SDM PROGRAM ANALYSIS: THE IMPLEMENTATION AND DIFFUSION OF ORGANIZATIONAL LEARNING IN THE WORKPLACE

by

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ABSTRACT

A study was carried out on the MIT Systems Design and Management (SDM) program in order to evaluate the usefulness of the program for individual students and uncover ways to improve the program. The study was conducted by gathering data in the form of feedback from students via surveys and interviews. Students were asked to answer questions in the following areas: 1. How they were utilizing in the workplace what they had learned in the program; 2. What transition and interaction issues were encountered from the program to work and home; 3. How effective was each communication medium setup by the program.

The results show that the usefulness of the program for an individual student varies a great deal due to many factors, only some of which, the program can affect. One of the major factors which contributes to the program's success, but is outside of the program's control, is the support received by the student from his or her family. However, the usefulness of the SDM program can be enhanced by working to continually improve factors which are within its control, such as: continuous adjustment of course material based on current issues and student feedback, improving communication mediums, actively working towards building Communities of Practice, and educating and working with the students' companies in a partnership to build or strengthen support networks within the corporate culture for the students.

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1 Introduction

For many years, there has been a great deal of burgeoning interest and activity in the field of distance learning. Educational systems around the world are faced with growing demands for increased educational opportunities. However, without correspondingly increased budgets, some education systems are developing distance learning programs, in order to expand educational opportunities in a more cost-effective manner.

One of the main concerns about distance learning has always been the effectiveness of this method compared to that of traditional methods. Effectiveness studies have been quite consistent in showing that when used appropriately in business, military training, and adult learning, there is no significant difference in effectiveness between distance learning and traditional instruction methods. In addition, these studies show that student attitudes are generally positive about the experience (http://www.usdla.org). The rapid pace of technological advancement in the computer and telecommunications industries has contributed greatly to the success of distance learning programs.

This paper describes and analyzes one such distance learning program, the MIT Systems Design and Management (SDM) program, in order to evaluate the usefulness of the program and to uncover ways of improving it. The analysis is performed primarily by looking at data gathered in the form of student responses to survey and interview questions. The questions were focused on the following primary areas: Utilization of the course material in the workplace; transition and interaction issues from the program to the workplace and home; and evaluation of the different types of communication media provided by the program in order to help build learning communities for the students.

The results uncover important factors which contribute to the usefulness of the program. In addition, the results highlight ways in which the program can be improved, primarily by working to continually improve those important factors which are within its control, such as: continuous adjustment of course material based on current issues and student feedback; improving communication mediums; actively working towards building Communities-of-Practice; and educating and working with the students' companies in a partnership to build or strengthen support networks for the students within the corporate culture.

2 The MIT System Design and Management Program

Conventional educational programs are characterized by a tendency to deliver a tremendous amount of material over a lengthy period of time. It is a little known fact that when students graduate from such programs and enter the workforce, they only retain approximately 40% of the material which was taught to them. This can be disturbing in light of how much time, money and effort is invested by the students. Such statistics have spurred the creation of innovative educational programs which aim to increase the retention and utilization of the knowledge gained in the program.

One example of such an innovative program was setup at Sybase Corporation, and is called Sybase Connected Learning. This program attempts to promote retention and utilization of knowledge by encouraging students to continuously implement what they learn. Instructors tailor classes based upon the expectations and preparation of the students, and there is a web-based follow-up to classes for questions and discussion. The program has been suspended due to the overall financial difficulties at Sybase.

Recently at MIT, a similar program was designed in order to encourage and promote this new initiative: educating the students of the future. In the words of Dr. Charles Vest, President of MIT:

> *We cannot expect continuing education to be provided only within the ivied walls of brick and mortar universities. We must now use computer technologies...to deliver excellent learning experiences at the professional's place of work.*

The MIT System Design and Management program (SDM) began with a pilot class driven by co-directors Tom Magnanti and Edward Crawley. The program was created in order to combine depth in system designs and the needed breadth of management in order to face the challenge of increased complexity in large-scale systems design. The pilot took off in 1996 with only 12 engineers and by 1997, the SDM program started going full steam ahead with an incoming class of 35 engineers. In 1998, SDM admitted a class of 58 engineers representing roughly 20 industry partnerships.

The program was devised via a partnership between one of the world's most prominent engineering schools, the MIT School of Engineering, and one of the most distinguished management schools, the MIT Sloan School of Management. This partnership has provided the participants in the program with an opportunity to earn a Master's degree in both engineering and management. The SDM program offers both on-campus and distance learning opportunities to its participants. The terms "distance education" or "distance learning" have been applied interchangeably by many different researchers to a great variety of programs, providers, audiences, and media. Its hallmarks are the separation of teacher and learner in space and/or time (Perraton, 1988), the volitional control of learning by the student rather than the distance instructor (Jonassen, 1992), and noncontiguous communication between student and teacher, mediated by print or some form of technology (Keegan, 1986; Garrison and Shale, 1987). Distance learning as defined by the United States Distance Learning Association (1991) is the obtainment of knowledge and skills through mediated information and instruction and collaboration, encompassing all technologies and other forms of learning at a distance.

So far, the MIT System Design and Management program has successfully integrated the unification of distance learning and on-campus learning. The program's mission is:

> *To create future technical leaders in systems engineering/architecture and the conception & design of complex products and systems preparing them for careers as the technically grounded senior managers of their enterprise.*[1]

From this mission, one can infer that the program is more complex in nature than it may seem at first glance. The program intends to create managers and technical leaders in both systems engineering and architecture, in addition to building a community of collaborate learning (Communities-of-Practice "CoP"). This has been a major challenge for the SDM program.

To aid in meeting this challenge, a method must be devised for evaluating the effectiveness of this integrated system. As the program grows, there are continuous improvements, but a strategy is necessary for evaluating what should and should not be taught and implemented. In addition, there needs to be continuous development of Communities-of-Practice and an understanding of the key elements to building them.

3 What are Communities-of-Practice (CoP)?

A CoP is a "reticulation of informal relationships spanning from functions and divisions among groups of people who have worked together in some form or another over a period of

[1] MIT System Design and Management information packet (1997).

time and who through intensive communication have developed a common sense of purpose and a desire to share work-related knowledge and experience" (Brown and Duguid, 1991).

In order for the CoP to exist and thrive, there needs to be a high degree of collaboration among the participants. Collaboration as a goal of learning goes hand-in-hand with other learning goals such as: the integration of theory and practice, the coping with uncertainty, and the challenges of change. Most of the students in the SDM program are employed full-time and are also studying full-time. Their employers encourage them to participate in this program because the firm wants to expand its potential for "organizational learning", while the students themselves want to expand their current professional competence and advance their career goals (Chritiansen, Ellen & Dirckinck-Holmfeld, Lone, 1995). The students' and the organizations' need for shared understanding stimulates the social imagination and forces them to go behind every-day knowledge, seeking a shared view based on relevant information. In this process, they develop communicative competencies and the ability to participate in intellectual collaborative work processes.

In order for collaborative learning to take effect, there are a few issues that need to be addressed in order to motivate such an experience. First, there must be an examination of the technologies and tools of communication that are available and of how willing and able the students are to use these tools. This is considered to be the first step in developing and maintaining the CoP. Second, there must be an examination of the various types of knowledge transfer that occurs amongst students in the program, within their corporations and across the various organizations. Third, there must be an analysis of the support mechanisms experienced by students as they journey into the SDM program and as they leave the program and transition themselves back into the workforce.

4 Methodology

The primary data were collected through student surveys which were electronically dispersed to the two current classes of System Design and Management (SDM) students. Open-ended questions was used in order to motivate the participants to tell stories about what they have encountered thus far. This method made it possible for the students to freely express their views and opinions, as well as to interject their feelings, something which would not be present in a quantitative analysis. The survey focused on three specific areas:

- Utilization of Course Material in the Work Environment
- Transition and Interaction in the Work and Home Environment
- Communication Media for Building Communities of Practice

The students were asked to narrow their thoughts into these three primary areas in order to evaluate the amount of knowledge being integrated into their work environment and to investigate the possibility of creating a network of shared best practices across companies. Out of a combined total of 99 students (58 from class of 1998 and 31 from class of 1997) there was a grand total of 43 responses (30 from the Class of 1998—51% responded and 13 from the Class of 1997—42% responded). It must be noted that the sample size for the class of 1997 is much smaller than for the class of 1998, therefore those results may be statistically somewhat less reliable. Incredibly enough, each student wanted to write novels about their experiences thus far in the program. It was quite encouraging to see the response rate; this may have been due to the rapport and interaction established by the author with the students while operating as a teaching assistant.

For each specific area, the methodology used to measure the data varied due to the nature of the responses received from each student.

4.1 Utilization of Course Material in the Work Environment

In this area, five utilization categories were identified against which each response was classified:

1) **Reflective and observational** —the student was able to be more cognizant of what was affecting her organization and is mostly observing.

2) **Self-betterment**—the student took one more step beyond just being cognizant, she actually implemented the knowledge into her daily work products.

3) **Implicit sharing**—the student shared information through informal media (e.g. posting of summaries on her walls.)

4) **Explicit sharing**—the student was asked to contribute what she had learned in order to help reform the organization; or the student directly shared knowledge with co-workers either in groups or one on one.

5) **Non-Utilization**—there is currently no utilization of the material either due to the fact that the student is on campus or has not yet had the opportunity to put the knowledge to use.

Classification of responses into these categories did not lend itself to useful interpretation of the data. Therefore, the information was separated further by dealing separately with the two participating classes (1997 and 1998). This became necessary because there was a difference in perspective between the students of the two participating classes. The class of 1998 had just recently begun their journey into the SDM program and were fresh and eager to utilize much of the material which had been presented to them during the beginning of the program. In contrast, the majority of the students in the class of 1997 had been in the program for two years and were getting ready to graduate. This made them less motivated to contribute and more focused on completion of the program. Table 1 and Table 2, therefore, show the utilization of course material for 1998 and 1997, respectively. It must be noted that in the "Overall" section for both classes, the percentage refers to the number of students out of all respondents who wrote about using the general concepts of the course rather than mentioning specific classes..

4.2 Transition and Interaction in the Work and Home Environment

The responses in this area were classified into one of four categories. Each category is characterized by the number of sources from which the student receives support. There are three sources identified: family, direct managers and peers, and the student's organization as a whole. The categories are:

1) **Very positive**—the student has a strong support system from all three sources.
2) **Moderately positive**—the student lacks support from one of the three sources.
3) **Moderately negative**— the student lacks support from two of the three sources.
4) **Very negative**—the student lacks support from all three sources, i.e. the student has no support system in place.

Using the above terms, Table 3 shows the level of support received by the students during transition and interaction.

4.3 Communication Media for Building Communities of Practice

The responses in this area were categorized according to the perceived effectiveness implied by the response. Perceived effectiveness was classified into four categories representing different levels of effectiveness:

1) **Very effective**—indicates that the utilization is high and it is the most preferred method for communication.
2) **Effective**—indicates that there is some utilization.
3) **Not Effective**—usually indicates that the media was more trouble than it was worth and that the hassle involved in learning and utilizing it outweighs the benefit.

4) **Do not use**—indicates that the student had no experience with the media and did not have the desire to learn.

Table 4 summarizes the responses in this area using the categories defined above. In addition to effectiveness, Table 4 also lists the purpose, problems encountered, and frequency of usage for each type of communication medium.

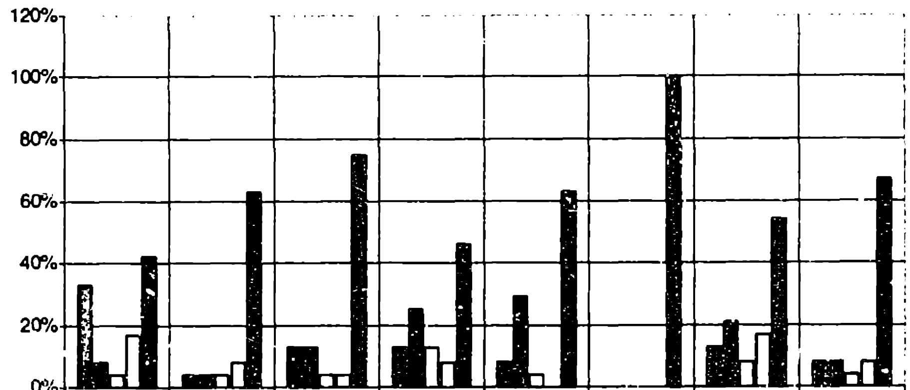
5 Results and Analysis

The data are analyzed separately for each of the three areas described in section 4. As mentioned in that section, the analysis of the results must be tempered by the fact that the sample size for the class of 1997 is much smaller than for the class of 1998, therefore those results may be statistically somewhat less reliable.

5.1 Utilization of Course Material in the Work Environment

In order to evaluate the success of the SDM program and how well it has been implemented, this section will analyze the utilization of the course material in the work environment. Utilization is defined here in the very broadest of terms to mean: how much of the knowledge learned in the courses is being integrated into the workplace. The transfer of knowledge may take one or more of the following five forms: reflective and observational, self-betterment, implicit sharing, explicit sharing, and non-utilization. These forms are defined in sections 4.1, 4.2, and 4.3, respectively.

Class of 1998
Utilization of Course Material in the Work Environment



	Cultural, Political, and	Managing Change	OLD to NEW	Team Process	Negotiation and Conflict Resolution	Cultural Diversity	Overall Course	Systems Architecture
1. Reflective and observational	33%	4%	13%	13%	8%	0%	13%	8%
2. Self Betterment	8%	4%	13%	25%	29%	0%	21%	8%
3. Implicit Sharing	4%	4%	4%	13%	4%	0%	8%	4%
4. Explicit Sharing	17%	8%	4%	8%	0%	0%	17%	8%
5. Non-Utilization	42%	63%	75%	46%	63%	100%	54%	67%

According to the survey results displayed above, the SDM students from the class of 1998 did not, in general, appear to fully utilize the material that was taught in the short period of time that they were in the program. On average, over 60% of the students did not utilize the material at all. For the rest, most of the utilization was for reflection and observation or for self-betterment, with very few actually sharing the material, either implicitly or explicitly. This pattern of utilization probably reflects the fact that the students are still in the early stages of the program, and therefore may not feel completely comfortable with applying the material. They may be hesitant to contribute and be recognized at their firm. In addition, the material presented thus far may not lend itself to immediate sharing as perceived by each student. The few students who utilized the material most effectively did so by implicitly sharing with their colleagues and direct management or by explicitly contributing to the molding of the organization, sometimes due to solicitation from their direct or senior management. For example, one student stated that he was invited to present the results of his course project on organizational initiative at the next reorganization meeting. Yet another student stated that because of the program, his organization has asked him to assist in the reengineering of their engineering facilities.

These examples suggest that in order for students to immediately utilize the material to make an impact in their organization, there needs to be a strong support mechanism within the firm. This mechanism needs to have buy-in from the program and the student. Another, less measurable factor is the willingness and attitude of the students to want to be change agents within their firm. Many students stated during the program that they were looking to advance their career and therefore felt that the program was the next step to take.

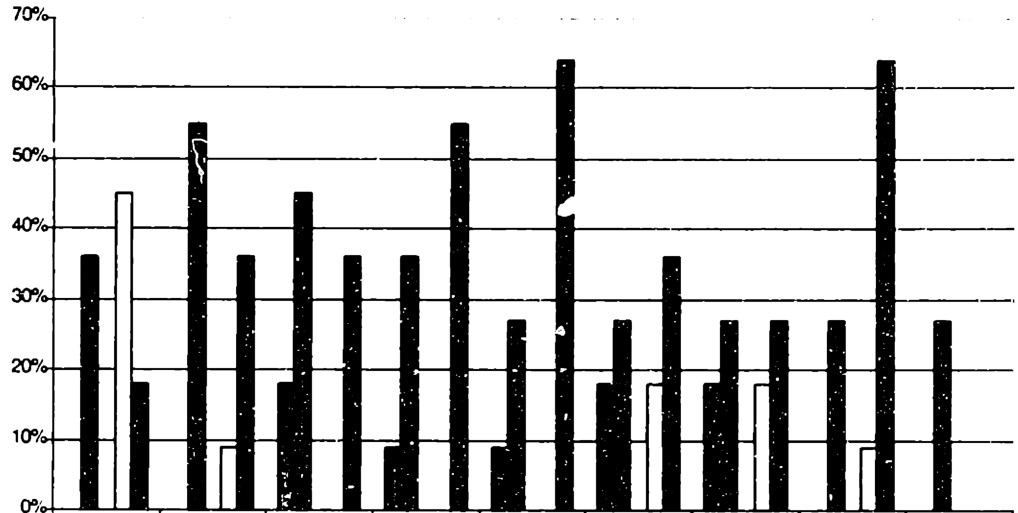
Most of the students seem to be eager to contribute to the changes within their organization, after they leave the program and transition themselves back to the firm after a month of separation. There is evidence that some students are so overwhelmed when they return to their work environments that some even become ill. Many times this is due in part to the fact that while they are away from work for a month, their work continues to pile up and no one is assigned to "pick up the slack". When they return to work after just completing a very stressful one month program, they are faced with an overwhelming amount of work.

Utilization is also affected by whether or not the opportunity actually does arise for the students to make contributions to the organizational learning when they return to the workforce. This opportunity is obviously severely diminished for on-campus students. They can only utilize the material within themselves, and typically cannot influence change in their organization. Lastly, we must also consider the fact that many students are not currently in a position at their firm from which they can realistically influence and/or make changes.

For the class of 1997, the survey results (see chart below) show a modified utilization pattern. In general, the students did utilize the material. On average, over 60% of the students utilized the material in some way. For the most part, students utilized the material mainly for reflection and observation or for self-betterment, with very few actually sharing the material, either implicitly or explicitly. One notable exception is the utilization of material for Organizational Process. The utilization of this material for explicit sharing was much higher than average.

Most of the students in the class of 1997 utilized the material for self-betterment. The students seem to recognize that the information they learned was useful in softening their rough edges and making them more cognizant of their surroundings. Some students who were making strides in the shaping of their organization could not share their experience explicitly. They did, however, imply that without the support of top management they would not have been given the opportunity to apply what they learned from the program. Some students expressed that as they came closer to completion of the program, they found that they were being redirected into more high level management positions with much more responsibility. In one extreme case, a student clearly wanted to "run the show" in a development project. He got his wish, for just recently he discovered that he has to develop, organize, and manage a new program from the bottom up, utilizing everything that he has learned throughout his two years in the program.

Class of 1997
Utilization of Course Material in the Work Environment



	Organizational Processes	Systems Architecture	Operations Management	ERBA	Marketing	Systems Engineering	System and Project Management	Systems Optimization	Overall Courses in SDM program
1. Reflective and observational	0%	0%	18%	9%	9%	18%	18%	0%	0%
2. Self Betterment	36%	55%	45%	36%	27%	27%	27%	27%	27%
3. Implicit Sharing	0%	0%	0%	0%	0%	0%	0%	0%	0%
4. Explicit Sharing	45%	9%	0%	0%	0%	18%	18%	9%	0%
5. Non- Utilization	18%	36%	36%	55%	64%	36%	27%	64%	0%

As the chart above indicates, a majority of the students felt that what they learned thus far really caused them to stop and reflect. Almost everyone felt that the material they had been taught would be more useful and utilized in a future period in their career path. There were no specific timeframes given for when they felt that they would be able to utilize the knowledge they gained.

Utilization of the material also seemed to correlate to the perception of the students as change agents. The following was discovered:

- It was discovered in the data that those students who had the ability to be change agents were in fact solicited by their organization to participate.

- Students were also perceived as change agents because of a course-related project in the program which created an opportunity for interaction between the students and senior management. This ignited senior management's curiosity and their desire to have the students share their results.

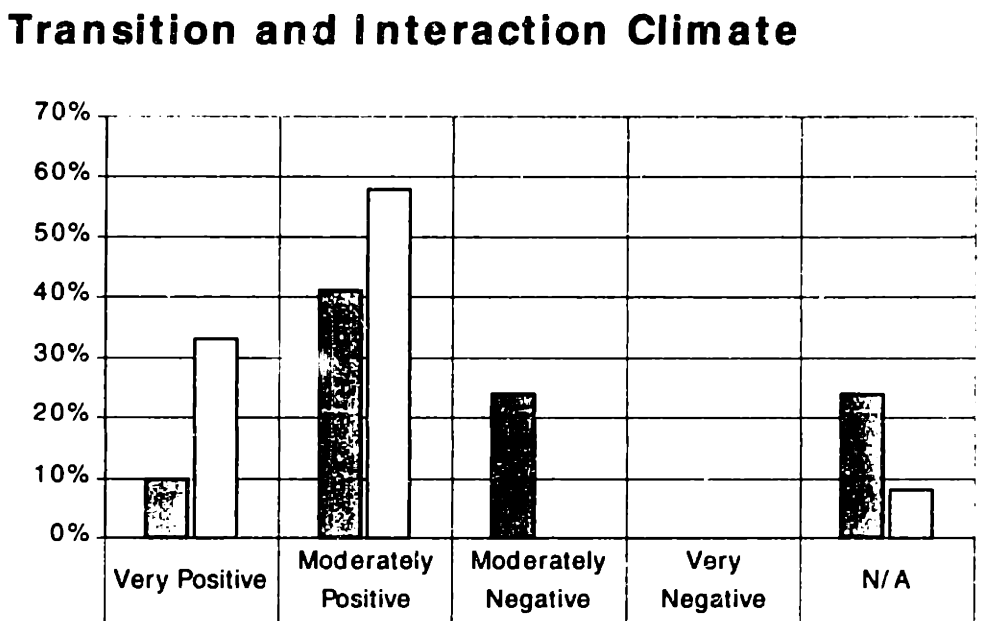
Utilization of course materials depends on many factors, including the student's current position, professional background, educational background, and the support of the direct managers and the company as a whole. When the students were encouraged to contribute the knowledge which they learned in the program, they were more likely to become change agents. This support mechanism is not in place for some organizations. The support mechanism even varies from one division to another within the same firm.

Overall key drivers for utilization of course material:

- Whether or not the students are currently on campus.
- Whether the student's attitude or desire is to become a change agent
- Whether the students are currently in a position where they are able to promote and/or implement the techniques gained in the program.
- Whether or not the students' work environment encourages or supports them as change agents.

5.2 Transition and Interaction in the Work and Home Environment

This section will focus on the ease of transition from the program to the work and family environment. Several areas were highlighted by the stories told by current participants in the program. These areas included the following: the relationship between non-SDM peers and SDM peers; the interaction with and acceptance from direct managers and senior management; the interaction with immediate family members.



	Very Positive	Moderately Positive	Moderately Negative	Very Negative	N/A
1998 Responses	10%	41%	24%	0%	24%
1997 Responses	33%	58%	0%	0%	8%

As the chart above indicates, on average both classes felt that their transition back to their family, peers, direct supervisor, and the firm as a whole was moderately positive. This means that the student had most, but not all, elements of support. The majority of the students felt that they were sacrificing their family life in order to participate in the program. Overall, 57% of the students felt this way: 75% in the class of '97, 51% in the class of '98. This disparity is probably a reflection of the fact that the class of '97 has had more time to realize the effect on their family. In addition, the perceived sacrifice may seem greater over time. One student remarked, "I don't even have kids and you wouldn't believe some of the heat I've taken."

The separation period seemed to dictate where the transition and interaction difficulties came from. For the initial part of the program (January period), the students tended to face lots of difficulty with their family transition. As they moved further into the program, the difficulty switched from family to the peers and direct managers at the firm. This was probably due to the fact that the students were then away from their jobs for a full semester. This causes confusion in the work environment and the managers and peers have to prepare for this. Some direct managers prepare the student's group or team by assigning a temporary replacement for the student. However, this action makes some students feel as if they may lose their position when they go back after their semester on campus.

During the program, some students found that they had been moved to a new position after the January period. The justification for the move was that the new position would better accommodate the student's need to attend classes and study while still being able to meet work obligations. In some cases, the student felt that the move was motivated more by jealousy or resentment. Some students viewed the move as a demotion, others viewed it as a positive sign of support from their manager.

One can infer that some direct managers operating on a P&L (profit and loss) mentality might wonder why they should be stuck with such a large investment, given that at the end they will not be able to reap any benefits, because the assumption is that once someone has been selected for the program, he or she is on the fast track to a higher-level, executive position. Further study should be conducted in this area.

It is surprising to find that there were a high percentage of "N/A" responses for the class of 1998. This would have been expected if the majority of the class were on campus; however, this was not the case. One possible explanation is that the student's felt that their job was still the same as before. Another possibility is that they chose not to tell others in the organization about the program and pretended as if everything was going as normal.

It is disturbing to note that for the class of 1998, 24% of the students felt that they faced a moderately negative transition and interaction environment after returning from the program. Some of the students became quite ill due to the work environment overload. The perception tended to be: "he is attending MIT, he can handle it." This attitude resulted in massive overloads. Many students in this situation just continued to go on and tried to deal with everything that was thrown their way. They tried not to lose faith in the program and tried to keep focused on "the light at the end of the tunnel."

5.3 Building Communities of Practice (CoP)

Brown and Duguid believe that to build a community of practice there needs to be some sharing of work, language, or belief. In most books they would consider this as the building of an organizational culture, wherein artifacts are created and shared language and understanding is a means of communication. It is quite evident in this program that there is some sharing that is occurring but it cannot quite be determined whether it is as a result of an established community or merely something in the process of development.

During this study, it became apparent that many of the pieces necessary for building CoP are at least partially present. Some examples are:

- As seen in section 4.1, there is some implicit and explicit sharing that is occurring in the work environment of some of the students.
- The students shared language among each other in the program and among their peers, supervisors and organization

- An example of shared learning across organizations – a relationship was established between a student from the class of 1997 and one from the class of 1998. The mechanism or encouragement of the courses during the January period did not foster this relationship. A member of the SDM staff suggested the link when one student requested more information about a project or an idea for a thesis.

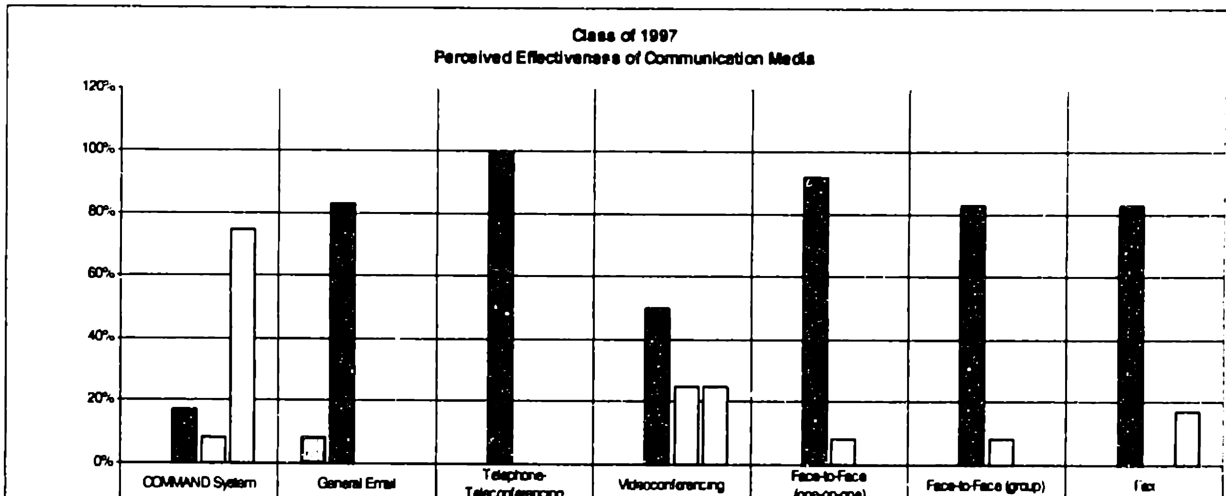
Despite these positive signs, there are many other issues that must be considered and evaluated. One important factor uncovered in the study was the unwillingness of students to form teams outside of their own organization. The majority of students indicated that they preferred to form teams in the same location, for reasons which include: the hassle associated with trying to arrange meeting times, technical problems with communications media, and coping with differences in corporate culture. Many students pointed out that one of the main barriers to electronic sharing is the firewall that exists between the organizations.

It is apparent that the program must continue to take proactive steps to spur the development of CoP. These efforts must be continually evaluated. For example, in the program's attempt to help nurture and promote the first stages of Communities-of-Practice, this year a poster session was incorporated into the organizational process course. The idea behind this poster session was to encourage the class of '97 to interact with the class of '98 and become aware of the various initiatives that the class of '98 was engaged in. The students in the class of '98 were asked to create a visual poster that would explain and display the organizational initiatives that they chose to address for the end of the course. The class of '97 was invited to attend the poster session in order to give them an opportunity to interact with the new class and to make connection with the various projects that they were working on at work or with what they did last year. Although the poster session did encourage interaction among the students in both classes during the session, the interaction did not continue beyond the session.

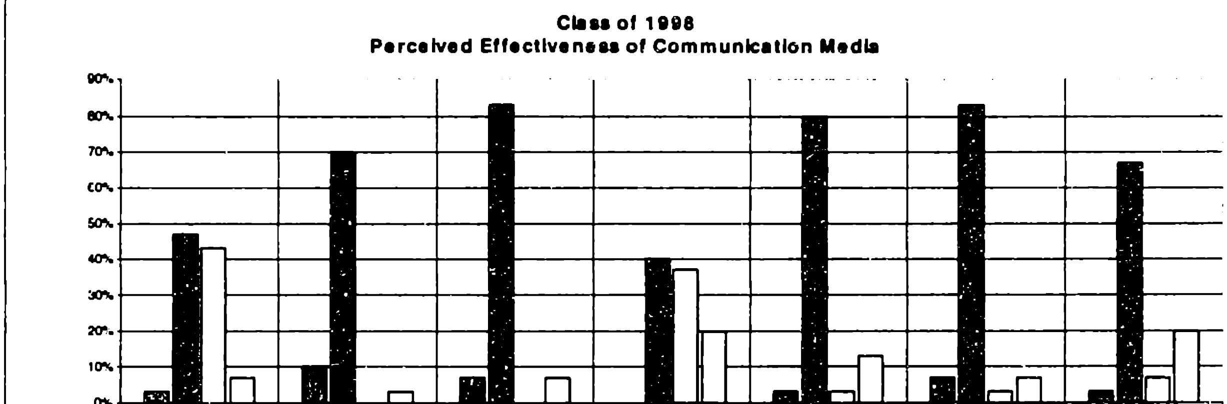
Another way to stimulate CoP's is by aligning the needs of the students and their organizations to the teaching of the courses offered in the program. This alignment will help to increase the organizational learning which is a goal of the program.

CoP's can also be stimulated by making sure that the incentive programs offer enough motivation for the student to participate. This is the responsibility of the organization and the SDM program to assure that each student will have a means for advancement or increased knowledge for the advancement of their projects and/or work.

One of the most important factors when building Communities-of-Practice is the tools and technology that are in place to support this community. A continuous evaluation of this factor is essential. The program currently offers the tools and technological equipment shown below for the students.



	COMMAND System	General Email	Telephone-Teleconferencing	Videoconferencing	Face-to-Face (one-on-one)	Face-to-Face (group)	Fax
Very Effective	0%	8%	0%	0%	0%	0%	0%
Effective	17%	83%	100%	50%	92%	83%	83%
Not Effective	8%	0%	0%	25%	8%	8%	0%
Don't Use	75%	0%	0%	25%	0%	0%	17%



	COMMAND System	General Email	Telephone-Teleconferencing	Videoconferencing	Face-to-Face (one-on-one)	Face-to-Face (group)	Fax
Very Effective	3%	10%	7%	0%	3%	7%	3%
Effective	47%	70%	83%	40%	80%	83%	67%
Not Effective	43%	0%	0%	37%	3%	3%	7%
Don't Use	7%	3%	7%	20%	13%	7%	20%

The charts above display the perceived effectiveness of each communication tool as viewed by each class. As expected, traditional communication methods received the highest approval rate: telephone and face-to-face interaction. A close second in approval rate were the methods which are becoming traditional over the past decade: email and fax. Less traditional and less standard methods (COMMAND and Videoconferencing) received the lowest approval rate. The approval rate was closely tied to the number and frequency of perceived problems with the tool. It is interesting to note that no tool was overwhelmingly perceived as Very Effective. The closest was Email at 10%. There are not enough data in this preliminary study to draw solid explanations for this phenomenon. It is an area for possible further research. However, one possible explanation may be that most students are so overwhelmed by work and school that no tool can make up for the lack of time to use it to its full potential.

For the class of 1997, the COMMAND system was not yet in place and a majority of them do not know what it is. Some have tried to utilize the system only because the course they were taking required it. Many of them felt that the tool was not effective and was too cumbersome.

Videoconferencing was another tool which a significant number of students felt was not effective. For the most part, this perception was linked directly to problems with the technology which they experienced and/or observed. On the plus side, we should see an increase in the perceived effectiveness of this tool as the technology continues to improve.

There are other factors that can affect the perceived effectiveness of a communication tool. If the student is already familiar with a tool, he is more likely to use it effectively. The perceived effectiveness of unfamiliar tools is influenced by the student's willingness to invest the time to learn the tool, and then to have the desire to use the tool. Many students expressed their unwillingness to add yet another task to their already full plate.

6 Conclusions and Observations

Throughout the months of research, one particular theme was always consistent: in order for this program to be successful, there needs to be stronger support mechanisms in the corporate culture of the partner companies. This will probably require a more significant investment of time, resources, and money by partner companies in order to build this relationship and commitment to their future leaders. Therefore, it would seem that one of the best ways to improve the effectiveness of the SDM program is for the program itself to spearhead efforts to help partner companies establish these stronger support mechanisms. A possible direction for future research would be studying ways in which the SDM program could best achieve such a goal.

One of the chance results from the interviews was that students with the most positive transitions had a direct manager who could relate to their situation. Typically, a manager could relate to a student's situation either because the manager was in a similar program at MIT or elsewhere, or because the manager had full buy-in, understanding, and an open-mind for the opportunity at hand for the student. Thus, it would appear that the success of the program will feed upon itself. In other words, over time there will be more and more graduates of the SDM program out in the workforce, and, therefore, future students will be more likely to have a manager at some level who can relate.

Ironically, support from the organization can sometimes have a negative effect on the student. When there is support, it is also likely that there are higher expectations for the student. This can be detrimental to an already overloaded student who is now also trying to prove that he or she is the "wonder-person" that the manager and/or the organization envisioned. This phenomenon must be taken into account by the program when trying to setup support networks.

Here are some proactive recommendations for the student's organization and SDM to consider in developing the support mechanism that the students will need as they transition back into the firm.

- After the company determines which students should participate in the SDM program, they should meet with each student in order to set long term goals for the student. For example, making clear to the students that this program is an upward movement and that when they graduate they will be put in charge of a project of their choice. By stating the goals of the firm and matching it with the students' ambitions, any short-term actions can be seen in light of long term career movements.
- The company should get the student's direct supervisors involved in the understanding of the program and in being more sensitive to the needs and demands upon the students.

Ultimately, there should be a mentoring program in which graduates of the SDM program act as mentors to current students.

Interpretation of the results of the utilization of course material data is somewhat premature in cases of low utilization. Because the program is so young, there is no way to tell whether or not, and how, the material will be utilized in the future. The data collected here, therefore, might be more valuable as a baseline for future comparison than as a basis for conclusions at this point. Based on this study, a few recommendations for the program and future research are apparent:

- As previously mentioned, it is recommended that the SDM program look into setting up methods for helping to improve student support in partner companies.
- Data of the type collected for this study should be collected every year for trend and other comparative analyses.
- Students should be required to complete a comprehensive survey, of the type used for this study, before they leave the program. In addition, they should be informed about and encouraged to participate in future studies at which point they will have been in the workforce for several years.
- More detailed data spanning a longer period of time should be gathered in the future via case studies on groups of students.
- The survey used for this study should be expanded by adding more detailed questions and some multiple-choice questions. During the follow-up interviews, the students should be asked to list the various elements that helped them make a smooth transition back into the workplace. They should also be asked about their views on what were the driving forces behind the support that they received or did not receive.

- A study should be conducted that attempts to uncover ways in which utilization of the communication tools offered can be increased.
- Other effective communication tools should be explored in order to spur the creation of Communities of Practice. Examples of other tools are: dedicated websites, newsgroups, and list servers for alumni.
- Utilization of course material might be improved if feedback from incoming students is solicited in order to integrate to some degree into the courses the types of issues that they face that are important to them.

Properly evaluating the effectiveness of a complex educational program like SDM is a very difficult task, especially when the program is very young and therefore may not have a long enough history to provide sufficiently large body of data or experience. In addition, measurements are necessarily based on many highly subjective factors, so it is essential to continually re-examine and refine the methodology. However, this study is a good beginning towards establishing areas and methods through which to meaningfully measure effectiveness.

7 Next Steps

Below are some possible next steps for SDM to consider implementing:

Short-term Actions

- Form student focus groups to explore the elements of support from their respective companies that they view as helpful.
- Assemble company focus groups to examine why they decided to partner with the SDM program; what were their goals in terms of sponsorship; in what ways did SDM appeal to them; what is their view on the support mechanism that currently exists for the students; how can the program make it more marketable to the company.

- Follow the progress of a current student who is utilizing the course material.
- Follow the progress of an alumus to determine how well the program prepared him/her for new challenges.

Long-term Actions

- Examine the relative effectiveness between the SDM program verse the Sloan MBA and the Masters of Engineering.
- Research what topics are most conducive to distance learning
- Conduct on-going surveys and interviews to determine the perception of the SDM program
- Develop a mechanism in order to track the success of students after they leave the SDM program

8 Appendixes

8.1 Appendix 1 - Table 1: Summary of Utilization of Course Material in the Work Environment for Class of 1998

Course Material	Utilization Category	Use of Material – Sample Responses	% of Responses
▪ 3 lens of an organization	▪ **Reflective and observational**	▪ "…made me more aware of these different dimensions."	▪ 33%
	▪ **Self-Betterment**	▪ "It helps to compose my thoughts and come up with solutions."	▪ 8%
	▪ **Implicit Sharing**	▪ "…I have tried to suggest certain items to improve the objectives: aligning compensation, emphasizing negotiation skills, establishing control over envious colleagues."	▪ 4%
	▪ **Explicit sharing**	▪ "…my input has been solicited on several occasions to help determine the shape of the organization…using the three perspectives [has helped to] form my thoughts and responses to the inquiries. For example, …"	▪ 17%
	▪ **Non-Utilization**	▪ "I have not had the opportunity to use these tools..."	▪ 42%
▪ Managing Change	▪ **Reflective and observational**	▪ "…I am more cognizant of the need to manage change and more realistic in terms of believing I can effect change at my level."	▪ 4%
	▪ **Self-Betterment**	▪ "It has helped me with keeping the team focused on the goal..."	▪ 4%
	▪ **Implicit Sharing**	▪ "I have used the lessons...to help myself adjust to my new supervisor..."	▪ 4%
	▪ **Explicit sharing**	▪ "...my company is currently undergoing a large scale reorganization, and my input has been solicited..."	▪ 8%
	▪ **Non-Utilization**	▪ "I need to go back and look at this section to see if it can help me."	▪ 63%

Table 1: Summary of Utilization of Course Material in the Work Environment for Class of 1998 (Continued)

Course Material	Utilization Category	Sample Response	% of Responses
▪ Change from "OLD" to "NEW" Organization	▪ **Reflective and observational**	▪ "…more aware of networking issues now than ever. Taken more responsibility to be better 'connected' and am encouraging team members to use the tools available."	▪ 13%
	▪ **Self betterment**	▪ "..contrasting the old and new organizations has allowed me to better understand..."	▪ 13%
	▪ **Implicit sharing**	▪ "...I have been evaluating my role as a bridge...and have been looking for ways to make this function better..."	▪ 4%
	▪ **Explicit sharing**	▪ "...and contrasting the old and new organizations has allowed me to better understand....I have to present...to my direct reports"	▪ 4%
	▪ **Non-Utilization**	▪	▪ 75%
▪ Team Processes	▪ **Reflective and observational**	▪ "…As a member of a cross functional product development team, I became more conscious of the need to keep the support of those outside of the team—especially higher management."	▪ 13%
	▪ **Self betterment**	▪ "…Much of my work is performed in the context of quickly forming teams. These guidelines and practices are very helpful. It has helped with getting the team quickly on the same page and balancing priority and keeping the team focused on the goal, minimizing distractions of minor points."	▪ 25%
	▪ **Implicit sharing**	▪ "…I've saved the one-pagers which discuss do's/don'ts re: kicking off task forces / project teams, and team recognition/motivation…these are good 'nuggets' worth displaying or sharing with others not as experienced in the role."	▪ 13%
	▪ **Explicit sharing**	▪ "… I have made use of team process improvements within my workgroup: improving the communication by having more meetings where the emphasis is problem solving not just reporting and assuming more of a mentoring role instead of command and control role."	▪ 8%
	▪ **Non-Utilization**	▪	▪ 46%

Table 1: Summary of Utilization of Course Material in the Work Environment for Class of 1998 (Continued)

Course Material	Utilization Category	Sample Response	% of Responses
▪ Negotiation and Conflict Resolution	▪ **Reflective and observational**	▪ "...Training and the tools are helping me think through meeting situations prior to meetings heavily dominated by consensus resolution topics...helps to plan how to orchestrate the topics, the responses I can use to achieve my goals...[and] how to recognize when I need to get out of a collaborate posture!"	▪ 8%
	▪ **Self betterment**	▪ "...Used the negotiation skills to find areas of common interest to focus on when asking help from others."	▪ 29%
	▪ **Implicit sharing**	▪ "I have used some of the lessons...to work through areas where I disagree with his changes."	▪ 4%
	▪ **Explicit sharing**	▪ N/A	▪ 0%
	▪ **Non-Utilization**	▪	▪ 63%
▪ Cultural Diversity	▪ **Reflective and observational**	▪ N/A	▪ 0%
	▪ **Self betterment**	▪ N/A	▪ 0%
	▪ **Implicit sharing**	▪ N/A	▪ 0%
	▪ **Explicit sharing**	▪ N/A	▪ 0%
	▪ **Non-utilization**	▪ "...Company already does a pretty good job at this."	▪ 100%

Table 1: Summary of Utilization of Course Material in the Work Environment for Class of 1998 (Continued)

Course Material	Utilization Category	Use of Material for Self Improvements and/or Sharing	% of Responses
▪ Overall Course Material	▪ **Reflective and observational**	▪ "The most important thing I learned was to think about the environment/organization within the context of what we learned."	▪ 13%
	▪ **Self betterment**	▪ "…15.311 classes have been extremely important since they have changed my management technique…making a conscious effort to listen and try to understand the real causes of some of the things that concern other people…try to resolve if not understand. Before I was just going through the motions."	▪ 21%
	▪ **Implicit Sharing**	▪ "My group has been my audience on rare occasions..."	▪ 8%
	▪ **Explicit sharing**	▪ "…the most important thing I learned was to think about the environment/organization…gives a bases to reflect from…The presentation we did for the course, was distributed to management and now I am currently organizing a development team and using the techniques learned in class."	▪ 17%
	▪ **Non-utilization**	▪ "…I have not made an explicit attempt to summarize points from the education thus far to management or others in a FORMAL manner (e.g. regular sharing of the information to management)…there is next to no time to do anything like reflecting/sharing given the education and work responsibilities…hesitancy and not wanting to be seen as the know-it-all…"	▪ 54%
▪ Systems Architecture	▪ **Reflective and observational**	▪ "…[Gave me] better understanding of the product development process…I was able to step back and take a broader view of it. [The] understanding will help me to carry out my contributions to the product development process."	▪ 8%
	▪ **Self betterment**	▪ "…applied the competitive product development information in my projects…used system decomposition concepts to help segregate components in sourcing..."	▪ 8%
	▪ **Implicit sharing**	▪ "...I have applied....in peer design reviews"	▪ 4%
	▪ **Explicit sharing**	▪ "…the simple bubble diagram about making sure you architect with the Customer, Management, and Subject matter expertise involved [is used] everyday with my group. The picture reinforces the concept."	▪ 8%
	▪ **Non-utilization**	▪ "Frankly, I haven't used much but should..."	▪ 67%

Table 1: Summary of Utilization of Course Material in the Work Environment for Class of 1998 (Continued)

Course Material	Utilization Category	Use of Material for Self Improvements and/or Sharing	% of Responses
▪ Overall Course Material	▪ **Reflective and observational**	▪ "The most important thing I learned was to think about the environment/organization within the context of what we learned."	▪ 13%
	▪ **Self betterment**	▪ "…15.311 classes have been extremely important since they have changed my management technique…making a conscious effort to listen and try to understand the real causes of some of the things that concern other people…try to resolve if not understand. Before I was just going through the motions."	▪ 21%
	▪ **Implicit Sharing**	▪ "My group has been my audience on rare occasions..."	▪ 8%
	▪ **Explicit sharing**	▪ "…the most important thing I learned was to think about the environment/organization…gives a bases to reflect from…The presentation we did for the course, was distributed to management and now I am currently organizing a development team and using the techniques learned in class."	▪ 17%
	▪ **Non-utilization**	▪ "…I have not made an explicit attempt to summarize points from the education thus far to management or others in a FORMAL manner (e.g. regular sharing of the information to management)…there is next to no time to do anything like reflecting/sharing given the education and work responsibilities…hesitancy and not wanting to be seen as the know-it-all…"	▪ 54%
▪ Systems Architecture	▪ **Reflective and observational**	▪ "…[Gave me] better understanding of the product development process…I was able to step back and take a broader view of it. [The] understanding will help me to carry out my contributions to the product development process."	▪ 8%
	▪ **Self betterment**	▪ "…applied the competitive product development information in my projects…used system decomposition concepts to help segregate components in sourcing..."	▪ 8%
	▪ **Implicit sharing**	▪ "...I have applied....in peer design reviews"	▪ 4%
	▪ **Explicit sharing**	▪ "…the simple bubble diagram about making sure you architect with the Customer, Management, and Subject matter expertise involved [is used] everyday with my group. The picture reinforces the concept."	▪ 8%
	▪ **Non-utilization**	▪ "Frankly, I haven't used much but should..."	▪ 67%

8.2 Appendix 2 - Table 2: Summary of Utilization of Course Material in the Work Environment for Class of 1997

Course	Utilization Category	Use of Material	% of Responses
▪ Organizational Processes	▪ **Reflective and Observational**	▪ N/A	▪ 0%
	▪ **Self Betterment**	▪ "I have been more careful of managing my boundaries and the 3 perspective lenses"	▪ 36%
	▪ **Implicit Sharing**	▪ N/A	▪ 0%
	▪ **Explicit Sharing**	▪ "Citing those 3 perspectives...during discussions..."	▪ 45%
	▪ **Non-utilization**	▪	▪ 18%
▪ Systems Architecture	▪ **Reflective and observational**	▪ N/A	▪ 0%
	▪ **Self betterment**	▪ "I can now look at things and recognize their architecture...identify interfaces"	▪ 55%
	▪ **Implicit sharing**	▪ N/A	▪ 0%
	▪ **Explicit sharing**	▪ "Presented "Principles of Good Systems Architecture" to a group of about 30..."	▪ 9%
	▪ **Non-utilization**	▪ "I think [this class] will be one of the most valuable in about 3 or 4 years..."	▪ 36%
▪ Operations Management	▪ **Reflective and observational**	▪ "...course material provided me with insight into modern production methods..."	▪ 18%
	▪ **Self betterment**	▪ "I now know how our company deals with day to day operations on the shop floor".	▪ 45%
	▪ **Implicit sharing**	▪ N/A	▪ 0%
	▪ **Explicit sharing**	▪ N/A	▪ 0%
	▪ **Non-utilization**	▪ "Haven't applied directly..."	▪ 36%

Table 2: Summary of Utilization of Course Material in the Work Environment for Class of 1997 (Continued)

ERBA	**Reflective and observational**	"...went beyond most of what I already had."	9%
	Self betterment	"...have attempted to use probabilistic decision analysis and CBA in my work"	36%
	Implicit sharing	N/A	0%
	Explicit sharing	N/A	0%
	Non-utilization	"I have not used any ERBA analysis yet..."	55%
Marketing	**Reflective and observational**	"Has reinforced the need for engineers to take a "customer" focus..."	9%
	Self betterment	"...and marketing is providing [me] great ammo to use in discussion..."	27%
	Implicit sharing	N/A	0%
	Explicit sharing	N/A	0%
	Non-utilization	"Have not used any marketing as of yet..."	64%
System Engineering	**Reflective and observational**	"...the source material....is useful and will be applied to quality control...."	18%
	Self betterment	"I have made use of the materials for reference..."	27%
	Implicit sharing	N/A	0%
	Explicit sharing	"[Company] is trying to use many of the concepts presented"	18%
	Non-utilization	"Frankly, I haven't used much but should..."	36%

Table 2: Summary of Utilization of Course Material in the Work Environment for Class of 1997 (Continued)

▪ System and Project Management	▪ **Reflective and observational**	▪ "...got me to think of project management as a discipline..."	▪ 18%
	▪ **Self betterment**	▪ "...have been able to apply many of the concepts...to my job"	▪ 27%
	▪ **Implicit sharing**	▪ N/A	▪ 0%
	▪ **Explicit sharing**	▪ "...ideas from the critical chain are being used..."	▪ 18%
	▪ **Non-utilization**	▪ "Unfortunately, this class didn't offer much..."	▪ 27%
▪ Systems Optimization	▪ **Reflective and observational**	▪ N/A	▪ 0%
	▪ **Self betterment**	▪ "...I have gotten very good at using Excel solver for optimization analyses"	▪ 27%
	▪ **Implicit sharing**	▪ N/A	▪ 0%
	▪ **Explicit sharing**	▪ "...I have written one program here...to try and model the flow of material..."	▪ 9%
	▪ **Non-utilization**	▪ "have not had the occasion to apply"	▪ 64%
▪ Overall Courses in the SDM Program	▪ **Self betterment**	▪ "...the classes (combined) have just affected the way I think"	▪ 27%

8.3 Appendix 3 - Table 3: Summary of Transition and Interaction Climate

Transition and Interaction Climate	Sample Response	% of Responses (1998)	% of Responses (1997)
▪ Very Positive	"With regard to my supervisors, in some ways I feel like I have been admitted to (or at least closer to) the inner circle"	10%	33%
▪ Moderately Positive	"I am getting a lot of sympathy from my staff and subordinates since a number of them obtained advanced degrees while working during the day"	41%	58%
▪ Moderately Negative	"My project managers have not been real excited about the time away..."	24%	0%
▪ Very Negative	N/A	0%	0%
▪ N/A		24%	8%

8.4 Appendix 4 - Table 4: Summary of the Communication Media for Building Communities of Practice

Communication Media	Purpose	Problems
▪ COMMAND System	▪ Posting information. ▪ Sharing of files between teammates. ▪ Obtaining course information and assignments.	▪ "There have been problems with the system and I have found other ways to get things done" ▪ "Fine when it is up and running." ▪ "...Redundant actions...that drives you crazy and the graphics bogs the system down." ▪ "Very inefficient. Have to search every category every time."
▪ General Email	▪ Primary mode of communication. It provides a written record and is efficient. ▪ General interaction with colleagues within company.	▪ "...Lacks real time responses."
▪ Telephone, Teleconferencing	▪ To foster the spirit of teamwork. ▪ Explore in-depth details on assignments.	▪ "...It does require that folks distribute materials in advance."
▪ Video conferencing	▪ Primarily for classes	▪ "Very disappointed in the quality coming from MIT. Start times of classes are variable and the professors use the medium as an excuse to be unclear. The exchanges that have been the most frustrating are those when the Professor is not prepared, has mistakes in overheads and homework, and does not use the blackboard or camera to elaborate on key points..." ▪ "...More trouble than it is worth. Wasted time trying to establish connection, audio-problems, awkwardness, and lack of knowledge re: video conferencing etiquette." ▪ "Problems with equipment are frequent, reflect the state-of-art."
▪ Face-to-Face (one-on-one)	▪ To clarify points with teammates. ▪ When at same location—used to discuss issues related to homework assignments or hold a tutorial session.	▪ "Generally impractical unless everyone is co-located." ▪ "It's the only way to spread good gossip and jokes."
▪ Face-to-Face (group)	▪ To clarify and resolve disconnects within a project amongst the team members. ▪ To accomplish homework assignments with other SDM students at same location.	▪ "...Use the format as an excuse to wander and occasionally be unprepared."
▪ Fax	▪ Used for transfer of homework and exams.	▪ "Cannot deliver 20 pages of text therefore has limited capacity."

Table 4: Summary of the Communication Media for Building Communities of Practice (Continued)

Communication Media	Frequency	% Very Effective		% Effective		% Not Effective		% Do not use	
		1998	1997	1998	1997	1998	1997	1998	1997
▪ COMMAND System	▪ 0-4 times a week.	3%	0%	47%	17%	43%	8%	7%	75%
▪ General Email	▪ 1-5 times a day.	10%	8%	70%	83%	0%	0%	3%	0%
▪ Telephone, Teleconferencing	▪ 1-3 times a week for 1 to 2 hours.	7%	0%	83%	100%	0%	0%	7%	0%
▪ Video conferencing	▪ Range from no usage [on campus student] to once in a while to see faces of classmates and frequently for classes.	0%	0%	40%	50%	37%	25%	20%	25%
▪ Face-to-Face (one-on-one)	▪ Range from 0 to 4 times a week to always.	3%	0%	80%	92%	3%	8%	13%	0%
▪ Face-to-Face (group)	▪ Range from 0 to 4 times a week.	7%	0%	83%	83%	3%	8%	7%	0%
▪ Fax	▪ Only when needed.	3%	0%	67%	83%	7%	0%	20%	17%

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