Negotiating Learning Cultures at a Distance: MIT Academics Teach Corporate Engineers

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> Abstract: MIT's System Design & Management program (SDM) is a distance education master's degree program in engineering and management for industry employees that hopes to overcome some of the typical barriers to organizational learning. The author has collected a variety of data on the SDM program, and this paper discusses some of the results so far. Findings focus on the technology used for distance learning, the students' ability to apply their learning in the workplace, and the difficulty for students and faculty to adapt to the distance learning setting.

> Keywords: videoconferencing, community settings, situated learning

Introduction

Organizations have spent vast amounts of money to equip employees with the technical and managerial knowledge needed to change their practices and improve their performances. In spite of these expenditures, over 80% of organizational change efforts fail to achieve the expected results (Lave & Wenger 1991, Martin & Carlile 1997). Simply sending individuals to university programs is not sufficient: the curriculum is typically too far removed from the employees' work, and employees returning to their organizations are too isolated to serve as effective agents of change across their company.

MIT's System Design & Management program (SDM) is a master's degree program in engineering and management for industry employees that hopes to overcome some of these barriers to organizational learning. The SDM program differs from many by teaching the students university courses while they remain at work, and by allowing students to adapt course projects to their job tasks at hand. The authors have recently collected a variety of data on the SDM program, and this paper discusses some of our results so far. Our findings focus on the students' ability to apply their learning to their work and the technology used for distance learning.

The SDM program

Students in the SDM program are usually engineers with 5-10 years experience in the workplace who would like management training that is placed in an engineering context. The SDM program combines the distance education experience with time on campus to build rapport. Students begin the program with classes and workshops in the month of January and then return to their sponsoring companies. During the rest of their two-year program of both engineering and business courses, students learn mostly via two-way

videoconference or videotaped lectures and videoconference recitations. Most course projects are based on topics from their own workplace. Every semester (spring, summer, and fall) they return to MIT for a three- to five-day "business trip," reuniting them with classmates and engaging them in class exercises that cannot be completed at a distance. The program also requires that each student spend one semester in residence at MIT. Currently the SDM program is working with its second and third cohorts. The first cohort, the class of '97 (entered in 1997) had 31 students, and the class of '98 had 58 students. Our research focuses on the 1997 and 1998 students. The students come from over 20 different companies. The companies most highly represented are Ford, IBM, Kodak, UTC, and Xerox.

The SDM curriculum

The SDM curriculum is designed to give engineers management expertise and a systems approach to their industry. The courses therefore include both engineering methods and management case studies. The three core courses are System Engineering, System Architecture, and System and Project Management. Students take other courses depending on their focus within the program. Some examples of other courses are Engineering Risk-Benefit Analysis, Finance and Managerial Accounting, Product Design and Development, and Software Architecting, Design and Development.

An important part of the SDM experience is the large number of group projects that students participate in. Students work in groups of 3-6 in many of the courses, and in one product design course, in groups of 8-10. In a distance setting, coordinating these groups can be a challenge, as we will see below.

Communication tools

Students use many kinds of media besides videoconferencing to smooth communications among their peers at different sites, as well as with the professor. SDM uses a collection of web tools called Command. The Command system, developed at MIT with help from Lotus, is much like any other "college course on the web" system, like Blackboard.com's CourseSite, WebCT's CourseTools, or Lotus's LearningSpace. It allows professors to post their syllabi, their notes, their assignments, etc., and also allows students to upload homework and have online newsgroup-style discussions.

It is worth noting that some students did not have ready access to the web at work. Some had computers on their desks that were limited to the corporate intranet, and others that did have web access had a firewall that hindered the more complex features of the Command system, such as chat. At one company students used shared "public" Internet terminals to upload and download their homework, for example.

Similarly, because of this lack of uniform Web access, SDM uses traditional two-way videoconferencing using double ISDN phone lines. Almost all companies had conference rooms equipped for this approach. Although there is much Internet-based "virtual classroom" software available, such as White Pine's ClassPoint and ILINC's LearnLinc, as well as more general collaboration tools like PlaceWare's Conference Center and

Microsoft's NetMeeting, less than half the companies had Internet access and PCs in their conference rooms. These Internet-based systems assume that each student sits at an individual computer and participates, while we found benefits (see below) from the classroom environment that comes from several nearby students meeting together in a conference room.

All students had access to telephone, fax, and email.

Research questions and methodology

This research focuses on three questions. 1) What technologies do distance learning students find effective? 2) Do they find the learning useful at work? 3) Is it difficult for students and faculty to adapt to the distance learning environment?

We (the author and two graduate students) collected data on the SDM program from several sources. We distributed two surveys, one on applying learning at work and technology use (Ngo 1998), and another one a semester later on technology use. We also conducted interviews with 10 students and three faculty members one-on-one, following an interview protocol based on our questions. We made two site visits to students' companies to talk with them and observe interactions at work, and we also observed 10 classes on campus within 4 different courses. Lastly, based on the suggestion of the students, we carried out a small focus group with 6 students on the conflicts of work, school, and family.

Findings

The response to the first survey on applying learning was relatively high (n=43, 48% of students). We had a smaller return on the technology survey (n=24, 27% of students). The qualitative data from observations and interviews fleshes out the survey data.

Technology preferences

One question we asked on the first survey was "How effective did you find each of the following media for interaction with fellow SDMers? Rank them as very effective, effective, not effective, or didn't use." The results appear in Table 1. Traditional
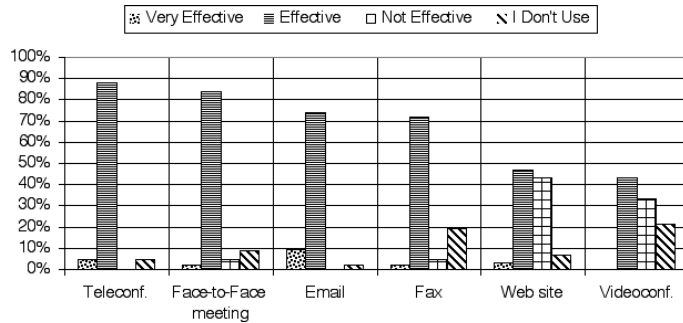
Table 1: Rated Effectiveness of Media for Communication within SDM (n=43)

communication methods received the highest approval rate: telephone and face-to-face interaction. A close second in approval rate were the methods that have grown popular in recent years: email and fax. Less traditional methods (the Command web system and videoconferencing) received the lowest approval rate. In qualitative responses, the approval rate was closely tied to the number and frequency of perceived problems with the tool. Early misunderstandings about how to upload homework to the Command web site, for example, led to Command creating a bad first impression, even though students and professors eventually used it smoothly. Also, it seems that students rank teleconferencing (one-to-one phone calls or group phone calls) slightly higher than face-to-face because in group phone calls, someone often mediates the discussion, and there is time pressure to finish the call. These circumstances sometimes lead to a more efficient meeting than a typical conference room meeting.

These data were surprising because fax is surely not as effective as email in some contexts. We then asked about different uses of media in our second survey. We asked for the frequency of use for the different media for performing various tasks such as "communicating with students at other sites," "communicating with professor," "revising group work," and "turning in homework." From these results, we learned that email, fax, and the web were used primarily to turn in homework and other forms of data transfer. For communicating with people, email and telephone were used more often. Despite our attempts to make videoconferencing easily accessible, it was considered difficult to use, because of both the time delay in the real-time use of the system and the difficulty of reserving the videoconferencing rooms at the various sites.

A second technology finding concerns whether students preferred live videoconferenced classes or videotapes of classes. We asked, "True or false: Lectures should be taped instead of videoconferenced." Four students said, "True," four students said, "True, but [comment]," and 15 said "False." The "True, but" students' comments included "only if the class is mostly lecture with little interaction" or "only if you can offer good quality." Overall, students preferred the live classes. However, each side claimed advantages for their method. Those who preferred tapes liked the time flexibility; they could "attend" class whenever they wanted. Plus, they could rewind and replay if they missed something. Students who preferred videoconferencing noted that the peer interaction in the conference room was valuable, and that the scheduled times to meet promoted

attendance. They noted that videos sometimes piled up unwatched without the scheduled class time.

Lastly, we asked students how they preferred to communicate when they worked on group projects with team members at different sites. Apparently the logistic burden of planning a meeting across different corporate cultures and the technical burdens of setting up videoconferencing were great enough that most were reluctant to form teams outside of their own organization, if they had a choice. (Some professors allowed this; some didn't.) Groups that were distributed across sites reported that they usually did initial planning over emails or on the videoconferencing system momentarily after class, and that as time on a project grew short, they began using 1-2 hour long teleconferences in the evenings. Despite the length of such calls, students claimed that with someone managing the call well, it was a good way to organize and delegate work on a project.

Applying the learning

The survey on applying learning at work reminded students of the various topics in the SDM curriculum and asked them to rate their application at work as one of different levels of use. The first two levels ("Used myself") meant that a student used the material herself, either by understanding her workplace better or by applying content directly to her work. The next two levels ("Sharing") meant that the student shared her knowledge via indirect methods, such as running a meeting differently, or that the student shared knowledge directly with colleagues or was asked to contribute what she had learned. Lastly, "Unused" meant that the material in that category wasn't used.

According to the survey results, the SDM students from the class of 1998 did not appear to utilize much of the material that was taught in the short period of time that they were in the program (approximately 3 months). On average across curriculum topics, over 60% of the students did not utilize the material at all. For the rest, most of the utilization was for personal reflection, with very few actually sharing the material with co-workers. A few students utilized the material effectively by sharing with their colleagues and direct management or by contributing in meetings, sometimes due to solicitation from their direct or senior management.

For the class of 1997, the survey results show that on average across courses, 58% of the students utilized the material in some way. Also, almost everyone felt that the material they had been taught would be more useful at some future time in their career path. The students' use, however, was still largely personal and did not involve sharing with co-workers.

In interviews, students cited several reasons for not sharing the course content at work. Some hesitated to share so they would not stand out at their firm; they were not willing to be "change agents." For others, the material presented did not lend itself to immediate or easy sharing. Thirdly, some students stated that they had enrolled in SDM chiefly to advance their career and were not particularly motivated to revolutionize their workplace.

An interesting finding appears when the data are grouped according to whether the content comes from a management course or an engineering course. See Table 2. In this chart we have collapsed the categories to three: using the material on one's own, sharing the material, and not using it. We see that significantly less engineering material is shared, and more goes unused. This difference could again stem from the fact that it can be difficult to share engineering course content casually. Several students noted, however, that they found it sometimes particularly difficult to share a new engineering method if it cut across the grain of the company culture, e.g. the "way things have always been done." This comment suggests that if a company hopes that its students will learn how to be innovative via SDM, then students must be well supported in their efforts to change work practice.

We want to note that despite the significant amount of content that was marked as not use used explicitly, several students noted that although they had not applied material specifically, it was often quite useful to them for gaining a better understanding of other parts of their company. Also, several hoped to use the material later in their careers.

Table 2: Applying learning at work: Differences by content type (n=43)

Management Courses			Engineering Courses		
Used myself	40%		Used myself	73%	
Shared	32%		Shared	9%	
Unused	28%		Unused	18%	

Lastly, an important factor influencing the ability of students to apply their learning at work is the general conflict between the goals of different participants in the student's life. Our focus group on these conflicts emphasized the difficulty of time management during the program. Though the schooling of almost all students was supported financially by their companies, company policies on studying during work hours varied widely. One company allows up to 5 paid hours off per week, one-half hour of work for every hour of class. Other companies required students to make up the time. One student reported his supervisor reacting strongly when he tried to describe the importance of an upcoming videoconferenced class: "What do you mean you can't make that meeting?!" Another student described how he had worked out time with his family. After his children had gone to bed, he might spend a little time with his wife and then do his homework from 11pm to 1am or so. Another fellow recalled finishing up a project report in a hospital room while his wife was in labor. These sorts of time-management problems can even get worse: in a discussion about peers' reaction to the SDM program, one student described a potentially difficult jealousy situation. He had been picked by the supervisor to attend SDM, so once when there was new work to be done, they said, "Give the job to the MIT boy!" These sorts of forces in the learning environment can obviously make it difficult to learn the material in the first place, let alone apply it on the job. See Figure 1 for a display of some of the characteristic dynamics that arose during the program.
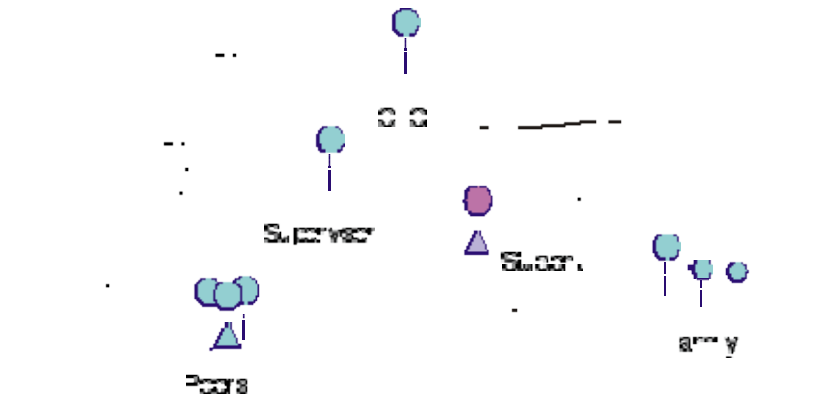
Figure 1: Characteristically different expectations from different players in the SDM program; they can make it difficult to apply learning on the job.

Adapting to distance

In our interviews with students and professors, we asked them what aspects of the distance learning setting required some adaptation from the traditional classroom setting. We also took notes during class observations.

One general idea that we heard often was that the professors had a somewhat harder time adapting to the distance setting than the students did. The students considered the logistics of distance learning, such as scheduling meetings, formatting homework properly for the web site, and downloading lecture presentations before class, to be an added burden (sometimes a whole extra hour each week), but many were familiar with it from distributed teams in their company. For many of the professors, the situation was new.

Technology

One of the most obvious factors to adapt to is the technology itself. A professor had to learn how to use a document camera (a videoconferencing version of the overhead projector), and how to talk with the videoconferencing technician (VCTech) during class, telling him whether to broadcast presentation slides, the document camera, her face, or the class as a whole. The idea of paying so much more attention to the "performance" aspects of teaching, e.g. how quickly one speaks and how one presents oneself, was new to some professors, and certainly having to coordinate these factors with the VCTech complicated things further. Students also needed to learn distance learning procedures, such as identifying oneself before speaking, and waiting longer before responding to compensate for the videoconference delay.

The presence of the videoconference delay and the fact that there were sometimes up to 10 distant sites participating made it difficult to have fluid discussions. Some professors made the best of this situation by keeping a face board of student photos on hand to cold-

call students, e.g. "Mary, at Xerox, what do you think?" In the 4 courses visited, this technique seemed to work most smoothly.

Logistics and lead time

An important factor in distance learning that the professors did not typically anticipate was the degree to which they had to plan their lectures and due dates ahead of time. Because presentation slides were supposed to be emailed or faxed to all distant students ahead of the lecture, professors had to finish preparing their lectures sometimes two days in advance. This lead-time was unusual for some, who preferred to adapt the lecture until just before class or during class as new topics arose. In addition, assignment deadlines for the entire semester were practically set in stone once issued, since the students often booked their work calendar far in advance around those dates.

Academic vs. corporate learning culture

Another very strong factor that professors had to adapt to was the different motivation of employed students. This difference arose not so much from the distance setting per se but rather from the different cultures of university education and corporate education. The professors were used to undergraduates or sometimes graduate students with some work experience; usually these students felt that the professor knew more than they, and the traditional learning paradigm of "professor as wise teacher" arose. While it is inappropriate to conclude that SDM students respected professors any less, the students did have a rich body of experience to compare the professors' more theoretical teachings with. Several students reported that one professor's theory seemed nonsensical because, "That's not the way things work in industry." In general, the SDM students sought more applied knowledge than the typical university student, so that they could apply it in their situation at work. Professors also noted that this background sometimes enriched the classes because students would be able to comment from so many different perspectives.

Good videoconferencing professors

Lastly, in Table 3, we offer students' suggestions for how to be a good videoconferencing professor. It is worth noting that some of these suggestions seem somewhat contradictory, and are likely reactions to particular SDM professors as opposed to general truths. One student commented that though it was unfortunate, the best way to communicate clearly via videoconferencing was to be very dry and boring.

Table 3: Student Descriptions of "a good videoconferencing professor"

Conclusions & future work

In general we learned that the entire suite of distance learning technologies, email, teleconferencing, faxing, videoconferencing, and web site, all require significant training

for the participants and managerial support throughout the semester in order for a course to run smoothly.

Also, even with the best technological support, there are many other more subtle stumbling blocks for corporate students learning in a university setting. All the people involved, the students, her supervisor, peers, family, and professor, need to understand each other's expectations.

In the face of our findings, we are left with several new questions to pursue. Interviews and observations suggested that professors adapt with differing ease to the demands of the distance learning classroom. Why might that be? It could depend on the type of content they teach; perhaps some courses are more amenable to distance teaching than others. Or, the ability to adapt might depend on the amount that the professor regularly reflects on her own practice.

Lastly, given the difficulty that a student can experience trying to introduce newly learned methods into his workplace, are there ways that the SDM program (or any distance learning program) could support such a student? Perhaps good collaborative technology, combined with appropriate pedagogy, could help build a community of practice around that new method and support the student in his efforts.

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