to industry or by receiving royalty payments from publications.

In sum, the development process for IT-based shareable learning resources worked best when all six factors were present to support the process. When some of all of the factors were missing, the development process was either slowed, disrupted or stopped altogether.

6.2 Planning, Monitoring, Managing and Evaluating SLRs. In addition to the work process factors mentioned above, we found four other factors related to planning, monitoring managing and evaluating IT-based shareable learning resources: 1) an assessment process, 2) adequate technology, 3) a sharing process, 4) orientation to and trial of materials.

1) *Assessment process.* In hindsight, one of the respondents we interviewed mentioned that faculty had jumped into the development process without any clear understanding or process for evaluating the impact or results of the SLRs on student learning. This viewpoint was echoed by others. Consequently, the diffusion of SLRs

was slowed by the lack of clear evidence of their relevance, utility and positive impact. Assessment was cited as important not just to evaluation in the classroom, but also to industry in the evaluation of students' mastery of concepts and skills. Academically, respondents mentioned that assessment of SLRs should be directly linked to ABET and that citations of work on the scholarship of teaching, where SLRs are the focus, would be another way to evaluate the extent of diffusion into the wider engineering educational community. They cautioned that assessment should not distract from teaching, and that one way to accomplish assessment in an unobtrusive way would be to embed it in an electronic monitoring process that could document student progress, track users and measure the impact of learning over time.

2) *Adequate technology.* Simply put, respondents reiterated the need for computers in the classroom with reliable high speed internet access and networking capability.

3) *Sharing process.* Defining and rewarding a process for sharing information about IT-based SLRS and SLRs themselves is necessary for the diffusion of these resources, especially in light of cultural values that promote faculty members "doing their own thing" and keeping resources to themselves to further their individual career interests. There needs to be a mechanism for sharing on the web as well as for sharing tools for the assessment and evaluation of SLRs. Respondents who were developers also told us that they themselves were not particularly good at the diffusion of their own resources. The fact is, they enjoy developing, but not the promotion, and marketing nearly as much.

4) *Orientation and trial.* Prior to engaging in development, faculty members need some orientation to using IT-based resources and development tools and the opportunity and time to try them out and get comfortable with them in a safe environment. They also need to be able to try out others' materials in the same way.

7. Communication Processes

This study of the diffusion of IT-based shareable learning resources included several questions addressing the promotion and dissemination of the resources. We wanted to know who communicates with whom, through what media channels, with what results, in the diffusion efforts for SLRs aimed at increasing the use of these resources in engineering education. Overall, the promotion of SLRs takes place through six primary channels: 1) word of mouth, 2) publications, 3) websites, 4) demonstration and presentation events, and 5) awards.

1) *Word of mouth.* SLRs are promoted and diffused through personal faculty networks. Faculty members share ideas with people they trust and associate with. Faculty members are most willing to try something new when it comes highly recommended via personal referral from someone they know and respect. One respondent said, "People only use new software if someone they know recommends it to them. People have to refer and make the connections." Faculty members are likely to share new teaching ideas with others who teach the same courses. The positive "buzz"

about materials is viewed as essential for legitimacy of the materials and is a precursor to formal conference presentations, publications and other public dissemination events.

2) *Publications.* Publications in the form of conference papers and journal articles were cited as a commonly used method to promote awareness and use of the SLRs in the academic community. Not surprisingly, this channel was mentioned as the mainstream vehicle for communication among academics and for the transfer of knowledge and tools. Several respondents also told us that the professional press is a good way to extend awareness to people in industry. Publishers also promote published SLRs at academic and industry conferences. Professional associations publish in their newsletters about SLRs as well.

3) *Websites*. A third commonly used channel for communicating about and learning about SLRs was the internet and websites. Developers of SLRs commonly have websites where they promote their materials and offer demonstrations and access to materials. Websites also let others know about materials under development and often invite people to try new materials and provide feedback, generally in an informal way. They often describe the tools and processes used to construct the materials and even include these tools as downloadable files for others to use. Not only are the websites themselves important, but the search engines, such as Google, must be able to retrieve relevant material. One of the common problems in dissemination is the inability of potential users to locate material on the internet, especially in a timely way. Websites let people know what materials are out there for use, invite participation or comment, and serve as a mechanism for sharing with others in the academic and professional community. Some websites are introducing monthly theme pages to highlight or feature specific SLRs that encourage a habit of periodic revisiting of the website. The idea behind these features is to reward those who have expended effort to create the materials and to build momentum in diffusion. Websites can include searchable databases as well, such as the NEEDS database, that are centralized repositories of SLRs. Centralization of materials developed by many helps to provide ease of access for the entire academic engineering community. In most cases, however, developers of SLRs feature only their own materials on their websites. It should be noted, however, that websites need to be carefully designed for ease of navigation and must be kept updated and in working order to be credible. ListServe broadcasts to subscribers were also mentioned as a mechanism for generating awareness and for troubleshooting in the use of SLRs.

4) *Demonstration and presentation events.* Users of SLRs and potential adopters of these materials alike cited the observable demonstration and presentation of materials as an important way to understand the capabilities of the materials, to learn how the materials might fit in with courses they were teaching, and to engage in dialogue with developers. These events take place in a number of different venues, such as academic conferences, professional engineering societies, workshops and seminars at universities, usually by invitation or special arrangement, or as publisher promotional events. Events are sometimes held in partnership with professional associations and even industry or industry organizations. Demonstration and presentation events are often accompanied by promotional material in the form of brochures and other “take-aways” describing the

materials and even offering samples. The observability and hands-on experience and one-on-one conversations that these demonstration events facilitate were frequently cited by developers as the most significant way to move people from awareness of SLRs to actual trial and adoption. In addition, those attending these events state that the ease of use, the modular and flexible design of the materials, and the relevance of the case studies are attributes of the SLRs that appeal to potential adopters. On the other hand, some developers and potential users state they prefer an entire class and packaged learning system that that can adopt outright without have to customize or tailor activities to fit with existing course materials and teaching approaches. There is clearly a debate in the academic community on this issue.

5) *Awards.* Another mechanism for generating visibility and awareness, enhancing credibility, and increasing the likelihood of adoption is to provide an academically recognized and prestigious award that comes from review by distinguished peers. This type of award is completely consistent with the culture of higher education and is, therefore, and quick way to move IT-based shareable learning resources into the limelight. When only a few developers actually receive awards, the award announcement reaches a wide audience, and the awards are acknowledged as an enhancement in tenure and promotion, there is incentive to work hard to create quality materials. Competition in this case, serves quality well. However, these awards are generally given to people who develop original materials, or who alter materials to be used in new contexts in new ways, although this is not as common yet. Awards also do not serve as well to reward the use of others' materials unchanged. Again, this is consistent with an academic culture that favors the creation of new knowledge over the use of knowledge created by others. Awards do lead in some cases to the commercialization of SLRs through publishers, in which case simple reuse is considered acceptable.

This study of the diffusion of IT-based shareable learning resources provides some qualitative evidence of results, but no quantitative measure of the extent of SLR adoption or impact of the materials on student experiences and learning. We heard from a number of developers and those who have used SLRs in their own classrooms that SLRs have diffused beyond their own institutions and classrooms to the wider educational community. One group of developers told us that after four to five years of concentrated outreach effort they estimated that they have diffused their materials to as many as 24 other institutions, over 100 faculty members, and have impacted approximately 10,000 or more undergraduate students. Nevertheless, accurate tracking of use is necessary before any conclusions can be drawn about the adoption and impact of IT-based shareable learning resources.

Discussion and Recommendations

Discussion of the findings from this study will begin with a return to the research questions that we proposed to answer regarding the diffusion of IT-based shareable learning resources. The answers are based upon rich qualitative data. We can provide articulation of the key diffusion issues facing the engineering educational community and some recommendations for future research directions and simple steps that can be taken to accelerate diffusion based upon the data we have gathered.

Research Question One: How do the perceived attributes of the sharable learning resources (SLR) affect their adoption?

Proposition 1a: The relative advantage of the SLR, as perceived by faculty and students, is positively related to the rate of adoption.

Discussion 1a: First, we can say that students really have very little say in what instructional methods or materials faculty decide to use in their classrooms. They do influence the adoption process, however, by providing positive or negative feedback to their instructors. Second, relative advantage depends upon a faculty member's point of view and skills. If a faculty member accepts the pedagogical shift from a traditional theoretical, lecture-style presentation of materials to one that is more interactive and based in discovery, in which the faculty member is more of a facilitator than lecturer, then IT-based SLRs have a relative advantage and faculty members are more likely to adopt the materials. At present, there is a greater need for assessment to document the educational value of SLRs to provide evidence and justify the relative advantage of these materials and the pedagogical shift they require.

Proposition 1b: The compatibility of the SLR, as perceived by faculty and students, is positively related to the rate of adoption.

Discussion 1b: For the majority of the faculty we interviewed and observed, SLRs are at present incompatible with the traditional approach to teaching as well as with the values in their university environments, especially at research universities where teaching does not receive the rewards accorded to research and publication. This incompatibility slows the rate of adoption. This is a core hindrance to diffusion of IT-based SLRs.

Proposition 1c: The complexity of an innovation, as perceived by faculty and students, is negatively related to the rate of adoption.

Discussion 1c: The results clearly indicate that the more technically complex the SLRs, and the more customized the SLRs, the less likely they are to be adopted by others. The technical hurdles faculty members must overcome to implement IT-based SLRs in their classrooms, even the simplest ones, take time and effort that many faculty members are not willing give, especially given the reward structure at many universities. In some cases the complexity is rooted in basic technical requirements like computer-equipped classrooms. In other cases the complexity is related to server access, the number of browser plug-ins required, and the technical support available to ensure the

materials function properly. Nevertheless, the Greenfield Coalition and other developers as well, have demonstrated that the complexity can be overcome with adequate resources to staff computer labs, equip students and faculty with computers that have been properly configured and tested, and quickly resolve problems. For complex SLRs, this type of controlled environment works best. For many professors who do not have this level of support, but who are working in lecture halls where students bring in a heterogeneous group of personal computers using different operating systems and with different browser configurations, the complexity can become a technological nightmare and discourage adoption.

Research Question Two: How do perceptions of the faculty and students about the SLR decision affect the rate of adoption of an innovation?

Proposition 2a: The rate of adoption of decisions perceived by faculty and students as authoritative will be faster than those decisions perceived as optional.

Discussion 2a: Given the norm of academic freedom, there is really no authoritative decision to mandate the use of shareable learning resources. The faculty decision to adopt is fully optional and takes place if faculty members believe in the materials and the materials are compatible with their own values and teaching approaches.

Proposition 2b: The rate of collective adoption of SLRs is positively related to the degree of power concentration in the educational system.

Discussion 2b: In our research we did not come across any collective adoption of SLRs by a department or any other university group or industry group. Consequently, we are unable to answer this question. However, we did find that if there is peer pressure, or if a group of faculty band together to help one another, there is more likelihood that SLRs will be at least tried and perhaps adopted successfully.

Research Question Three: How do mass media communication channels (such as advertising and direct mailings) and interpersonal channels of communication impact the rate of adoption of an innovation?

Proposition 3a: Mass media channels are relatively more important at the knowledge function and interpersonal channels are relatively more important at the persuasion function in the decision to adopt SLR.

Discussion 3a: Our findings suggest that mass media channels are indeed important at the awareness stage. Websites, publications, and publicity materials do work to increase people's knowledge that IT-based SLRs exist, and mass media channels also provide some indication of what specific resources are available. Nevertheless, there continues to be an awareness problem. We were told that searching on the internet for SLRs often is not productive. Consequently, mass media promotion via the internet still needs work. However, our findings do show clearly that developers' demonstrations in one-on-one settings, through conferences and workshops and in on-site visits to universities, are key interpersonal channels for both awareness and for persuading faculty to try SLRs. It is primarily through personal demonstration and persuasion that

faculty members can observe how the materials work and how they might be useful to faculty in the classroom. These word-of-mouth or interpersonal channels serve as mechanisms for both knowledge awareness and persuasion in the adoption process.

Proposition 3b: Mass media channels are relatively more important for early adopters of SLR than for later adopters.

Discussion 3b: SLRs have not diffused sufficiently to compare early or late adopters with one another. In our study population, almost everyone can be classified as an early adopter of the materials.

Proposition 3c: Opinion leaders have greater exposure to mass media than followers.

Discussion 3c: We cannot say whether opinion leaders have greater exposure to mass media than followers based upon our study findings. We can state that opinion leaders in the academic community who use SLRs and publicize these materials using mass media channels have an influence on the adoption of the materials.

Research Question Four: How does the nature of the social system (network communication patterns) impact the rate of adoption of an innovation?

*Proposition 4*a: The degree of communication integration among faculty is positively related to the rate of adoption of innovations.

Discussion 4a: Developers who participate in a community of practice for the creation, sharing and use of SLRs do support one another and can accelerate adoption of resources, but this acceleration generally occurs within the community only and does not extend to a wider audience. Some of our respondents also suggested that smaller universities might have more integrated faculty networks that could speed adoption, however, we do not have any direct evidence of this pattern.

Proposition 4b: Opinion leaders in the educational system have greater social participation than their followers.

Proposition 4c: Early adopters seek information about innovations more than later adopters.

Discussion 4b and 4c: Based upon our study findings, we are unable to address these questions.

Research Question Five: How does a change agent (e.g. an educator who demonstrates or teaches others about the SLR) impact the rate of adoption?

Proposition 5a: Change agent success is positively related to the extent he or she works through opinion leaders.

Discussion 5a: In our study the change agents were almost always the SLR faculty developers themselves and took on the role of opinion leaders for promotion of SLRs at

conferences and workshops, such as the one we attended and observed that was co-sponsored by SME and the Greenfield Coalition.

Proposition 5b: Change agent success is positively related to the extent of change agent effort in contacting potential users of the SLR.

Discussion 5b: Our study findings strongly support the relationship between change agent effort and the successful adoption of SLRs. Faculty developers engage in multiple activities as change agents. They develop the materials, they publish articles in both the academic and professional press advocating the use of SLRs, and they conduct workshops and demonstration events, set up websites to promote and provide access to materials, and interact, one-one-one, with potential users of the SLRs. Clearly, in our study findings, those developers/change agents who expended enormous effort, and exhibited commitment and dedication to promoting their materials over many years have had the greatest success.

In our study of the diffusion of IT-based sharable learning resources we have learned about factors that help and hinder diffusion and what it needed for wider dissemination of the materials beyond what we have addressed in these research questions and propositions. First, if we examine IT-based shareable learning resources from the perspective of the dynamics of innovation, we can characterize SLRs as a technological and pedagogical product innovation, which is currently in a fluid phase of product development (Utterback 1996). A fluid innovation has no dominant design, has frequent and major product changes, the source of the innovation is pioneers who are product users, there are often diverse and customized product offerings, the product development processes and organizational processes that surround the product are often trial and error, and informal and entrepreneurial. SLRs are experimental, with assessments of their classroom value only just taking shape. We speculate that SLRs will remain in the fluid stage in the next three to five years. Technology needs to stabilize and standardize, and a critical mass of users needs to be in place that can clearly document classroom results before SLRs will move to the transitional phase and mainstream adoption in the engineering educational community. Centralization of SLRs in a commonly shared format is a primary component of this phase. Further development of a community of practice for SLRs can help foster mainstream adoption.

IT-based sharable learning resources, on the S-shaped curve of adoption, are still in the innovation stage (Rogers 2003). They are very early in the diffusion cycle in which the innovators who create these resources, and a few early adopters who are risk-takers, are the primary users of the materials. The SLR activity is still in the pre-market or research and development phase. A community of practice of innovative professors could help standardize these resources for easy distribution and use by others and help to push this innovation further along the diffusion curve, perhaps creating products with commercial potential. While many of the developers of SLR resources are designing their materials as “freeware” either because that is how they encourage others to use the materials or because the development of materials is funded by public agencies, some of the developers are attempting to sell the materials to industry or have negotiated with

publishers to include their materials in textbooks. One of the developers told us that to really achieve wider use of SLRs it would be necessary to treat them ". . . like a business. If you really want to get it out big time, work with the publishers."

With regard to cultural assumptions and values and their interplay with organizational structure and systems, as well as with the characteristics of developers, users and potential adopters, the rewards and recognition are fundamental to achieving change. It will take academic leadership and technical leadership to support and encourage the risk-taking involved in the paradigm shift required for the use of SLRs in engineering education. The use of SLRs and the scholarship of teaching both need to be visibly and tangibly rewarded in higher education in general and in engineering education, specifically, for adoption to accelerate.

We recommend that the following steps be taken to foster the development, sharing and use of SLRs:

1) *Establish an assessment and evaluation initiative* that can be used commonly on a widespread basis to document the impact of SLRs on learning in the classroom in the near term and the impact of this learning on the job in industry in the long term. Assessment that can provide data for the observable, positive impact of SLRs will go a long way to overcoming the extra effort or risk involved in adoption of these materials and can also help to increase their marketability. Demonstrating the pedagogical validity of SLRs would encourage the scholarship of teaching and could also promote the cultural change in the academic community which is necessary to achieve and sustain the wider diffusion of SLRs.

2) *Develop the commercial potential of SLRs.* Attracting the attention of commercial publishers can provide the impetus to standardize and more easily distribute materials developed by the innovative community of practice that currently exists. Commercial publishers are in the business of taking materials developed by one faculty member, including lecture notes, case studies and classroom exercises, and turning these materials into a textbook to share with other faculty. A community of practice, led by the innovative developers, could team up with commercial firms or publishers could create suites of SLR products that have been tested and standardized, and then serve as the primary diffusers of these products, or the "market-makers" for SLRs. However, a word of caution is necessary. Commercial firms, in their effort to corner markets, can create proprietary formats leading to more complexity, which can discourage adoption. The key to diffusion is standardization for ease of use.

3) *Promote the use of SLRs* outside academic institutions to professional industry organizations, associations and in industry. There is a wider market for SLRs that has educational needs that could be well-suited as adopters of materials developed in academic institutions. Sales of materials to these audiences can also provide capital to support development in university settings.

4) *Identify a core of academic leaders and institutions* who have sufficient credibility, and trust in the academic community as opinion leaders to work together on changing the reward and recognition system for tenure and promotion to include the scholarship of teaching and the sharing of education materials, and to develop a standardized process for sharing of intellectual property and SLRs. Currently, SLRs depend primarily on a single or a small handful of dedicated faculty members who use their own servers, housed at their universities, to develop SLRs and allow others to access and use them, leaving users vulnerable if these resources become inaccessible. Also, as demand for SLRs increases, the question will be how will a local university be compensated for the support of SLRs used by other universities?

5) *Align shareable learning resources with the cultural assumptions and values* of higher education by altering the reward and recognition system. In our interviews we heard about programs that are attempting to take steps to reward the scholarship of teaching and encourage the use of SLRS in the classroom. Realignment will help sanction risk taking in the classroom and provide incentive to change established teaching habits. Some of the specific actions that could be part of a reward and recognition system to promote SLRs include the following:

- Formal peer review of SLRs and awards for developers of original material
- Grants and awards to faculty members who add value by reconfiguring and using others materials in new contexts
- Recognition for simple adoption of materials developed by others when there is demonstrable and documented success in the classroom
- Inclusion of innovation in teaching as part of faculty professional development that is recognized in tenure and promotion
- Increasing visibility of awards and recognition in the academic community at professional conferences, and in publications

6) *Consider that community colleges and teaching universities* may be easier audiences to target for adoption because they do not have research as their highest priority. Faculty at these institutions may be more readily open to using SLRs.

7) *Target younger faculty members* who have grown up in the digital age as potential adopters. They are less likely to have an investment in teaching approaches and materials that they are unlikely to be willing to change. A complete package of course materials could also be attractive to this audience. However, these faculty members are less likely to have tenure and will be concerned about how much time they spend on their teaching at the expense of research and publication. A supportive environment is necessary for this diffusion strategy to work.

8) *Increase the number of demonstrations* to provide observability and trialability of materials for faculty first-hand through one-on-one personal contact, allowing them to experience how SLRS can enhance teaching and learning in their own classrooms. Faculty members are making optional decisions to adopt on an individual basis. These demonstrations are essential to persuasion given the decentralization and personal

autonomy in decision-making about classroom pedagogical approaches, methods and materials in academic institutions.

9) *Provide funding to universities* who wish to promote the use of SLRs to help defray their costs of experimentation and for technical support.

10) *Provide expeditious, reliable, and accessible technical support for faculty and student users of SLRs* in order to decrease the lack of adoption and lack of acceptance due to technical factors.

In conclusion, we would like to emphasize that to accelerate the diffusion of IT-based shareable learning resources in the engineering educational community these resources need to be understood as part of a system of education involving not just developers, faculty and students, but also the organizational structure and systems, including the academic and technological leadership and support systems, as well as the larger information technology environment, including commercial firms. Use of IT-resources to support classroom teaching and learning requires more often than not, a significant pedagogical shift which begins with a change in cultural assumptions and values in higher education that will take time to accomplish. It may be that SLRs will diffuse more quickly in industry than in academe because the infrastructure in industry is more standardized and stable, and because the decision can be a corporate authoritative decision mandated for technical proficiency, rather than an optional decision made by individual faculty members for selected classes. It may also require the investment of commercial interests to provide the economic impetus to achieve the widespread diffusion of SLRs.

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Appendices

A. Interview Protocols

Interview Protocol: Potential Faculty Adopters
Greenfield Shareable Learning Resources Diffusion Study

Introduction

My name is _____. Thank you for taking the time to talk with us today. This interview is part of a National Science Foundation study to investigate the diffusion of information technology based shareable learning resources in the practice of engineering education. These are IT-based applications and tools for educational use that can be shared.

Our goal is to develop a diffusion toolkit for the educational community to help plan, monitor, evaluate and manage the diffusion of shareable learning resources.

We are talking with you because you are a member of the engineering educational community.

Your responses to our questions will be kept anonymous and confidential. Only our interview team will have access to this information. Our final report will include only summary statements and statistics and no individual will be identified by name. Do you have any questions about the study?

If it is okay with you, we would like to tape record the interview to help us in writing our report. Please feel free to ask us to turn off the tape recorder at any time during the interview if you feel it necessary.

Now, let's begin.

1. What is your position?

2. Have you, or do you now, use any IT-based shareable learning resources to teach engineering concepts or skills?
   1. Yes
      2a. Please explain.
   2. No
      2b. Please explain.

   [If "No" skip to question 5 at the top of page 4.]

3. How did you learn about these educational materials?

4. What are the objectives of these educational materials?
   4a. What makes these materials unique?
   4b. How are intellectual property issues handled?
   4c. What assumptions have been made about knowledge in the development of these IT-based educational materials, for example, how knowledge is created, and transferred?

5. What do you believe are the factors that do lead, or will lead to, the use of the shareable learning resources in the classroom?
   5a. Are there any rewards or incentives for faculty to use the shareable learning resources in the classroom?

6. What do you see as barriers to the use of shareable learning resources in the classroom?

7. What do you believe needs to happen to achieve wider use of shareable learning resource materials?

8. What do you need to help you plan, monitor, evaluate and manage the use of the shareable learning resources?

9. Is there anything that you would like to add that we haven't covered in this interview but that you believe is relevant?

10. Who else do you think we should talk with about the dissemination of IT-based shareable learning resources in general?

Now to conclude the interview I would like to gather some demographic information from you, please.

D01. Audience
   1. WSU Greenfield Developers
   2. Other Greenfield Developers
   3. Other Developers of SLR
   4. Greenfield Faculty
   5. Other Faculty
   6. Greenfield Staff
   7. Greenfield Students
   8. Potential Faculty Adopters
   9. Engineering Department Chairmen
   10. Other _____

D02. Faculty Status:
1. Adjunct
2. Lecturer
3. Assistant Professor
4. Associate Professor
5. Professor
6. Other
7. Not Applicable

D03. Tenure
1. Yes
2. No
3. Not Applicable

D03. Department Chair
1. Yes
2. No
3. Not Applicable

D04. Educational Institution:

1. Wayne State University
2. Lawrence Technological University
3. Lehigh University
4. Michigan State University
5. University of Detroit Mercy
6. Other _____
7. Not Applicable

D05. Years of University Teaching: _____
-1. Not Applicable

D06. Have you ever held an engineering position in industry?
1. Yes
   D06a. If yes, for how many years? _____
2. No
3. Not Applicable

D07. Gender
1. Male
2. Female

D08. Student Status
1. Freshman
2. Sophomore
3. Junior
4. Senior
5. Not Applicable

D09. Greenfield Staff
1. Developer
2. Instructional Designer
3. Technical Expert
4. Administration
5. Consultant
6. Other _____
7. Not Applicable

D10. Age (Interviewer estimate)
1. 21 or Under
2. 22 to 35
3. 36 to 55
4. 56 or older

Interviewer _____

Length of Interview _____

Interview Protocol: Greenfield Staff
Greenfield Shareable Learning Resources Diffusion Study

Introduction

My name is _____. Thank you for taking the time to talk with us today. This interview is part of a National Science Foundation study to investigate the diffusion of information technology based shareable learning resources in the practice of engineering education. Our goal is to develop a diffusion toolkit for the educational community to help plan, monitor, evaluate and manage the diffusion of shareable learning resources.

We are talking with you because you have been involved in the creation and deployment of the Greenfield Coalition engineering educational materials.

Your responses to our questions will be kept anonymous and confidential. Only our interview team will have access to this information. Our final report will include only summary statements and statistics and no individual will be identified by name. Do you have any questions about the study?

If it is okay with you, we would like to tape record the interview to help us in writing our report. Please feel free to ask us to turn off the tape recorder at any time during the interview if you feel it necessary.

Now, let's begin.

1. What is your position?

2. Could you please describe your role or involvement in the development and use of the Greenfield educational materials?

3. What were the objectives you were trying to achieve in the development of the materials?
   3a. What makes the Greenfield materials unique?
   3b. How has Greenfield handled intellectual property issues?
   3c. What assumptions have been made about knowledge in the development of the Greenfield materials, for example, how knowledge is created, and transferred?

Next, I'd like to turn to the factors that may have helped or hindered the development of the Greenfield materials.

4. First, can you describe the factors that helped the development of the materials?

5. Now, can you describe the factors that hindered the development of the materials?

6. What do you believe are the factors that do lead, or will lead to, the use of the materials in the classroom?
   6a. Are there any rewards or incentives for the faculty to use the shareable learning resources in the classroom?

7. What do you see as barriers to the use of the materials in the classroom?
   7a. What is the technical infrastructure required to support the shareable learning resources?
   7b. What kind of technical support is available to the faculty?
   7c. What kind of technical support is available to the students?

8. How have the materials been promoted within the Greenfield Coalition?
   8a. With what results?

Now I'd like ask you some questions about your communication regarding Greenfield educational materials. Specifically, I'd like to explore how Greenfield materials are being disseminated within the engineering educational community or to others.

9. With whom do you talk about promoting or disseminating Greenfield educational materials? First, please provide me with names and organizational affiliations.

   Now tell me how often you talk with each person [interviewer read names].

Name	Organization	Frequency of Communication

10. How does Greenfield being the originator of the materials affect the acceptance of the materials by the engineering educational community?

11. How have the materials been promoted outside the Greenfield Coalition?
    11a. With what results?

12. What do you believe needs to happen to achieve wider use of these materials?

13. Who else do you think we should talk with about the dissemination of Greenfield materials?

Finally, I'd like to ask you about shareable learning resources that have been developed by others outside the Greenfield Coalition.

14. Who do you know of, outside the Greenfield Coalition, who has developed shareable learning resources?
    14a. What do you know about these materials?
    14b. What is your opinion about these materials?
    14c. Who uses these materials?
    14d. Why do they use these materials?

15. What do you need to help you plan, monitor, evaluate and manage the use of the materials?

16. Is there anything that you would like to add that we haven't covered in this interview but that you believe is relevant?

17. Who else do you think we should talk with about the dissemination of Greenfield materials?

Now to conclude the interview I would like to gather some demographic information from you, please.

D01. Audience
1. WSU Greenfield Developers
2. Other Greenfield Developers
3. Other Developers of SLR
4. Greenfield Faculty
5. Other Faculty
6. Greenfield Staff
7. Greenfield Students
8. Potential Faculty Adopters
9. Engineering Department Chairmen
10. Other _____

D02. Faculty Status:
1. Adjunct
2. Lecturer
3. Assistant Professor
4. Associate Professor
5. Professor
6. Other
7. Not Applicable

D03. Tenure
1. Yes
2. No
3. Not Applicable

D03. Department Chair
1. Yes
2. No
3. Not Applicable

D04. Educational Institution:
1. Wayne State University
2. Lawrence Technological University
3. Lehigh University
4. Michigan State University
5. University of Detroit Mercy
6. Other _____
7. Not Applicable

D05. Years of University Teaching: _____
-1. Not Applicable

D06. Have you ever held an engineering position in industry?
1. Yes
   D06a. If yes, for how many years? _____
2. No
3. Not Applicable

D07. Gender
1. Male
2. Female

D08. Student Status
1. Freshman
2. Sophomore
3. Junior
4. Senior
5. Not Applicable

D09. Greenfield Staff
1. Developer
2. Instructional Designer
3. Technical Expert
4. Administration
5. Consultant
6. Other _____
8. Not Applicable

D10. Age (Interviewer estimate)
5. 21 or Under
6. 22 to 35
7. 36 to 55
8. 56 or older

Interviewer _____
Length of Interview _____

Interview Protocol: Greenfield Faculty
Greenfield Shareable Learning Resources Diffusion Study

Introduction

My name is _____. Thank you for taking the time to talk with us today. This interview is part of a National Science Foundation study to investigate the diffusion of information technology based shareable learning resources in the practice of engineering education. Our goal is to develop a diffusion toolkit for the educational community to help plan, monitor, evaluate and manage the diffusion of shareable learning resources.

We are talking with you because you have been involved in the creation and/or deployment of the Greenfield Coalition engineering educational materials.

Your responses to our questions will be kept anonymous and confidential. Only our interview team will have access to this information. Our final report will include only summary statements and statistics and no individual will be identified by name. Do you have any questions about the study?

If it is okay with you, we would like to tape record the interview to help us in writing our report. Please feel free to ask us to turn off the tape recorder at any time during the interview if you feel it necessary.

Now, let's begin.

1. What is your position?

2. Could you please describe your role or involvement in the development and use of the Greenfield educational materials?

3. What are the objectives of the Greenfield educational materials?
   3a. What makes the Greenfield materials unique?
   3b. How has Greenfield handled intellectual property issues?
   3c. What assumptions have been made about knowledge in the development of the Greenfield materials, for example, how knowledge is created, and transferred?

Next, I'd like to turn to the factors that may have helped or hindered the use of the Greenfield materials in the classroom.

4. First, what do you believe are the factors that lead to the use of the materials in the classroom?

5. Now, what do you as barriers to the use of the materials in the classroom?

6. Are there any rewards or incentives for the faculty to use the shareable learning resources in the classroom?

7. What is the technical infrastructure required to support the shareable learning resources?
   7a. What kind of technical support is available to the faculty?
   7c. What kind of technical support is available to the students?

8. How have the materials been promoted within the Greenfield Coalition?
   8a. With what results?

Now I'd like ask you some questions about your communication regarding Greenfield educational materials. Specifically, I'd like to explore how Greenfield materials are being disseminated within the engineering educational community or to others.

9. With whom do you talk about promoting or disseminating Greenfield educational materials? First, please provide me with names and organizational affiliations.

   Now tell me how often you talk with each person [interviewer read names].

Name	Organization	Frequency of Communication

10. How does Greenfield being the originator of the materials affect the acceptance of the materials by the engineering educational community?

11. How have the materials been promoted outside the Greenfield Coalition?
    11a. With what results?

12. What do you believe needs to happen to achieve wider use of these materials?

Finally, I'd like to ask you about shareable learning resources that have been developed by others outside the Greenfield Coalition.

13. Who do you know of, outside the Greenfield Coalition, who has developed shareable learning resources?
    13a. What do you know about these materials?
    13b. What is your opinion about these materials?
    13c. Who uses these materials?
    13d. Why do they use these materials?

14. What do you need to help you plan, monitor, evaluate and manage the use of the materials?

15. Is there anything that you would like to add that we haven't covered in this interview but that you believe is relevant?

16. Who else do you think we should talk with about the dissemination of Greenfield materials?

Now to conclude the interview I would like to gather some demographic information from you, please.

D01. Audience
1. WSU Greenfield Developers
2. Other Greenfield Developers
3. Other Developers of SLR
4. Greenfield Faculty
5. Other Faculty
6. Greenfield Staff
7. Greenfield Students
8. Potential Faculty Adopters
9. Engineering Department Chairmen
10. Other _____

D02. Faculty Status:
1. Adjunct
2. Lecturer
3. Assistant Professor
4. Associate Professor
5. Professor
6. Other
7. Not Applicable

D03. Tenure
1. Yes
2. No
3. Not Applicable

D03. Department Chair
1. Yes
2. No
3. Not Applicable

D04. Educational Institution:
1. Wayne State University
2. Lawrence Technological University
3. Lehigh University
4. Michigan State University
5. University of Detroit Mercy
6. Other _____
7. Not Applicable

D05. Years of University Teaching: _____
-1. Not Applicable

D06. Have you ever held an engineering position in industry?
1. Yes
   D06a. If yes, for how many years? _____
2. No
3. Not Applicable

D07. Gender
1. Male
2. Female

D08. Student Status
1. Freshman
2. Sophomore
3. Junior
4. Senior
5. Not Applicable

D09. Greenfield Staff
1. Developer
2. Instructional Designer
3. Technical Expert
4. Administration
5. Consultant
6. Other _____
7. Not Applicable

D10. Age (Interviewer estimate)
1. 21 or Under
2. 22 to 35
3. 36 to 55
4. 56 or older

Interviewer _____

Length of Interview _____

Interview Protocol: Other Developers of SLR
Greenfield Shareable Learning Resources Diffusion Study

Introduction

My name is _____. Thank you for taking the time to talk with us today. This interview is part of a National Science Foundation study to investigate the diffusion of information technology based shareable learning resources in the practice of engineering education. Our goal is to develop a diffusion toolkit for the educational community to help plan, monitor, evaluate and manage the diffusion of shareable learning resources.

We are talking with you because you have been involved in the creation and deployment of shareable learning resources for engineering education.

Your responses to our questions will be kept anonymous and confidential. Only our interview team will have access to this information. Our final report will include only summary statements and statistics and no individual will be identified by name. Do you have any questions about the study?

If it is okay with you, we would like to tape record the interview to help us in writing our report. Please feel free to ask us to turn off the tape recorder at any time during the interview if you feel it necessary.

Now, let's begin.

1. What is your position?

2. Could you please describe your role or involvement in the development and use of the shareable learning resources?

3. What were the objectives you were trying to achieve in the development of the materials?
   3a. What makes these materials unique?
   3b. How have intellectual property issues been handled?
   3c. What assumptions have been made about knowledge in the development of the shareable learning resource materials, for example, how knowledge is created, and transferred?

Next, I'd like to turn to the factors that may have helped or hindered the development of the shareable learning resource materials.

4. First, can you describe the factors that helped the development of the materials?

5. Now, can you describe the factors that hindered the development of the materials?

6. In the classroom, do you use any of the shareable learning resource materials that you helped develop?
   1. Yes
   6a. Why?
   2. No
   6b. Why not?

7. In the classroom, do you use any shareable learning resources developed by others?
   1. Yes
   7a. Why?
   2. No
   7b. Why not?

8. What do you believe are the factors that do lead, or will lead to, the use of the shareable learning resource materials in the classroom?
   8a. Are there any rewards or incentives for the faculty to use the shareable learning resources in the classroom?

9. What do you see as barriers to the use of the materials in the classroom?
   9a. What is the technical infrastructure required to support the shareable learning resources?
   9b. What kind of technical support is available to the faculty?
   9c. What kind of technical support is available to the students?

10. How have the materials been promoted?
    10a. With what results?

Now I'd like ask you some questions about your communication regarding shareable learning resource educational materials. Specifically, I'd like to explore how these materials are being disseminated within the engineering educational community or to others.

11. With whom do you talk about promoting or disseminating shareable learning resource educational materials? First, please provide me with names and organizational affiliations.

    Now tell me how often you talk with each person [interviewer read names].

Name	Organization	Frequency of Communication

12. How does _____ [fill in name as appropriate] being the originator of the materials affect the acceptance of the materials by the engineering educational community?

13. What do you believe needs to happen to achieve wider use of these materials?

14. Who else do you think we should talk with about the dissemination of shareable learning resource materials?

15. What do you need to help you plan, monitor, evaluate and manage the use of the materials?

16. Is there anything that you would like to add that we haven't covered in this interview but that you believe is relevant?

Now to conclude the interview I would like to gather some demographic information from you, please.

D01. Audience
1. WSU Greenfield Developers
2. Other Greenfield Developers
3. Other Developers of SLR
4. Greenfield Faculty
5. Other Faculty
6. Greenfield Staff
7. Greenfield Students
8. Potential Faculty Adopters
9. Engineering Department Chairmen
10. Other _____

D02. Faculty Status:
1. Adjunct
2. Lecturer
3. Assistant Professor
4. Associate Professor
5. Professor
6. Other
7. Not Applicable

D03. Tenure
1. Yes
2. No
3. Not Applicable

D03. Department Chair
1. Yes
2. No
3. Not Applicable

D04. Educational Institution:
1. Wayne State University
2. Lawrence Technological University
3. Lehigh University
4. Michigan State University
5. University of Detroit Mercy
6. Other _____
7. Not Applicable

D05. Years of University Teaching: _____
-1. Not Applicable

D06. Have you ever held an engineering position in industry?
1. Yes
   D06a. If yes, for how many years? _____
2. No
3. Not Applicable

D07. Gender
1. Male
2. Female

D08. Student Status
1. Freshman
2. Sophomore
3. Junior
4. Senior
5. Not Applicable

D09. Greenfield Staff
1. Developer
2. Instructional Designer
3. Technical Expert
4. Administration
5. Consultant
6. Other _____
7. Not Applicable

D10. Age (Interviewer estimate)
1. 21 or Under
2. 22 to 35
3. 36 to 55
4. 56 or older

Interviewer _____
Length of Interview _____

Interview Protocol: Greenfield Faculty Developers
Greenfield Shareable Learning Resources Diffusion Study

Introduction

My name is _____. Thank you for taking the time to talk with us today. This interview is part of a National Science Foundation study to investigate the diffusion of information technology based shareable learning resources in the practice of engineering education. Our goal is to develop a diffusion toolkit for the educational community to help plan, monitor, evaluate and manage the diffusion of shareable learning resources.

We are talking with you because you have been involved in the creation and deployment of the Greenfield Coalition engineering educational materials.

Your responses to our questions will be kept anonymous and confidential. Only our interview team will have access to this information. Our final report will include only summary statements and statistics and no individual will be identified by name. Do you have any questions about the study?

If it is okay with you, we would like to tape record the interview to help us in writing our report. Please feel free to ask us to turn off the tape recorder at any time during the interview if you feel it necessary.

Now, let's begin.

1. What is your position?

2. Could you please describe your role or involvement in the development and use of the Greenfield educational materials?

3. What were the objectives you were trying to achieve in the development of the materials?
   3a. What makes the Greenfield materials unique?
   3b. How has Greenfield handled intellectual property issues?
   3c. What assumptions have been made about knowledge in the development of the Greenfield materials, for example, how knowledge is crated, and transferred?

Next, I'd like to turn to the factors that may have helped or hindered the development of the Greenfield materials.

4. First, can you describe the factors that helped the development of the materials?

5. Now, can you describe the factors that hindered the development of the materials?

6. In the classroom, do you use any of the Greenfield materials that you helped develop?
   1. Yes
   6a. Why?
   2. No
   6b. Why not?

7. In the classroom, do you use any shareable learning resources developed by others outside the Greenfield coalition?
   1. Yes
   7a. Why?
   2. No
   7b. Why not?

8. What do you believe are the factors that do lead, or will lead to, the use of the materials in the classroom?
   8a. Are there any rewards or incentives for the faculty to use the shareable learning resources in the classroom?

9. What do you see as barriers to the use of the materials in the classroom?
   9a. What is the technical infrastructure required to support the shareable learning resources?
   9b. What kind of technical support is available to the faculty?
   9c. What kind of technical support is available to the students?

10. How have the materials been promoted *within* the Greenfield Coalition?
    10a. With what results?

Now I'd like ask you some questions about your communication regarding Greenfield educational materials. Specifically, I'd like to explore how Greenfield materials are being disseminated within the engineering educational community or to others.

11. With whom do you talk about promoting or disseminating Greenfield educational materials? First, please provide me with names and organizational affiliations.

Now tell me how often you talk with each person [interviewer read names].

Name	Organization	Frequency of Communication

12. How does Greenfield being the originator of the materials affect the acceptance of the materials by the engineering educational community?

13. How have the materials been promoted *outside* the Greenfield Coalition?
    13a. With what results?

14. What do you believe needs to happen to achieve wider use of these materials?

15. Who else do you think we should talk with about the dissemination of Greenfield materials?

Finally, I'd like to ask you about shareable learning resources that have been developed by others outside the Greenfield Coalition.

16. Who do you know of, outside the Greenfield Coalition, who has developed shareable learning resources?
    16a. What do you know about these materials?
    16b. What is your opinion about these materials?
    16c. Who uses these materials?
    16d. Why do they use these materials?

17. What do you need to help you plan, monitor, evaluate and manage the use of the materials?

18. Is there anything that you would like to add that we haven't covered in this interview but that you believe is relevant?

19. Who else do you think we should talk with about the dissemination of shareable learning resources in general?

Now to conclude the interview I would like to gather some demographic information from you, please.

D01. Audience
1. WSU Greenfield Developers
2. Other Greenfield Developers
3. Other Developers of SLR
4. Greenfield Faculty
5. Other Faculty
6. Greenfield Staff
7. Greenfield Students
8. Potential Faculty Adopters
9. Engineering Department Chairmen
10. Other _____

D02. Faculty Status:
1. Adjunct
2. Lecturer
3. Assistant Professor
4. Associate Professor
5. Professor
6. Other
7. Not Applicable

D03. Tenure
1. Yes
2. No
3. Not Applicable

D03. Department Chair
1. Yes
2. No
3. Not Applicable

D04. Educational Institution:
1. Wayne State University
2. Lawrence Technological University
3. Lehigh University
4. Michigan State University
5. University of Detroit Mercy
6. Other _____
7. Not Applicable

D05. Years of University Teaching: _____
-1. Not Applicable

D06. Have you ever held an engineering position in industry?
1. Yes
   D06a. If yes, for how many years? _____
2. No
3. Not Applicable

D07. Gender
1. Male
2. Female

D08. Student Status
1. Freshman
2. Sophomore
3. Junior
4. Senior
5. Not Applicable

D09. Greenfield Staff
1. Developer
2. Instructional Designer
3. Technical Expert
4. Administration
5. Consultant
6. Other _____
7. Not Applicable

D10. Age (Interviewer estimate)
1. 21 or Under
2. 22 to 35
3. 36 to 55
4. 56 or older

Interviewer _____

Length of Interview _____

Interview Protocol: Non-Greenfield Faculty Users of Greenfield Materials
Greenfield Shareable Learning Resources Diffusion Study

Introduction

My name is _____. Thank you for taking the time to talk with us today. This interview is part of a National Science Foundation study to investigate the diffusion of information technology based shareable learning resources in the practice of engineering education. Our goal is to develop a diffusion toolkit for the educational community to help plan, monitor, evaluate and manage the diffusion of shareable learning resources.

We are talking with you because you are using the Greenfield Coalition engineering educational materials.

Your responses to our questions will be kept anonymous and confidential. Only our interview team will have access to this information. Our final report will include only summary statements and statistics and no individual will be identified by name. Do you have any questions about the study?

If it is okay with you, we would like to tape record the interview to help us in writing our report. Please feel free to ask us to turn off the tape recorder at any time during the interview if you feel it necessary.

Now, let's begin.

1. What is your position?

2. How did you learn about Greenfield educational materials?

3. What are the objectives of the Greenfield educational materials?
   3a. What makes the Greenfield materials unique?
   3b. How has Greenfield handled intellectual property issues?
   3c. What assumptions have been made about knowledge in the development of the Greenfield materials, for example, how knowledge is created, and transferred?

4. In the classroom, do you use any shareable learning resources developed by others outside the Greenfield coalition?
   1. Yes
   4a. Why?
   2. No
   4b. Why not?

5. What do you believe are the factors that do lead, or will lead to, the use of the Greenfield shareable learning resources in the classroom?
   5a. Are there any rewards or incentives for the faculty to use the shareable learning resources in the classroom?

6. What do you see as barriers to the use of Greenfield shareable learning resources in the classroom?
   6a. What is the technical infrastructure required to support the shareable learning resources?
   6b. What kind of technical support is available to the faculty?
   6c. What kind of technical support is available to the students?

Now I'd like ask you some questions about your communication regarding Greenfield educational materials. Specifically, I'd like to explore how Greenfield materials are being disseminated within the engineering educational community or to others.

7. With whom do you talk about Greenfield educational materials? First, please provide me with names and organizational affiliations.

   Now tell me how often you talk with each person [interviewer read names].

Name	Organization	Frequency of Communication

8. How does Greenfield being the originator of the materials affect the acceptance of the materials by the engineering educational community?

9. What do you believe needs to happen to achieve wider use of Greenfield shareable learning resource materials?

10. Who else do you think we should talk with about the dissemination of Greenfield materials?

Finally, I'd like to ask you about shareable learning resources that have been developed by others outside the Greenfield Coalition.

11. Who do you know of, outside the Greenfield Coalition, who has developed shareable learning resources?
    11a. What do you know about these materials?
    11b. What is your opinion about these materials?
    11c. Who uses these materials?
    11d. Why do they use these materials?

12. What do you need to help you plan, monitor, evaluate and manage the use of the shareable learning resources?

13. Is there anything that you would like to add that we haven't covered in this interview but that you believe is relevant?

14. Who else do you think we should talk with about the dissemination of shareable learning resources in general?

Now to conclude the interview I would like to gather some demographic information from you, please.

D01. Audience
1. WSU Greenfield Developers
2. Other Greenfield Developers
3. Other Developers of SLR
4. Greenfield Faculty
5. Other Faculty
6. Greenfield Staff
7. Greenfield Students
8. Potential Faculty Adopters
9. Engineering Department Chairmen
10. Other _____

D02. Faculty Status:
1. Adjunct
2. Lecturer
3. Assistant Professor
4. Associate Professor
5. Professor
6. Other
7. Not Applicable

D03. Tenure
1. Yes
2. No
3. Not Applicable

D03. Department Chair
1. Yes
2. No
3. Not Applicable

D04. Educational Institution:
1. Wayne State University
2. Lawrence Technological University
3. Lehigh University
4. Michigan State University
5. University of Detroit Mercy
6. Other _____
7. Not Applicable

D05. Years of University Teaching: _____
-1. Not Applicable

D06. Have you ever held an engineering position in industry?
1. Yes
   D06a. If yes, for how many years? _____
2. No
3. Not Applicable

D07. Gender
1. Male
2. Female

D08. Student Status
1. Freshman
2. Sophomore
3. Junior
4. Senior
5. Not Applicable

D09. Greenfield Staff
1. Developer
2. Instructional Designer
3. Technical Expert
4. Administration
5. Consultant
6. Other _____
7. Not Applicable

D10. Age (Interviewer estimate)
1. 21 or Under
2. 22 to 35
3. 36 to 55
4. 56 or older

Interviewer _____
Length of Interview _____

Interview Protocol: NEEDS
Greenfield Shareable Learning Resources Diffusion Study

Introduction

Thank you for taking the time to talk with us today. This interview is part of a National Science Foundation study to investigate the diffusion of information technology based shareable learning resources in the practice of engineering education. Our goal is to develop a diffusion toolkit for the educational community to help plan, monitor, evaluate and manage the diffusion of shareable learning resources.

Don Falkenburg recommended we talk with you because you have been a leader in this area and with the NEEDS program in particular.

Your responses to our questions will be kept anonymous and confidential. Only our interview team will have access to this information. Our final report will include only summary statements and statistics and no individual will be identified by name. Do you have any questions about the study?

If it is okay with you, we would like to tape record the interview to help us in writing our report. Please feel free to ask us to turn off the tape recorder at any time during the interview if you feel it necessary.

Now, let's begin.

1. Could you please describe your role or involvement in the development and use of IT-based shareable learning resources for engineering education?

2. What were the objectives you were trying to achieve in the development of the materials?
   2a. What makes these materials unique?
   2b. How have you handled intellectual property issues?
   2c. What assumptions have been made about knowledge in the development of the materials, for example, how knowledge is created, and transferred?

3. Do you, yourself, use any IT-based resources in the classroom?
   1= Yes
   3a. Why?
   2=No
   3b. Why not?

4. What do you believe are the factors that will lead to the use of IT-based shareable learning resources in the classroom?
   4a. Are there any rewards or incentives for the faculty to use the shareable learning resources in the classroom?

5. What do you see as barriers to the use of IT-based shareable learning resources in the classroom?

6. What do you believe needs to happen to achieve wider use of these materials?

7. What was done to promote or disseminate the NEEDS materials to the engineering education community?
   7a. What worked well?
   7b. What didn't work?

8. What would you do differently if you had it to do it all over again?

9. Is there anything that you would like to add that we haven't covered in this interview but that you believe is relevant to diffusion of IT-based shareable learning resources?

Now to conclude the interview I would like to gather some demographic information from you, please.

D01. Audience
1. WSU Greenfield Developers
2. Other Greenfield Developers
3. Other Developers of SLR
4. Greenfield Faculty
5. Other Faculty
6. Greenfield Staff
7. Greenfield Students
8. Potential Faculty Adopters
9. Engineering Department Chairmen
10. Other _____

D02. Faculty Status:
1. Adjunct
2. Lecturer
3. Assistant Professor
4. Associate Professor
5. Professor
6. Other
7. Not Applicable

D03. Tenure
1. Yes
2. No
3. Not Applicable

D03. Department Chair
1. Yes
2. No
3. Not Applicable

D04. Educational Institution:
1. Wayne State University
2. Lawrence Technological University
3. Lehigh University
4. Michigan State University
5. University of Detroit Mercy
6. Other _____
7. Not Applicable

D05. Years of University Teaching: _____
-1. Not Applicable

D06. Have you ever held an engineering position in industry?
1. Yes
   D06a. If yes, for how many years? _____
2. No
3. Not Applicable

D07. Gender
1. Male
2. Female

D08. Student Status
1. Freshman
2. Sophomore
3. Junior
4. Senior
5. Not Applicable

D09. Greenfield Staff
1. Developer
2. Instructional Designer
3. Technical Expert
4. Administration
5. Consultant
6. Other _____
7. Not Applicable

D10. Age
1. 21 or Under
2. 22 to 35
3. 36 to 55
4. 56 or older

Interviewer _____

Length of Interview _____

B. Workshop Evaluation Report and Form

Report of Findings
SME / Greenfield Coalition Workshop on Learning Resources
June 4 – 5, 2004

Evaluation of IT-Enabled Learning Resources

Based on a response rate of N=21.

1. Based upon today's presentation regarding web-based, information technology enabled learning resources, how likely are you to use these resources in the classroom within the next year for manufacturing engineering education?

1	2	3	4	5	6
Will Definitely Use	Very Likely to Use	Somewhat Likely to Use	Not At All Likely to Use	Will Not Use	Don't Know
N=8 38.1%	N=7 33.2%	N=3 14.3%	N=0 0%	N=2 9.5%	N=1 4.8%

Please tell us why you rated this question as you did?

Q1 Rating #, Comment

1 No Comment

1 This the way to teach.
--Methodology of the Future!!!

1 I am a developer and like the approach

1 -Forming one was awesome!
-Overall, I enjoyed this workshop a lot.
-Thank you.

1 I also develop courses

1 Because I believe these materials provide the best learning resources for the students.

1 Learned from Greenfield course development experience the importance of these

1 I really enjoyed!

2 Very good materials and well organized

2 I'm already a "convert". Have to adapt to electrical telecom, aeronautical engineering, and IT programs in an institution to which I've just moved this month . . . so it's a "2" instead of a "1".

2 Same as yesterday.

2 Limitations on manufacturing engineers.
Use a great deal of web classroom and case study.

2 I find these things useful but not always specific enough for my applications

2 Have been thinking for years that this is the way engineering programs and the courses must be taught

2 I think this method can give more information to student.

3 It's a good try to have some web-based resources to aid the regular class, but it still can not replace it. So, I would like to try, but not sure in the next step, depending on student reaction and resources available in the school.

3 I'm not directly related to the topics that discussed today.

3 I need to get into the System and find out the topics (modules) that relate to the courses I normally teach. It seems very useful.

5 I don't teach any courses for which these materials would be appropriate.

5 No Comment

6 Would definitely use, if I could access it with my Macintosh computer.

2. If you are not planning to use IT-enabled learning materials in the next year, what would it take for you to be willing to use them in the future?

a. Computer expert/webmaster assigned as assistant for the course.

b. Good GTA

c. GTA Assurance

d. I use IT-enabled learning materials in my machine design class. I'll check out the possibilities in using it for my manufacturing class.

e. Time

f. Time

g. To understand fully, through trials, the skills I need to have myself in order to use the above

3. What additional information would help you or others decide to use these educational materials in the classroom?

* Availability
Curricular fit.
User - friendliness
Tech - platform compatibility

* Ease of Access
Stability of modules on multiple platforms

* How to find real world problem

* If I could access it with my Macintosh computer.
* I'm not sure yet but I'll definitely check out the rest of the modules. The material seems ready for use.
* In case stories Nuggets
* Interaction with the case writers.
* More publicity. Got to learn about Greenfield recently. Presentations similar to today's through national conferences will help to get the message.
* More useful & practical materials
* Provide us with more real world examples and case studies in engineering or technology related subjects.
  All materials must be easy to access and use.
* Step-by-step procedures or guidelines as to how to actually use the resources.
* There seems to be enough info now
* To add more courses (Materials)

4. Would you like one of the members of the Greenfield Coalition to contact you about IT-enabled learning resources?

	Count	Percent
No	8	38.1%
Yes	13	61.9%
Total	21	100.0%

Thank you for your interest and your time!

SME / Greenfield Coalition Workshop on Learning Resources
June 4 – 5, 2004

Evaluation of IT-Enabled Learning Resources

5. Based upon today's presentation regarding web-based, information technology enabled learning resources, how likely are you to use these resources in the classroom within the next year for manufacturing engineering education?

1	2	3	4	5	6
Will Definitely Use	Very Likely to Use	Somewhat Likely to Use	Not At All Likely to Use	Will Not Use	Don't Know

Please tell us why you rated this question as you did?

6. If you are not planning to use IT-enabled learning materials in the next year, what would it take for you to be willing to use them in the future?

7. What additional information would help you or others decide to use these educational materials in the classroom?

8. Would you like one of the members of the Greenfield Coalition to contact you about IT-enabled learning resources?

   No _____

   Yes _____

   Name: _____

   Institution: _____

   Department: _____

   Phone: _____

   Email: _____

9. Who else do you know who might be interested in learning about web-based, information technology enabled learning resources for manufacturing engineering education? Please list names and institutional affiliations

Name_____ Institution _____

Name_____ Institution _____

Name_____ Institution _____

Name_____ Institution _____

Name_____ Institution _____

Name_____ Institution _____

Name_____ Institution _____

Thank you for your interest and your time!

C. Professional Biographies

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Research Manager
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Professional Preparation
University of Michigan, Ann Arbor, MI. English and Anthropology. B.A. with honors. 2000
Wayne State University, Detroit, MI. Anthropology. M.A. 2002

Appointments
Research Manager, Institute for Information Technology and Culture, Detroit, MI. Wayne State University. 2002-Present.

Research Technician, Institute for Information Technology and Culture, Detroit, MI. Wayne State University. Spring 2000 and Summer 2002.

Graduate Research Assistant. Institute for Information Technology and Culture, Detroit, MI. Wayne State University. Fall 2000- Winter 2002.

Research Technician. Merrill-Palmer Institute, Detroit, MI. Wayne State University. Summer 2002-Present.

Intern. Milliken and Company, Spartanburg, SC. Summer 2001.

Research Technician & Data Manager. Department of Anthropology, University of Michigan, Ann Arbor, MI. Summer 2000.

Research Assistant. Department of Anthropology, University of Michigan, Ann Arbor, MI. 1997-2000.

Website Editor and Intern. Welcome Information Services, Detroit, Michigan. Summer 1999.

Mathematics and Reading Tutor. America Reads Program, University of Michigan, Ann Arbor, MI. 1997-1998.

Conversational English Tutor. HALLA Mando Machinery Corp, Ann Arbor, MI. 1997-1998.

Editorial Assistant. Hayden-McNeil Publishing, Plymouth, MI. Summer 1997.

Publications

Gluesing, J., T. Alcordo, M. Baba, D. Britt, W. McKether, L. Monplaisir, H. Ratner, and K. Riopelle, K. Harris Wagner. 2003. "The Development of Global Virtual Teams." *In* Cohen, S. & C. Gibson (Eds), Creating Conditions for Effective Virtual Teams. San Francisco: Jossey-Bass.

Riopelle, K., J. Gluesing, T. Alcordo, M. Baba, D. Britt, W., McKether, L. Monplaisir, H. Ratner, K. Harris Wagner. 2003. *In* Cohen, S. & C. Gibson (Eds), Creating Conditions for Effective Virtual Teams. San Francisco: Jossey-Bass.

Synergistic Activities

Training Video Producer – As a research technician at the Merrill-Palmer Institute, worked to organize and produce the first in a series of training videos for the Reggio Emelia Staff Development Project, whose goal is to familiarize American teachers with the teaching and learning methodology originating in the children's school system of Reggio Emelia, Italy.

Graduate Research Assistant – NSF IOC Program Grant to Wayne State University, in collaboration with Ford Motor Co., Milliken, Motorola and Procter and Gamble as industry sponsors. The goal of this research was to investigate the relationship between human and technological factors in distributed work teams and how this relationship affects successful virtual teaming, 1999-present.

Paper Presentation – 2001 American Anthropological Association Annual Meetings in Washington, DC on the subject of nation-building and entrepreneurship in Singapore, entitled, "Eastern Values Meets Western Individualism—Identity and Success in Singapore," December 1, 2001. The paper's goal was to make a case for why research should be conducted on the effect of capitalism in Singapore during the twentieth century and how this may have contributed to the development of its nation state, its presence of entrepreneurial capitalists and current international competitiveness in the global economy.

Collaborators & Other Affiliations

(i) Collaborators

Principal Investigators NSF IOC Program Grant to Wayne State University: Dr. Marietta Baba, Dr. David Britt, Dr. Donald Falkenburg, Dr. Julia Gluesing, Dr. Jeffrey Lockledge, Dr. Olugbenga Mejabi, Dr. Leslie Monplaisir and Dr. Hilary Ratner all of Wayne State University, Detroit, MI. Dr. Kenneth R. Riopelle from Cultural Connections, Inc.

Other Collaborators on this Project:
Dr. Willie McKether and Robin Champieux from Wayne State University and Kimberly Harris from the University of California Los Angeles.

(ii) Graduate Advisors
Dr. Marietta Baba, Dean, College of Liberal Arts, Michigan State University, E. Lansing, MI (MA Advisor)
Dr. Allen Batteau, Anthropology, Wayne State University, Detroit, MI (M.A. advisor)

Marietta L. Baba, PH.D., MBA

Present Position: Professor of Anthropology and Dean, College of Social Science, Michigan State University, East Lansing, MI (2001 – present)

Previous Position: Professor and Chair, Department of Anthropology, Wayne State University, Detroit, MI (1996-2001)

Research Experience (Selected Projects):

National Science Foundation. 1999-2002. Principal Investigator on an interdisciplinary project entitled: "The Evolution of Globally Distributed Teams: Organizational Learning and the Role of Information Technology". $300,000 [PI role transferred to Dr. Julia Gluesing in 2001]

Wayne State University. 1998-2001. Principal Investigator on a multi-disciplinary project entitled "Advanced Information Technology in Industrial, Health Care, and Community Contexts". $600,000

Ford Motor Company. 1993-97. Team member of a multi-disciplinary R&D group charged with building a prototype simulation model of cross-functional team dynamics in the product development process.
$125,000

National Science Foundation. 1994-97. Wrote proposal, and later Rejoined team, on a multi-disciplinary project focused on modeling the Interaction of technical and sociocultural factors involved in the quality transformation of the automotive product development process. $300,000

General Motors. 1990-94. Team leader of the Socio-Technical Systems Team at GM's C4 (CADICAM/CAE/CIM) Program. Managed multi-disciplinary team research at 11 work sites, and led tool development effort. $600,000

U.S. Air Force/Wizdom Systems, Inc. 1992-94. Senior technical advisor And research subcontractor on Wizdom System's Phase I/lI SBIR project Entitled "Human Issues in CALS Implementation", funded by the Armstrong Laboratories, US Air Force, for $300,000.

Selected Publications:

Baba, M. L. 1990. Local Knowledge Systems in Advanced Technology Organizations. In *Organizational Issues in High Technology Management*. L. Gomez-Mejia and M. Lawless, eds. JAI Press, pp.57-76.

Baba, M. L. 1991. The Skill Requirements of Work Activity: An Ethnographic Perspective. *Anthropology of Work Review* XII(3):2- II.

Baba, M. L. 1995. The Cultural Ecology of the Corporation: Explaining Diversity in Work Group Responses to Organizational Transformation. *Journal of Applied Behavioral Science*. 3 l(2):202-233.

Baba, M. L. 1997. Advances in Sociotechnical Systems Integration: Object-Oriented Simulation Modeling for Joint Optimization of Social and Technical Subsystems. *Human Factors in Ergonomics and Manufacturing*. *7(1)1-25.*

Baba, M. L. 1998. The Anthropology of Work in the Fortune 1000: A Critical Retrospective. *Anthropology of Work Review*. XVII(4): 17-28.

Baba, M. L. 1999. Dangerous Liaisons: Trust, Distrust, and Information Technology in American Work Organizations. *Human Organization* 58(3):331-346.

Baba, M. L. 2002. Beyond Dilbert: The Cultural Construction of Work Organizations in the United States. In: *Ethnographic Essays in Cultural Anthropology*, R. B. Morrison and C. Roderick Wilson, eds. Peacock Publishers, pp. 183-210.

Patent: Inventor on 1988 U.S. Patent #4773862, "Method for Mapping Joint Ventures and Maps Produced Thereby".

Teaching (Selected Course)

Management of Technology Change (Industrial Engineering 795) Ford Motor Company-Wayne State University Joint Master's Degree Program in Engineering Management.

Awards

Director's Award for Management Excellence. National Science Foundation. 1996
Distinguished Faculty Fellowship. Wayne State University. 1994-96
Morton Fried Prize for Best Article Published in the American Anthropologist (with E. Briody). American Anthropological Association. 1991

Professional Appointments/Elected Offices (Selected):

American Anthropologist. Advisory Editor for Organizational Anthropology (1990-93)
American Anthropological Association. Executive Committee Member (1986-88)
National Association for the Practice of Anthropology. President (1986-88**)**
State of Michigan Small Business Research Fund Review Panel (1982-94) Appointed by House Majority Leader

Biographical Citation: Who's Who in America (1992-Present)

Education: MBA, Advanced Management Program, Michigan State University (1994); PhD, Physical Anthropology (dissertation research conducted in The School of Medicine under the direction of Professor Morris Goodman), Wayne State University (1975).

Julia C. Gluesing
Associate Director, Institute for Information Technology and Culture
Wayne State University
Detroit, MI 48202

Professional Preparation

University of California, Davis, CA. French and Russian. B.A. with honors, Phi Beta Kappa. 1971

Michigan State University, East Lansing, MI. Communication. M.A. with honors, Phi Kappa Phi. 1985

Wayne State University, Detroit, MI. Anthropology. Ph.D. with honors. 1995

Appointments

Research Associate and Lecturer, Wayne State University, Detroit, MI. Anthropology. 2000–Present.

Research Associate and Adjunct Professor, Wayne State University, Detroit, MI. Industrial and Manufacturing Engineering. 1995–2000.

President, Cultural Connections, Inc., Troy, MI. 1993–Present.

Principal, JK Research Associates, Troy, MI. 1991–1993.

Research Manager, Sandy Corporation, Troy, MI. 1985–1991.

Publications:

Gluesing, J. C. (2004) Teaching Culture 'On The Fly and Promoting Learning in Working' in Global Teams. *In* Goodman, L, N. Boyacigiller & M. Phillips (Eds), Teaching Culture: Lessons from Master Teachers. Routledge,

Baba, M., J. C Gluesing, H. Ratner and K. Wagner. 2004. "The Contexts of Knowing: Natural History of a Globally Distributed Team." Journal of Organizational Behavior, 25: 547-587.

Gluesing, J., Alcordo, T., Baba, M. Britt, D., Wagner, K., McKether, W., Monplaisir, L., Ratner, H. & Riopelle, K. (2003). The development of global virtual teams. In Gibson, C. & Cohen, S. *Virtual Teams that Work: Creating Conditions for Virtual Team Effectiveness* (pp. 353-380). San Francisco: Jossey-Bass.

Gluesing, J. G. & Gibson, C. (2003). Designing and forming effective global teams. In Lane, H., Maznevski, M. Mendenhall, M. & McNett, J. (Eds.) Handbook of Global Organizing and Managing. Malden, MA: Blackwell.

Gluesing, J. G. (1998). Building Connections and Balancing Power in Global Teams: Toward a Reconceptualization of Culture as Composite. In Hamada, T. (Ed.), Special Volume on Anthropology of Business Organizations, *Anthropology of Work Review*, 18(2):18-30.

Gluesing, J. G. and M.Y. Brannen. (1998). Transferring Knowledge, Technology and Processes across Cultures in Global Product Development. In Jayachandran, C., Balasubramanian, N. & Dastagir (Eds.). *Managing Economic Liberalization in South Asia: Directions for the 21st Century* (pp. 70-82). New Dehli: Macmillan India Limited.

Gluesing, J. G. (1995). *Fragile Alliances: Negotiating Global Teaming in a Turbulent Environment*. Ph.D. Dissertation. Wayne State University, Detroit, MI.

Teaching:

Industrial and Manufacturing Engineering, 1997-2001: IE783 – Management of Technology Change.

Anthropology, Wayne State University, 1992-1998: ANT315 - Business Anthropology.

Communication, Michigan State University, 1981 - 1985: COM100 - Introduction to Human Communication., COM315 - Organizational Communication, COM326 - Business Communication,
COM352 - Nonverbal Communication, COM830 - Nonverbal Communication,
Hotel Restaurant & Institutional Management, 1982-1985: HRI375, 475 and 876 - Hospitality Marketing.

Other Research and Professional Experience:
Ford Motor Company (1997 - Present) –Consultant, researcher, and cultural trainer for the Team Effectiveness Coaches. Support global product development, World Wide Cycle Planning, and Electrical and Electronics Systems Engineering, helping them implement strategic initiatives across the global enterprise, emphasizing knowledge transfer across borders in complex organizational systems. Researched and created Knowledge Base for sharing learning among global team of coaches.
NSK Corporation (1997-1998) – Collaborator on an interdisciplinary research project with the University of Michigan to understand the social and cultural dynamics involved in implementing lean manufacturing methods in a U.S. context, particularly in the "team" context on the manufacturing floor, and transfer of knowledge across national boundaries and across organizations.
Principal Investigator – NSF IOC Program Grant to Wayne State University, in collaboration with Ford Motor Co., Milliken, Motorola and Procter and Gamble as industry sponsors. The goals of this research are to investigate the relationship of information technology and team processes, such as intersubjectivity and shared learning, in the development of global teams that are geographically dispersed, 1999-2002.
Co-Principal Investigator – NSF Grant, Wayne State University, Transformations to Quality Organizations Program, with Ford Motor Co. and General Motors as industry sponsors. The goals of this research were to understand the factors that influence quality outcomes in product development teams, particularly those related to the team's communication patterns and networks, and the team's effective use of work process and information technology tools, 1995-1998.

Collaborators & Other Affiliations
(i) Collaborators
Co-Principal Investigators NSF IOC Division Grant:
Dr. M. Baba, Michigan State University and Dr. Hilary Ratner, Dr. Jeff Lockledge, Dr. Don Falkenberg, Dr.
Leslie Monplaisir, and Dr. David Britt, all of Wayne State University, Detroit, MI.
Collaborators on this Project:
Dr. Kenneth Riopelle, Willie McKether, Tara Alcordo
Co-Authors:
Dr. Mary Yoko Brannen, Associate Professor, San Jose State University.
(ii) Graduate Advisors
Dr. Marietta Baba, Dean, College of Liberal Arts, Michigan State University, E. Lansing, MI. (Ph.D. Advisor)
Dr. Judy Burgoon, Professor, Arizona State University, E. Lansing, MI. (MA Advisor)

Diane R. Pawlowski
630 Merrick Apt. #106
Detroit, MI 48202
(313) 831-7713 - ac8359@wayne.edu

EDUCATION

Ph.D. Anthropology (Cultural). Dissertation defense: 14 February 2001. Wayne State University.

Dissertation: *The Body Shop: Staff Work & Life in an Urban Medical Rehabilitation Institute.*

National Science Foundation Summer Institute on Research Design and Methods in Anthropology. 1997.

M.A. Religious Studies (Biomedical and Social Ethics). University of Windsor - Windsor, Ontario. 1987.
Masters Thesis: *Dignity: the Organization.*

B.A. Honors Anthropology and Psychology. University of Michigan - Ann Arbor, MI. 1984.
Honors Thesis: *On the Origins of Religion.*

A.A. Wayne County Community College. Anthropology and Psychology. 1982

ACADEMIC WORK EXPERIENCE

CURRENT POSITION: *Research Associate. Principal Investigator in Culture Change Project. Conduct interviews, classroom observations and other aspects of participatory action ethnographic research to document and support Greenfield Coalition for New Manufacturing Education, a $10.7 million National Science Foundation funded project to change engineering education culture. Participate in planning and formation of interdisciplinary Institute for Information, Culture & Technology.* January 2000 to present**.**

Assist pilot project set-up: ethnography of breast cancer treatment, technology and culture. 1998-1999.

Principal Investigator. Agency for Health Care Policy and Research Dissertation Grant: 1 R03 HS 09603-1. Wayne State University - Graduate Research Assistant II. 1997 - 1998.

Computer Laboratory Administrator. Wayne State University Anthropology Department. 1997.

Wayne State University Rumble Fellow. 1995 - 1997.

Research Fellow. Rehabilitation Institute of Michigan; National Institutes of Health Training Fellowship in Physical Medicine & Rehabilitation. Principal Investigator: Ethnography of a Medical Rehabilitation Hospital; Changing Body Image in Amputees. 1993-1995.

Graduate Student Assistant. Developmental Disabilities Institute. Plan, implement qualitative assessment of award-winning pilot study. Submit narrative progress reports to grant agency. 1992-1993.

Pierian Press. Assistant Editor, *A Matter of Fact*. Editorial Assist. *Media Review Digest*. 1985-1987.

Editor and Research Assistant. International Student Pugwash-Collegiate Institute for Values. University of Michigan. Project chief: Dr. Nicholas Stenech, History Department. 1983-1984.

Research Assistant. University of Michigan Center for Human Growth & Development. 1983.

Laboratory Assistant. University of Michigan Department of Biological Sciences. 1982-1983.

Free-Lance Writer. Local, regional, and national publications. 1967-1980.

Diane R. Pawlowski

MAJOR GRANTS AND RESEARCH FELLOWSHIPS

Agency for Health Care Policy and Research Dissertation Grant: 1 R03 HS 09603-1. 1997-1999.
Thomas C. Rumble University Graduate Fellowship. Wayne State University. 1995-1996; 1996-1997.
Blue Cross Blue Shield of Michigan Foundation Student Grant. 1997.
National Institutes of Health / Rehabilitation Institute of Michigan. PM&R Training Fellowship: 1993-1995.

TEACHING EXPERIENCE

Graduate Teaching Assistant. Wayne State University Anthropology Department. 1998 - 2000.
University of Windsor Graduate Assistant. Department of Religious Studies. 1987-1990.

Wayne County Community College. Instructor. Writing for Publication course. 1977-1979

SELECTED HONORS, SCHOLARSHIPS, AWARDS

Metropolitan Detroit Rehabilitation Association Scholarship. 1998-1999.
Wayne State University Graduate-Professional Scholarship. Barba Family Scholarship. 1997-1998.
Del Harder Rehabilitation Research Award. Rehabilitation Institute of Michigan. 1995.

ACADEMIC PUBLICATIONS

Pawlowski, Diane R., Marietta Baba and Donald Falkenburg. *Changing and Improving Engineering Education Culture.* Anthropology News. April 2002:43(40); 52

Baba, Marietta and Diane Pawlowski. *Creating Culture Change: An Ethnographic Approach to the Transformation of Engineering Education*. Proceedings, 2001 International Conference of Engineering Education. Oslo, Norway pp. 7E3-5 - 7E3-9.

---------. 2001 (Invited manuscript - in press) *Creating Culture Change*. In La Antropologia Aplicada, Davydd J. Greenwood, Ed., Revista de Etnologia de Cataluña,vol. 20 (Barcelona, 2001). Edición del Departamento de Cultura de la Generalitat de Catalunya.

Pawlowski, Diane. *Work of Staff with Disabilities in an Urban Medical Rehabilitation Hospital.* Society for Disability Studies Quarterly. Summer 2001. 21(3); 67-75.

---------.Working Paper #99-01. *Staff with Disabilities in a Medical Rehabilitation Hospital*. Program on Mediating Theory on Democratic Systems. Wayne State University. Detroit, MI.

---------. (1995). *Idle or Idol Sins of Worship: Maleness and the Mass*. Semiotics 1993: Proceedings of 8th Annual Meetings of the Semiotic Society of America. Eds: Robert S. Corrington and John Deely. New York: Peter Lang. *Liturgies for Oppressed Peoples.* pp. 288-294; pp. 516-522.

INTERNATIONAL & NATIONAL CONFERENCE PRESENTATIONS

March 2003. *Ethnography, Anthropology & Greenfield Coalition: Changing Engineering Education Culture.* Session Organizer: Anthropology & Education. Society for Applied Anthropology Annual Meeting. Portland, Oregon.

November 2002. *Teaching & Learning About Disabilities. Session Discussant.* American Anthropology Association Annual Meetings. New Orleans, LA.

November 2002. *Ethnography & The Greenfield Coalition: Changing Engineering Education Culture.* Frontiers in Enginering Education Conference. Boston, MA.

May 2002. *Ethnography, Anthropology & The Greenfield Coalition for New Manufacturing Education*. Joint Meetings: Society for Anthropology of North America and Canadian Anthropology Society / La Société Canadienne d′Anthropologie. University of Windsor. Ontario, Canada.

August 2001 *Creating Culture Change: An Ethnographic Approach to the Transformation of Engineering Education*. International Conference of Engineering Education. Oslo, Norway. Present paper co-authored with Dr. Marietta Baba.

May 1999. *Work of Staff with Disabilities in a Medical Rehabilitation Hospital.* Society for Disability Studies. Annual Meetings: Washington, DC. (Invited participant).

December 1998. *Work of Staff with Disabilities in a Medical Rehabilitation Hospital.* American Anthropological Association. 97th Annual Meeting: Philadelphia, PA.

November 1997. *Spirituality and Healing in a Medical Rehabilitation Hospital.* American Anthropological Association. 96th Annual Meeting: Washington, D.C.

October 1994. *Rehabilitation or Re-Culturation?* Canadian Association for Physical Anthropology. Annual Meetings: Windsor, Ontario (Canada).

October 1993. *Idle or Idol Sins of Worship; Liturgies for Oppressed Peoples.* Semiotic Society of America Annual Meetings.. St. Louis, MO.

Kenneth R. Riopelle
6295 Sandshores Court
Troy, MI 48085
(248) 879-9619

Professional Preparation
Michigan State University, East Lansing MI. B.A. Communications with Honors, 1972
Eastern Michigan University, Ypsilanti MI, M.A. Educational Leadership with Honors, 1978
University of Michigan, Ann Arbor MI, Ph.D. Adult Education with Honors, 1983

Appointments
Adjunct Professor, Wayne State University, Detroit, MI. Industrial and Manufacturing Engineering. 1997– Present.
Principal, Cultural Connections, Inc., Troy, MI. 1996–Present.
Director of Research and Measurement, Sandy Corporation, Troy, MI. 1986–1996.
Research Analyst, Market Opinion Research, Detroit MI 1984-1985
Acting Director of Admissions, Eastern Michigan University, 1984.
Research Associate, Eastern Michigan University, Ypsialanti MI 1979-1983
Coordinator of Curriculum and Research, Grand Rapids Public Schools, Grand Rapids MI 1973-1979

Publications:

Riopelle, Kenneth R. 1983. *A Management Information System Using Social Indicators for Adult Education Market Analysis and Strategic Decision Making.* Ph.D. Dissertation. University of Michigan, Ann Arbor, MI.

Riopelle, K. Gluesing, J., Alcordo, T., Baba, M. Britt, D.,., McKether, W., Monplaisir, L., Ratner, H. & Wagner, K. (2003). Context, task, and the evolution of technology use in global virtual teams. In Gibson, C. & Cohen, S. *Virtual Teams that Work: Creating Conditions for Virtual Team Effectiveness* (pp. 239-264). San Francisco: Jossey-Bass.

Gluesing, J., Alcordo, T., Baba, M. Britt, D., Wagner, K., McKether, W., Monplaisir, L., Ratner, H. & Riopelle, K. (2003). The development of global virtual teams. In Gibson, C. & Cohen, S. *Virtual Teams that Work: Creating Conditions for Virtual Team Effectiveness* (pp. 353-380). San Francisco: Jossey-Bass.

Teaching:

Industrial and Manufacturing Engineering, Wayne State University, 1997-2002: IE783 – Management of Technology Change.

Management and Supervision, Central Michigan University 1992: MSA 600 – Administrative Research and Report Methods.

Professional Experience:

Ford Motor Company (1997 - Present) **–**Consultant, researcher, and cultural trainer for the Team Effectiveness Coaches. Support global product development, World Wide Cycle Planning, and Electrical and Electronics Systems Engineering, helping them implement strategic initiatives across the global enterprise, emphasizing knowledge transfer across borders in complex organizational systems. Researched and created Knowledge Base for sharing learning among global team of coaches.

General Motors Corporation (1999) – Completed pilot program and proof of concept for Chevrolet Brandline™. Designed, developed and implemented interactive telephone voice response system for delivering daily financial information, brand news and sales tips to dealership personnel throughout the country. System provided a way for brand managers to gather immediate feedback from sales people on the showroom floor about key brand issues and for sales people to ask questions of headquarters, offer opinions and share sales tips.
Research Associate – NSF IOC Program Grant to Wayne State University, in collaboration with Ford Motor Co., Milliken, Motorola and Procter and Gamble as industry sponsors. The goals of this research are to investigate the relationship of information technology and team processes, such as intersubjectivity and shared learning, in the development of global teams that are geographically dispersed. Designed and created custom database for field research data collection and analysis, 1999-2002.
Research Associate – NSF Grant, Wayne State University, Transformations to Quality Organizations Program, with Ford Motor Co. and General Motors as industry sponsors. The goals of this research were to understand the factors that influence quality outcomes in product development teams, particularly those related to the team's communication patterns and networks, and the team's effective use of work process and information technology tools, 1995-1998.
EDS Corporation (1996) – Conducted quantitative touch-tone polling survey and analysis of Functionally Integrated Product Development program to evaluate on-going program effectiveness.
Sandy Corporation (1986- 1996) Directed proprietary custom research studies for Fortune 500 compnaies with clients such as: McDonald's, Jaguar, Mercedes-Benz, General Motors, Exxon, Ford, Infinit, IBM, Cadillac and Harley -Davidson. Examples include:

Ford Motor Company (1995-1996) -- (1) Conducted Fordstar (closed-circuit business satellite system) town hall meetings with Dealers and field employees to assess the use of satellite technology for in-dealership training. The satellite broadcasts included one-touch data collection and reporting of audience response to key issues. (2) Facilitated year-long cross-divisional and supplier strategic team to develop Ford Motor Company's owner loyalty strategy.

McDonald's Corporation (1993-1996) -- (1) Consultant in the development of strategic "white papers" for the design of a digital pipeline to connect McDonald's retail operations globally. (2) Designed computer telephony application to gather owner/operator feedback on potential uses of closed-circuit business satellite system, McN. (3) Conducted exploratory research for the design and content of the McN television guide for owner/operators

Chevrolet Motor Division (1987-1993) -- (1) Pioneered customer satisfaction research which linked dealer financial profits, sales volume and Customer Satisfaction Index ratings for Chevrolet. (2) Designed and tested Chevrolet Fleet Customer Satisfaction Instrument used by Fleet Administrators to rate Chevrolet's performance in satisfying its Fleet customers. (3) Designed and administered training utilization tracking study to determine Chevrolet Dealerships' use of training materials and technology. Also assessed training utilization in competitive dealerships nationwide.

Professional Offices

President, Association of Public Data Users (APDU), 1988-1989.
Vice President, Association of Public Data Users (APDU), 1986-1987.
APDU Representative to Council of Professional Associations on Federal Statistics, 1990-1991.

Collaborators & Other Affiliations

(i) Collaborators

Co-Principal Investigators NSF IOC Division Grant:

Dr. M. Baba, Michigan State University and Dr. Hilary Ratner, Dr. Jeff Lockledge, Dr. Don Falkenberg, Dr.

Ben Mejabi and Dr. David Britt all of Wayne State University, Detroit, MI.

Collaborators on this Project:

Dr. Allen Batteau, Carolyn Psenka, Kirk Cornell, Margaret Karadjoff all of Wayne State University, Detroit, MI.

(ii) Graduate Advisors

Dr. William M. Cave, Professor Emeritus, University of Michigan, Ann Arbor, MI (Ph.D. Advisor)

Dr. Jack D. Minzey, Professor Emeritus, Eastern Michigan University, Ypsilanti, MI (M.A. Advisor)