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Monica Adya
Marquette University

Dhruv Nath
Management Development Institute, India

Varadharajan Sridhar
Management Development Institute, India

Amit Malik
Management Development Institute, India

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BRINGING GLOBAL SOURCING INTO THE CLASSROOM: LESSONS FROM AN EXPERIENTIAL SOFTWARE DEVELOPMENT PROJECT

Monica Adya

Department of Management
Marquette University
Milwaukee, WI-53201
monica.adya@mu.edu

Dhruv Nath
Varadharajan Sridhar
Amit Malik

Management Development Institute
Mehrauli Road
Gurgaon-122001, India

Abstract:

Global sourcing of software development has imposed new skill requirements on Information Technology (IT) personnel. In the U.S., this has resulted in a paradigm shift from technical to softer skills such as communications and virtual team management. Higher education institutions must, consequently, initiate innovative curriculum transformations to better prepare students for these emerging workforce needs. This paper describes one such venture between Marquette University (MU), U.S.A. and Management Development Institute (MDI), India, wherein IT students at MU collaborated with Management Information Systems (MIS) students at MDI on an offshore software development project. The class environment replicated an offshore client/vendor relationship in a fully virtual setting while integrating communications and virtual team management with traditional IT project management principles. Course measures indicated that students benefited from this project, gained first-hand experience in the process of software offshoring, and learned skills critical for conduct of global business. For faculty considering such initiatives, we describe the design and administration of this class over two semesters, lessons learned from our engagement, and factors critical to success of such initiatives and those detrimental to their sustenance.

Keywords: virtual teams, success factors, communication technologies, project management, time zone management, cultural differences, institutional support.

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I. INTRODUCTION

Technological advancement and changing business needs often result in paradigm shifts in IT workforce needs [Zweig and SIM Advocacy Group 2006]. In current times, the IT profession seems to be undergoing another transition as technical work is increasingly offshored to countries such as India, China, Russia, and Ireland. Spurred by cost efficiencies, improvements in telecommunications and technological infrastructure [Gopal, Mukhopadhyay, and Krishnan 2002; Sahay, Nicholson, and Krishna 2003], availability of skilled IT professionals in offshore locations [McAulay, Doherty, and Keval 2002], as well as improved quality and communications standards in vendor countries, global sourcing of IT function has demonstrated exponential growth this century. Workforce shortages due to low output of IT professionals from universities [Murphy 2003; Zhang 2006] and gaps left by retiring baby-boomer generation [Zweig, et al. 2006] continue to fuel this trend.

In response, the transformation in IT skill requirements has been dramatic. As opposed to a decade ago when delivery of robust technological solutions was the prime focus of IT units, this era of global sourcing is mainly concerned with managing the process of software delivery [Abraham, et al. 2006]. In a recent interview of 81 executives from 77 IT departments, Zweig, et al. [2006] found that "client-facing capabilities are critical to this mission as are project-management skills" [pg. 48]. Consequently, IT strategy for many organizations supports in-house retention of project management, business process engineering, and knowledge of business domain [Abraham, et al. 2006] while transporting technical functions to offshore vendor locations where necessary talents abound. At offshore locations, technical staff, business analysts, relationship managers, and project managers who can effectively communicate with clients and manage global project risks are desirable IT candidates. Unfortunately, until the global IT workforce adapts and retrains for these emergent needs, businesses face critical skill shortages that can be largely mitigated by a responsive and innovative education system [Luftman, Kempaiah and Nash 2005]. Accordingly, higher-education institutions must introduce strategic innovations to revitalize their curricula and prepare a workforce that meets the needs of a global business environment [Ahlawat and Ahlawat 2006].

In this paper, we describe one such project-based initiative in global software development jointly offered by Marquette University (MU), USA and Management Development Institute (MDI), India. IT student teams at MU were engaged as clients/project managers who outsourced software analysis and design work to MDI student teams. Unlike typical corporate settings where software teams have physical access to vendor locations, rich communications technologies, and well-defined exchange processes for requirements gathering, student teams were restricted to e-mail, instant messaging, and other desktop communication methods, making this a truly virtual undertaking. At many levels this collaboration could have been challenged by distance, culture, and motivation. Yet, at several levels it was a success. In the next few sections, we describe our implementation and discuss factors that worked and those that did not. First, we review a range of educational initiatives in global software development and contextualize our initiative within this purview. Subsequently, we describe motivations for and circumstances of this collaborative teaching environment. We then detail the course setting, class constructs, and outcomes from two of the four semesters this course was offered. Next, we discuss our lessons learned from these four semesters. Implications for educators, researchers, and practitioners are discussed briefly in the conclusions.

II. HIGHER EDUCATION INITIATIVES IN GLOBAL SOURCING

Global transformation and specialization of workforce needs have tasked IT educators with introducing innovative, client-facing enhancements to their curricula [Abraham, et al. 2006; Rao, Poole, Raven, and Lockwood 2006]. Although most business schools already emphasize skills as valuation, systems analysis and design, and business modeling [Abraham, et al. 2006], challenges posed by a globally distributed software environment obligate educators to look beyond traditional classroom offerings. Differences in telecommunications infrastructure, language abilities and expressions, and culture and time zones [Carmel 2006; Walsham 2001] lead to coordination difficulties. Transfer of knowledge to offshore teams may be hampered by distance [Sahay, Nicholson, and Krishnan 2003]. Consequently, training in offshore management requires further development in existing business curricula [Davis, Ein-Dor, and Torkzadeh, 2004] through innovative extensions to traditional offerings such as systems analysis and design [Batra and Satzinger, 2006].

Today's academic environment represents a melting pot of pedagogical initiatives on the topic of global sourcing [see Abraham, et al. 2006 for a comprehensive discussion]. Most common are individual course offerings that provide a strategic view of offshore software development and management. For instance, George [2005] implemented a class on sourcing management that addresses multiple aspects of outsourcing including strategies and options, contract types, stakeholder perceptions, and sourcing lifecycle. Often, these courses combine elements of IT and International Business (IB) topics [Biese, Collins, Niederman, Quan, and Moody 2005] to provide a global perspective on IT work. With the emphasis on global sourcing strategies and outsourcing management, such courses are appropriate as graduate level offerings where work experience can complement in-class pedagogy. However, for undergraduate students who have little real-world experience to draw upon, an experiential component that simulates global software delivery processes is necessary [Abraham, et al. 2006]. Devoid of this pragmatic element, a theoretical course cannot adequately convey the complexity of offshore project management to the undergraduate audience. Furthermore, an experiential, project-based approach can emphasize the management aspects of IT work while softening its image as a technical and "geeky" field [Adya and Kaiser 2005].

We examined existing literature to determine the extent to which offshore projects have been integrated in existing IS/IT curricula. Although there exists a substantial body of research on virtual teams and virtual project management [see Powell, Piccoli, and Ives 2004 for an overview] most studies in this genre have a strong research component that shed useful light on virtual team management but little on the conduct of collaborative offshore teaching initiatives. We located three educational case studies that described such initiatives comparable to ours. Evaristo, Audy, Pirkladnicki, Pillati, and Lopez [2005] provide a useful overview of the client/vendor relationships among collaborating teams, duration and nature of project, and processes and technologies used for project design, development, and management. This study was executed between Brazilian and American students. van Genuchten, Vogel, Rutkowski, and Saunders [2005] described a course designed to instill realities of global work trends in IT students. The strength of this initiative was its multinational coverage—the collaboration spanned six countries. The project, although not rooted in a software development environment, engaged students in writing a joint term paper on a topic related to IS. In a recent study, van Genuchten and Vogel [2007] describe the extension of the above project into a Web development domain wherein European, Asian, and American students collaborate in a virtual setting to discuss an IT related topic via Web sites created by students. In this fascinating setting, students are expected to build upon similar Web sites created by past teams, lending realism regarding software project continuity not found in most such virtual team courses. Finally, Bennett and Watson [2006] described the use of renewable projects that can evolve in an open-source format within a global context.

In contrast to the previously mentioned studies, the MU-MDI initiative is unique in several ways: (1) students were engaged for a period of two months in a software development project; (2) requirements were exchanged by students in a virtual mode, devoid of any face-to-face interaction; (3) time zone difference of 11 ½ hours made this implementation more complex than collaborations between European and American nations; and (4) several aspects of project management were left deliberately unstructured to enable self-reflection and enhance experiential learning. We detail these and other experiences in the next few sections.

III. DESCRIPTION OF THE CLASSROOM ENVIRONMENT

The MU-MDI collaboration could best be described as serendipitous. With no prior affiliation, the two faculty groups initiated a relationship during the winter of 2004 in response to a request for collaboration posted on the ISWorld listserv by MDI faculty. Prior to this, MDI faculty had already developed associations with European universities and were looking to expand into the U.S. Simultaneously, MU faculty had received a grant from 3M Foundation for curriculum improvements in response to prevailing global sourcing trends. Establishing a partnership with an Indian or Chinese university was one of the earliest objectives of this grant.

With the common goal of improved learning environment at both locations, the faculty engaged in course design over the summer of 2005 and made the first offering in the fall semester of the same year. In this first offering, undergraduate students enrolled in a Project Management (PM) course at MU and graduate students enrolled in Information Systems Analysis and Design (ISAD) at MDI jointly worked for two months on a software project. In spring of 2006, the same collaboration occurred between graduate PM students at MU and graduate Management Information Systems (MIS) students at MDI. During both semesters, MU teams learned the same project management methodology and were required to submit identical project deliverables. MDI teams, however, differed in the methodology used. ISAD students used object-oriented analysis and design (OOAD) while the MIS students followed structured systems analysis and design (SSAD). Their project delivery points, however, were identical in nature. Table 1 highlights the course objectives for the PM classes at MU as well as the ISAD and MIS classes at MDI. These varied offerings are described in the following sections.

THE VIRTUAL TEAM STRUCTURE: A MULTI TEAM ENVIRONMENT

Collaborating faculty should not expect congruity in size of student body at both locations [Evaristo, et al. 2005] and accordingly must explore innovative implementation models. With IT enrolments declining in the U.S. but growing in India, we realized this to be our first potential hitch.

Table 1. Course Objectives for MU and MDI Teams		
MU Course Objectives	**MDI Course Objectives Fall '05 – ISAD Course**	**MDI Course Objectives Spring '06 – Management Information Systems Course**
Learn concepts of IT project management	Learn concepts related to ISAD process	Learn concepts pertaining to MIS
Develop communication plans and strategies	Learn Object Oriented Analysis and Design (OOAD) approach to systems modeling and in particular, learn Rational Unified Process (RUP) for requirements analysis. Compare OOAD with Structured Systems Analysis and Design (SSAD) approach;	Learn Structured Systems Analysis and Design (SSAD) approach to systems modeling
Assess and mitigate project risks	Use Unified Modeling Language (UML) (Use Case Model, Use Case Specifications, Activity Diagram, Class Diagram and Sequence Diagram) as a tool for information systems modeling and documentation	Use Context Analysis Diagram(CAD), Data Flow Diagram(DFD, Process Specifications, Entity relationship Diagram(ERD) and Screen-based Prototypes for systems modeling and documentation
Develop and manage IT project documentation	Manage requirements analysis and other user-related issues	Manage requirements analysis and other user-related issues
Managing project team interactions	Undertake ISAD projects in a virtual team environment	Undertake MIS projects in a virtual team environment

Furthermore, since the PM class was offered for the first time at MU in fall 2005, we did not anticipate large enrolments. As expected, the fall '05 PM class had 17 students as opposed to 36 at MDI while spring '06 enrolments were 27 at MU and 127 at MDI. To leverage this differential without overburdening or underchallenging the participants, each MU team was asked to manage two MDI teams, A and B. The management of these teams was differentiated by use of strict and tight control with teams A and loose control with teams B. Specifically, teams A were required to deliver a project plan to MU teams, submit weekly status report, and interact routinely with the MU team lead. Teams B, on the other hand, were tasked with no requirements other than final delivery on time and as per requirements. Intermediate interactions with teams B were to be at the behest of teams B but were not required by the MU teams. Figure 1 illustrates the set up described above.

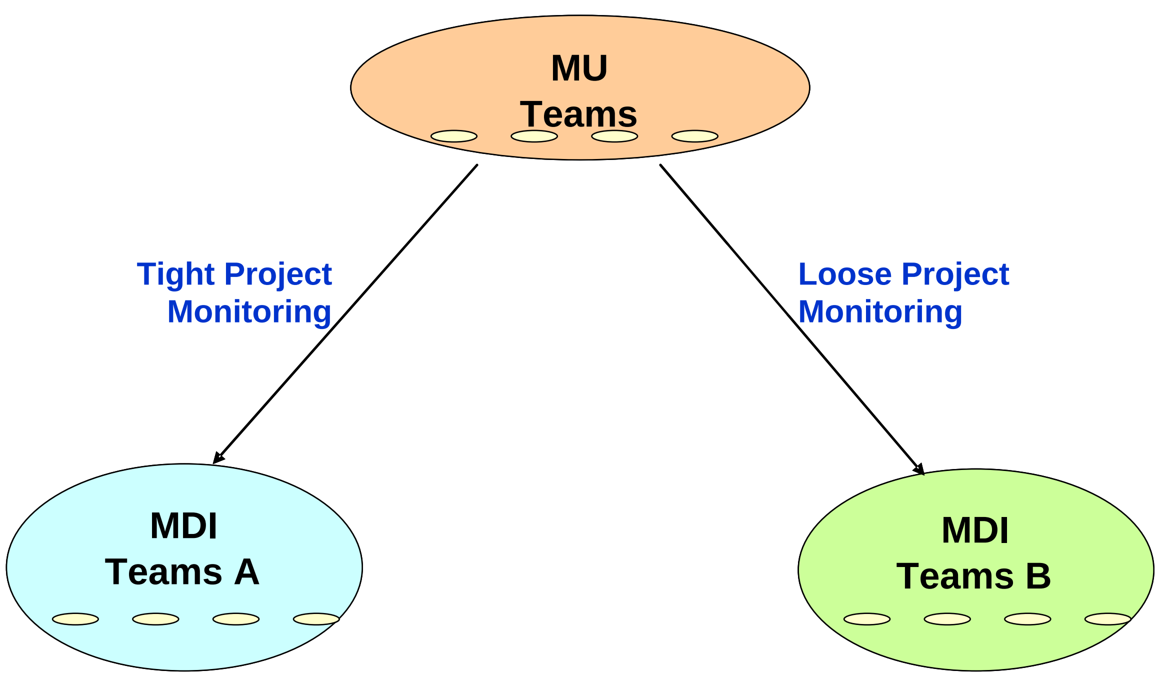

Figure 1. Structure of Virtual Project Teams at MDI and MU

During spring 2006, the same multi-team environment was replicated with primary differences being software development methodology and student constitution. At MU, with the exception of one senior undergraduate student, all students were graduate students with work experience ranging from 1-15 years. These arrangements yielded four MU and eight MDI teams in fall 2005 and 11 MU and 22 MDI teams in spring 2006.

The multi-team structure proved more beneficial than anticipated. MU teams were able to observe virtual team behavior in diverse settings and drive home lessons regarding management and communication styles. Furthermore, they realized the challenges of working with multiple virtual teams and projects while learning how to standardize the project management environment. MDI teams on the other hand were able to elicit requirements and then document, analyze and design corresponding artifacts from remote teams in a virtual field mode. Moreover, their awareness of the differential treatment from MU teams enabled them to compare and improve project management and communication processes.

THE TEAM PROJECTS

Constraining project scope was necessary due to limited overlap between MU and MDI teaching periods — end-September to end-November in fall 2005 and mid-January to mid-March in spring 2006. We first attempted to obtain projects from local corporations but faced scoping and legal issues, the latter because many firms were reluctant to release projects to student teams without legal binding. A useful alternative emerged from MUs' past service learning initiatives that brought forth limited-scope projects from non-profit and small for-profit organizations. Examples include a Web-based donation management system, volunteer management system, book inventory management system, and an e-commerce site for small coffee house. Due to the limited interaction time, no live clients were brought to class. Instead, the MU instructor role-played project sponsor and redefined project descriptions to keep the scope consistent on the basis of database and user interface complexity. Since analysis and design were to be conducted at MDI, MU teams only provided high level descriptions of projects. Detailed requirements were gathered by MDI teams through subsequent interactions in virtual mode. Figure 2 illustrates typical interaction between MU and MDI students.

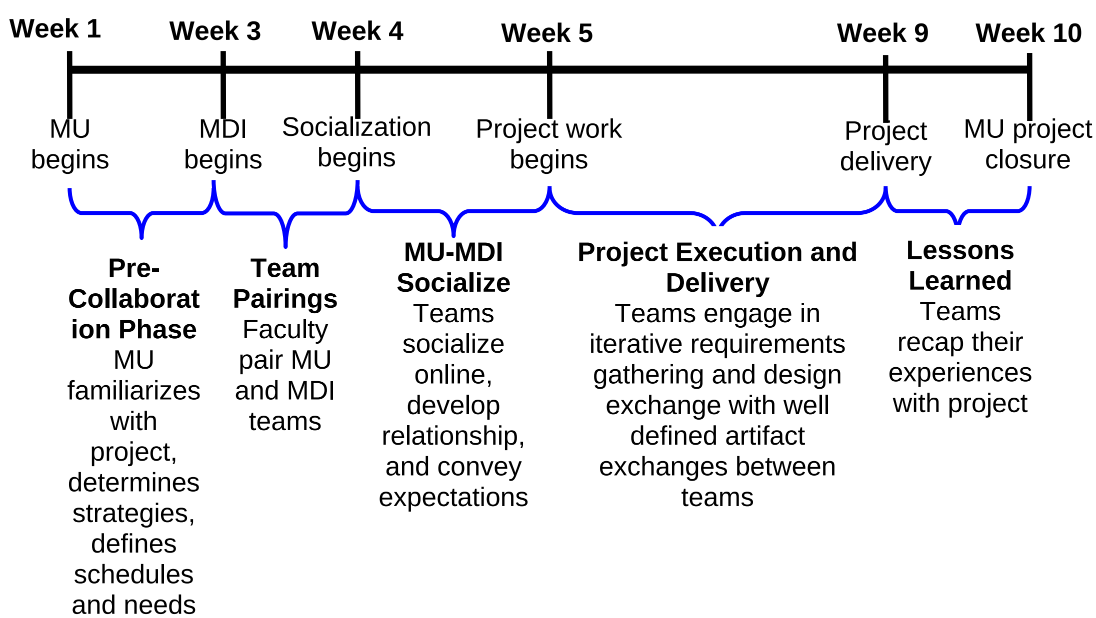

Figure 2. Typical Student Timeline for Fall Semester Collaborative Teaching Project

VIRTUAL TEAM COMMUNICATIONS

Virtual teams engaged in a week of socialization prior to project initiation. During this period, students exchanged personal profiles, determined viable communication methods and media, and set initial expectations. No project requirements were shared during this period. Students were exposed to an array of communication technologies but were required to determine the best alternatives for themselves based on time constraints and team preferences. Most students relied on instant messaging (IM) and e-mail exchange during socialization rather than desktop conferencing or other richer media. Time zone differences and limited access to computer technology and the Internet were most commonly cited as reasons for limited use of rich methods. There were, however, two teams in spring 2006 who used Skype for voice communications. These teams routinely communicated one night a week around 10:00 P.M. central standard time. Unlike Evaristo, et al. [2005] we did not use Blackboard or other online course management system to manage communications due to complexity of adding such large student groups to active directories of the collaborating institutions.

CLASS DELIVERABLES

During both semesters, MU teams were instructed to submit all traditional project management documentation starting with a project charter and concluding with final project signoff. They generated scope statements, work breakdown structures, and schedules, conducted risk assessment, and developed contingency and communications plans. The offshore setting required students to think beyond traditional factors. For instance, identified risks ranged from lack of cohesion with virtual team to impact of natural disasters, recognizing the December 2004 South Asian tsunami.

For MDI teams, methodological differences resulted in some variation in outputs from both semesters. During fall '05, ISAD groups submitted project plans, vision documents, use case diagram, use case specifications, supplementary specifications, glossary, class diagram and sequence diagrams, and screen-based prototypes. In spring '06, MIS teams delivered project plans, vision documents, entity-relationship diagrams (ERDs), data flow diagrams (DFDs), and screen-based prototypes. Additionally, tightly controlled teams A submitted weekly status reports and interim prototypes. Tables 2 and 3 summarize these deliverables.

Table 2. Required Deliverables from Virtual Teams, Fall 2005

Deliverables	MDI Teams A	MDI Teams B	MU Teams
Vision document	✓	✓	
Use Case Diagram	✓	✓	
Use Case Specifications	✓	✓	
Supplementary Specifications	✓	✓	
Glossary	✓	✓	
Screen shots	✓	✓	
Class Diagram	✓	✓	
Sequence Diagram	✓	✓	
Development Status Report	✓		
Project Charter			✓
Project Schedules and Resource Allocation			✓
Communication Plans			✓
Risk Assessment			✓
Contingency Plans			✓
Weekly Project Status Report (to Instructors)			✓
Project Closure Report			✓
Team A and B Assessment			✓

CLASS OUTCOMES

To determine teaching effectiveness, class outcomes were evaluated using multiple criteria. Foremost, we relied on traditional grade-based assessment of the PM, ISAD, and MIS deliverables presented in tables 2 and 3. For MDI students this assessment provided insight into their ability to capture and deliver system requirements and design to client satisfaction in a virtual environment. MU deliverables reflected student teams' ability to provide clear specifications, manage time zones and virtual team relationships, and keep projects on track from a time and scope perspective. Although a full assessment of these deliverables is beyond the scope of this paper, they provided sufficient and objective evidence regarding student learning of global sourcing processes and skills.

Next, we used survey-based assessment to determine whether students demonstrated greater motivation for and propensity towards virtual projects, were comfortable working with remote teams, and better understood the process, benefits, and challenges of global software development. A seven-point Likert scale survey was administered at the end of the project to measure the motivation, comfort and learning effectiveness of the participants. Survey items were adopted from Edwards and Sridhar [2005], Lurey and Raisinghani [2001], Jarvenpaa and Leidner [1999], and Jarvenpaa, Knoll, and Leidner [1998]. Readers are referred to Nath, Sridhar, Adya, and Malik [2007] and Sridhar, Nath, Adya, and Malik [2006] for a deeper disclosure of survey design and outcomes. Mean values and ANOVA results presented in Table 4 suggest that perceptions of MU students and MDI students did not differ significantly on the constructs of interest. High mean values of both the teams indicate that students were positively oriented toward the virtual team project on all parameters and support our recommendation that such virtual team exercises be integrated in other business courses to support global software trends.

Table 3. Required Deliverables from Virtual Teams, Spring 2006			
Deliverables	**MDI Teams A**	**MDI Teams B**	**MU Teams**
Context Analysis Diagram	✓	✓	
Data Flow Diagrams	✓	✓	
ER Diagrams	✓	✓	
Process Specifications	✓	✓	
Glossary	✓	✓	
Screen shots	✓	✓	
An intermediate version of all the above artifacts	✓		
Development Status Report	✓		
Project Charter			✓
Project Schedules and Resource Allocation			✓
Communication Plans			✓
Risk Assessment			✓
Contingency Plans			✓
Weekly Project Status Report (to Instructors)			✓
Project Closure Report			✓
Team A and B Assessment			✓

Table 4. ANOVA Results of Various Measures						
Variables	**Mean (MU Teams)**	**Mean (MDI Teams)**	**F (p)**	**Mean (MU Teams)**	**Mean (MDI Teams)**	**F (p)**
	Virtual Team Project – Fall 2005			**Virtual Team Project – Spring 2006**		
Motivation	5.94	5.93	0.003 (0.955)	5.42	5.79	5.727 (0.078)
Comfort	5.85	5.86	0.001 (0.973)	5.60	5.68	0.170 (0.681)
Learning	6.24	5.89	2.308 (0.135)	5.24	5.46	0.925 (0.338)

An unmeasured outcome of this collaboration was the improved marketability of students as a consequence of exposure to an offshore project environment. Students at MU provided many anecdotes, such as the one below, of positive employer reactions during job interview process:

> Compared to the 21 other students I interviewed with I was the one with the least technical experience but I was the only one that had the chance to manage remote teams to produce a project. In each of my interviews with (Fortune 100 company name blocked) as well as with (company executive), we focused on how as a college student I had the chance to be involved in a real project that dealt with an offshore team (or teams). *[Extract from an MU student's personal e-mail to instructor. The student successfully obtained full-time employment with this company]*

The experiential nature of this course and improved student marketability contributed to significant growth in subsequent enrolments for this course. MU version of the course received excellent ratings for both semesters and enrollments in the 2006-2007 academic year increased by 250 percent. The collaboration has directly supported the strategic aims of both collaborating institutions. Furthermore, the initiative aligns with MU's strategic vision for providing "transformational education in global societies" [MU Strategic Plan 2007-2013] as well as MDI's objectives of increasing similar collaboration in the United States.

Finally, from a faculty perspective, the collaboration has afforded us with several research prospects in conjunction with the opportunity to reflect current workforce needs in our IT curricula. Participating faculty have demonstrated high commitment to continued collaboration due to the strong working relationship established during the first year.

IV. LESSONS LEARNED: SUGGESTIONS FOR FUTURE GLOBAL PROJECTS

Virtual collaborative ventures face a range of risks that threaten their potential success. Since most international collaborations are initiated by individual faculty and only subsequently do benefits trickle up to the institution, faculty cohesion, shared objectives, and sustained commitment and enthusiasm are essential success factors. Next, student buy-in and commitment is essential in order to cope with the unprecedented demands and uncertainty associated with a virtual team project. Third, the virtual nature of this course behooves careful planning and active management of technological factors and class constructs, weaknesses in both of which can prove expensive for such short-term ventures. Finally, institutional and resource commitment are necessary for faculty to venture into new domains and introduce innovative improvements in the curricula. Where such commitment is lacking, educational institutions may be faced with uninspired faculty teaching in stagnant programs. In the next section, we elaborate on these lessons learned from our undertaking.

FACULTY RELATED FACTORS

Faculty Must Share a Vision Regarding Teaching and Research Outcomes

Collaborating faculty must share a vision for what they want to achieve from a global sourcing teaching initiative. This means putting aside personal agendas and taking the necessary risks, a conflict often encountered by untenured faculty who must balance teaching loads with intense research pressures. Especially for faculty at research institutions, such teaching enterprises may yield limited returns. Recognizing this, a primary motivation for both MDI and MU faculty was to have recognizable research outcome from this undertaking. Furthermore, considering the intensity of workload afforded by such collaborations, at minimum a three-year commitment is essential to provide economy of returns on these early efforts. Consequently, from the outset course planning and design emphasized long term commitment between participating faculty.

Faculty Must Define and Freeze Class Design Prior to Start of Semester

Mid-project changes to course design and constructs can cause confusion and frustration among students and result in lower morale and commitment. We discovered this during spring 2006 when we continued to refine our course offering into the semester and failed to freeze dates on deliverables to and from virtual teams. This resulted in communication delays and ambiguity which, unfortunately, cut into the socialization period. Concerted early preparations by faculty can reduce coordination and time delays. Consequently, the protocol for faculty at both MU and MDI now is to exchange key dates and expectations early in the design process and freeze dates two weeks prior to the first day of classes. Where dates must be unavoidably changed mid-project, faculty should leverage this learning opportunity to highlight project uncertainty and management strategies.

Faculty Must Experience Virtual Work to Relate to Student Experiences

Although virtual collaboration is not uncommon in academic research, the trust and commitment necessary for successful collaboration between dispersed partners is typically founded on some pre-existing affiliation. MDI and MU faculty did not have any such prior relationship, had never met, and in fact did not have any face-to-face or telephonic interaction until completion of the first semester of collaborative teaching, at which point the first author visited MDI. We limited ourselves to the same communications tools as students and designed, developed, and executed the courses in virtual mode. Since most of the design and development occurred over summer 2005, by fall, both faculty had obtained experiences similar to what students would undergo, had practical exposure to leveraging time zones, and identified appropriate communication media. Consequently, we were better equipped to provide effective guidance and problem resolution strategies than possible without this first-hand knowledge.

Face-to-face Communication is Essential for Sustained Relationship

Despite our effectiveness in virtual mode, we believe that the richness afforded by face-to-face meetings is most essential for reinforcement and sustained relationship. Since initiation of this collaborative effort, MU and MDI faculty have visited each other thrice. Each visit has been crucial for reinforcing positive outcomes of our efforts, revisiting lessons learned, revising strategies and plans, and reconfirming the need for this continued relationship. Rich discussions on these topics are challenging in virtual mode. Engaged faculty must either obtain buy-in from administration or seek external funding to facilitate such exchange at least once a year.

Communication between Faculty Must Be Defined, Frequent, and Clear

At both MDI and MU, students were taught that unclear, unresponsive, and ill-defined communication in a virtual setting can result in rapid breakdown of team trust. This principle guided the involved faculty extensively during course design and execution. E-mails were acknowledged and responded to within 24 hours. All collaborators were copied on messages and if one was unable to respond, the other would indicate expected response time. Faculty gave early indications of unavailability during critical phases. Since most communication was via e-mail, all points were bulleted in order to facilitate readability and assimilation of key issues. We had to carefully draft out messages so that ideas were conveyed clearly. Communication was respectful yet informal and most e-mails opened or ended on a personal note which continued to improve and enhance the spirit of collaboration.

Faculty Must Complement Each Other's Competencies and Roles

With the triple objectives of research, teaching, and student support, MU and MDI team members rapidly established complementary roles. The third author focused on experiment design in collaboration with the fourth author, a doctoral student, while the first and second authors concentrated on integrating these research and educational visions into their course design. Although effective in minimizing ambiguity, such well-defined role allocations run the risk of perpetuating insularity and overlooking input from all partners. Moreover, inadequate participation from partners who may become engrossed in managing their own responsibilities may hamper project cohesion. MU and MDI faculty provided input into each component of the venture at all stages of design and implementation, a factor that ensured buy-in from all members. Full agreement from all collaborators was a precondition to acceptance of a design or implementation detail. In this manner, different yet complementary perspectives were integrated in the end product. At our December 2005 debriefing, we agreed that this may have been the single most critical success factor for this project.

STUDENT-RELATED FACTORS

The demands of virtual projects can cause students to loose sight of long term benefits and rich learning opportunities afforded by the venture. To mitigate this, faculty must actively manage student expectations, enable trust between virtual teams, prepare students for contingencies, provide dedicated discussion times, and create an environment where students can self-reflect and find solutions. We discuss these and other student-level factors in this section.

Faculty Must Facilitate Student Buy-in and Manage Expectations

Both faculty and students engaged in this project did not have analogous experience from prior projects. As a result, we established an open relationship by emphasizing the novelty and underlying risks of the venture. Expectation management became important for student buy-in and sustained commitment during challenging periods of the project. For instance, one faculty's opening comments to the class were:

> I am going to experience and learn from this project with you. There are many things I will learn from you and many things that we will have to figure out as we go along.

This set the tone for students' relationship with the instructor as an experiential partner and facilitator. Students candidly shared their frustrations and challenges in the classroom and more interestingly, presented solutions that had already been deliberated upon or experimented with rather than expecting the instructor to identify a solution. Such facilitation imbued the learning environment with greater self-reflection and experimentation than originally planned.

Students Must Balance Social and Task Cohesion

Virtual teams must socialize in order to develop trust before engaging in project work. Over two semesters, some teams socialized more than others but those that only moderately did so appeared to struggle with cohesion throughout the semester. The student comment below highlights the necessity of such balance.

> I have no complaints about our MDI team because they do their best in response to the way we communicate. We are a "business-like" group which to me leads to no social interaction since early on. We started from the business end and skipped social aspects which has put us in this position. It works somewhat well, but leads our group to feel nervous out the submission of upcoming deliverables and status reports. [*Extract from weekly report submitted by MU student*]

While guiding groups that demonstrate low interaction, faculty must caution teams that continue to mingle extensively beyond the socialization period. Such teams can undermine their productivity through excessive fraternizing. To convey the desirability of balance between socialization and task focus, MU teams were required to read and discuss Croasdel, Fox, and Sarker [2003] that compares the performance of four virtual teams on varied dimensions of social and task cohesion. Students were then asked to compare their behaviors with the four teams and identify measures to bring about an ideal balance.

Provide Opportunities for Self-Reflection and Self-Correction

Often the richest learning environments emerge when instructors facilitate self-reflection and students learn experientially [Brooks 2000]. We did so by providing high-level guidance to students, allowing them to discover implementation details most congruent with their work styles, and requiring them to routinely reflect on failures and successes through weekly reports and in-class discussions. This flexibility obligated students to experiment with alternate strategies, reflect upon their work styles and habits, and determine best fit between the two. The following extract from a weekly report illustrates self-reflective behaviors encountered in this class.

> After the initial communication with the Indian team, my personal confidence in the project has decreased. The reason for this is very simple: we need to find a better way to communicate with the teams. . . . In the end I am hoping the lack of communication this past week was due to busy schedules. Hopefully we can set up a system of days/ times to communicate every week, no matter what. . . . We need to find a way to reenergize the whole team to be excited and ready to get to work on the project *[Extract from MU student's weekly report]*

Faculty must be prepared to manage complications associated with such deliberately ambiguous environments. Occasionally, our students became frustrated with the imposed process of self-discovery. To prevent escalation of negative perceptions, we provided opportunities for classroom discussion, enabling students to voice their frustrations and ponder over viability of potential solutions. In such open sessions, students can learn from a range of experiences across groups and work in a unified manner towards problem resolution. Such active learning and reflective strategies will impose demands on class time. We suggest that instructors should factor in routine discussion time into their class constructs and timelines.

Cultural and Time Zone Similarities/Differences: An Active Part of Class Discussion

One of the greatest early disappointments voiced by students was the limited cultural focus of this class. Limited social exchanges beyond the socialization period contributed to the dissatisfaction with this aspect of the course. Although since then we explicitly state that any cultural exposure will only be serendipitous, students continue to expect richer cultural exchange. Consequently, we now familiarize students with both national and work culture through alternate means. MU students, for instance, are given links to Web sites about the history, music, food, and religion of India. Books and movies representative of Indian culture are recommended. Similarities and differences in national and work culture are highlighted by inviting speakers with experience in both workplaces.

Unlike for culture, students do obtain deep first-hand experience with time zone differences. Some teams began understanding time zones challenges after failed attempts at organizing IM sessions with virtual teams.

> One major concern that was realized by our team over the weekend was that we will need to pay much more attention to the time differences between ourselves and the Indian teams than we had originally thought. Within our own team we began talking about how daylight savings time would affect when email updates would be received. We also discussed how we would not be as available to respond to any project submissions made by the MDI teams over the Thanksgiving holiday. If we were working on this project amongst ourselves or with other teams in the U.S. we would not have thought twice about not being very available over Thanksgiving break, but we must realize that the MDI teams will be expecting to continue working during the break. They will be expecting to maintain our existing means and frequency of communication regardless of what holiday customs we have. [*Extract from MU weekly report*]

It is not uncommon for students who do not effectively leverage time zone differences to become frustrated with long time lags. Our recommendations to these students range from setting routine times to exchange instant messages to keeping two clocks — one on Indian Standard Time (IST) and the other on Central Standard Time (CST). In all four semesters, we have found that no amount of lecturing on time-zone management can replace direct experience with these differences on a short term project.

Individual Characteristics Can Impact Team Cohesion and Motivation

Individual traits affect team atmosphere [Kleinman, Palmon, and Lee 2003] group cohesion [Zhang 2006; Peterson, Smith, Martorana, and Owens 2003], and interpersonal conflict [Jourdain 2004; Barki and Hatwick 2001]. In a virtual setting, the impact of individual attributes on team cohesion can be great and may require active monitoring and mitigation since the virtual team has no obligation to the remote instructor or team. This is particularly so for teams whose trust foundation is weak.

For us, two teams in particular demonstrated interesting contrasts. Team Communicative was guided by a leader who had global exposure through service learning and had demonstrated exceptional commitment to learning and to the project. She was an active communicator, a good listener, and enjoyed meeting new people. This team was able to build strong relationships with one of their MDI teams, which was also led by a similarly interpersonal leader. Team Communicative attributed the on-time and high quality of their project to trust and cohesion with this virtual team. Team Reticent was led by a member who was quiet and reserved not only with virtual teams but also with the local team. Two of her team members felt that her noncommunicative personality was detrimental to team cohesion. This group struggled throughout the semester to establish ground rules regarding conduct of the project. Eventually, only part of this team's project was delivered on time and as required. Members of team Reticent attributed this to the lack of cohesion at both local and virtual levels. Discussing the impact of individuals on team cohesion and trust can actively mitigate problems that might otherwise arise in a virtual team setting.

Find an Engaging Anchor for Graduate Business Students

Although this course was a success with undergraduate students at MU, graduate participants were less enthusiastic about its virtual component. Many were collaborating with global teams in their current workplace and had more sophisticated processes and technologies in place than a classroom could afford. Consequently, their enthusiasm for the project was tempered. However, graduate computer science (CS) and engineering students enrolled in the PM class expressed greater satisfaction with the course. While we do not have objective data to explain this, conversations with these students attributed this greater enthusiasm to limited global exposure in their traditional curriculum as well as limited virtual team experience in work settings. Such virtual team interactions were often handled by project or relationship managers. Faculty teaching such a course at the graduate level may receive better response by tailoring the project to audience profile. For instance, a virtual project based class could be offered in conjunction with a traditional class where students uninterested in virtual projects may bring in projects from work where they may have greater impact.

TECHNOLOGICAL FACTORS

Allow Students to Negotiate Technology to Fit Task and Work Styles

Students engaged in virtual team projects must be familiarized with three layers of technology – communications tools, project planning and monitoring tools, and documentation management tools which include content management and modeling tools. While it is tempting to equip students with uniform technologies at both locations, in reality, technology standardization is achieved between client and vendor organizations primarily via negotiation. At instructor level, we negotiated use of certain basic tools such as e-mail, IM, and MS Project (MSP). However, students were to negotiate modeling and specific communication tools. In effect, we facilitated task-technology fit rather than imposed a set of tools. While most MU students used MSN Messenger for IM and voice chats, MDI teams were more comfortable using Yahoo. Eventually, most teams found a common medium with some using Messenger while other using Yahoo or GoogleTalk. In our virtual project, many teams eventually determined that IM was most effective for socialization but not for project execution for which they preferred to use e-mail. Two teams, on the other hand, who acutely felt the lack of communications from their virtual teams, chose IM to routinely trigger conversation about the project and then followed up with e-mail.

With regard to PM technologies, all teams at MU and MDI were required to develop project plans in MSP. While one team attempted to use Excel during in the semester, team members soon realized the flexibility provided by MSP and reverted back to it. Another team found the simplicity and customizability of Excel spreadsheets more effective and remained dedicated to it.

Teams used a variety of technologies for content and documentation management. Two teams used content management Web sites such as www.plone.com or www.jot.com. Most such sites offer a free version with limited space but larger storage can be bought at a reasonable cost. These teams perceived smoother documentation management and communication with virtual teams. Most teams preferred to use Google mail due to larger space allocations and its threaded message storing format. Faculty may also use SharePoint or Desire2Learn (d2l) for this purpose.

Allowing students to negotiate technical standards provides a pragmatic learning environment but also increases the technological risks associated with the project. During requirements gathering, MDI team members found that MU students were unfamiliar with the design tool, Rational Rose. Since they were tasked with providing support for any deliverables to their client teams, MDI teams quickly discovered that Rational Rose outputs could be translated into Microsoft Word documents and this became the mode for exchange. As a MU student pointed out: "this made me aware of a new tool and forced me to learn about it." While there is value in letting students negotiate technological standards, instructors must be prepared to rapidly mitigate when these negotiations fail.

Anticipate and Manage Technological Risks

Technology downtime is a significant risk in virtual project settings. On short timelines, such outages can frustrate students and hamper the learning environment. In October 2005, during project kickoff, MDI experienced short downtime in its e-mail environment. Soon after MDI stabilized, MU experienced loss of external connectivity. Consequently students faced three to four noncommunication days during critical project time. The instructors suggested use of alternate e-mail addresses and subsequently, copying all e-mails to primary and secondary e-mail accounts became the norm.

Train Student Mindset to Use Technologies for Task Accomplishment

Most students use e-mail and IM for routine communication. Interestingly, however, they were challenged by the use of these same tools for task execution. A common discussion with MU students was how to word their e-mail messages so not to offend their MDI counterparts and yet convey firm requirements and timelines. As one student pointed out "I didn't realize how important it was to appropriately word my e-mail messages!" Another indicated how he had to go into a chat session with a written agenda because his team would often steer toward social conversation and needed to come "back on track." Instructors can use project discussion time and required submissions to train students on these aspects of communication management. They may also provide samples from past projects. The MU instructor also provides a "top 10" list of things to do or not when writing messages to virtual teams.

CLASS CONSTRUCTS

Design Manageable Projects

Since virtual team projects involve additional workload for faculty and students, it is important to keep the projects under manageable size and complexity while reflecting reality. One study, Favela and Pena-Mora [2002], has conducted virtual projects extending up to 32 weeks. Most other implementations, including ours, are of shorter duration typically ranging from two to eight weeks. Although short duration projects restrict the study of certain steady state behavior of teams [Edwards and Sridhar 2005], they allow students to reflect on multiple aspects of the project rather than getting overwhelmed with management of technical and logistical complexity.

Virtual Team Roles must be Complementary not Competitive

Synergy in a virtual project can be achieved when the virtual teams are given harmonious roles. In our case, MDI students' role as developers complemented MU students' role as project managers. Not only did this arrangement reduce the potential for conflict and role ambiguity, it also enabled students to observe dependencies that exist between complementary roles. For instance, MU students could only provide status reports to their instructor once they had received meaningful status reports from their MDI partners. As we discuss next, this arrangement enables teams to work with an enhanced spirit of partnership.

Create an Environment of Partnership

To minimize the feeling of "us versus them," faculty must work towards inculcating an environment of partnership between virtual teams. While there was ample opportunity to blame problems on virtual teams or technologies, instructors typically asked the local teams what they could have done better or differently. The focus then shifted to problem solving rather than fault-finding. After a few such initial encounters, this problem-solving mindset became the norm for most students. Furthermore, the grading structure did not reflect any competitiveness at the virtual team level. That said, there is value to having a grading structure that emphasizes a client/vendor relationship. We discuss this next.

Grading Structure should reflect Client/Vendor Interdependencies

In our initial offerings, we did not simulate any monetary aspects of client/vendor relationship in the classroom setting. Consequently, several students who struggled with timely responsiveness and relationship management issues with their virtual counterparts attributed it to this lack formalization. As one student reflected in his/her final evaluation:

> If this had been a true client/vendor relationship, the outcomes would have been different because we would have been more accountable to them as they would be to us.

We continued to see these comments throughout the first three semesters of collaboration. Consequently, since the fourth semester of implementation, 5 percent of the class grade for both MU and MDI students is based upon an evaluation from their virtual partners. We expect that this percentage is large enough to determine change in behaviors and commitment. We found little or no resistance to this addition both because we pitched this as a form of client/vendor performance evaluation and because students are used to peer evaluations in their traditional IT programs.

When Using Class for Experimentation, Plan for Alternate Measures in Experimental Design

The learning environment provides a valuable opportunity to integrate research objectives of concerned faculty. It permits researchers to experiment with newer approaches that may not have been explored by the industry yet. In order to support our research objectives, one of our early interests was to examine the impact of tight/ loose project monitoring on the quality of project deliverables during requirements analysis phase of offshored software projects as described in the earlier section describing the classroom environment. Such control settings have been actively used in distributed software engineering laboratories and business schools to conduct virtual team exercises [Powell, et al. 2005] and would have been ideal assuming all other factors remained constant across the two teams. However, since both teams A and B had equal project grades at stake, we observed that team B quickly learned about "tight monitoring" and began interacting with their MU teams with frequency similar to that of teams A, thereby weakening the control setting. Hence, faculty had to measure team member perceptions on project monitoring to allow for this learning effect. Results indicated that some members of team B indeed perceived higher levels of project monitoring, despite being part of "loosely controlled" groups. In using classroom for experimentation, faculty must anticipate potential compromises in control settings and plan for alternative measures for the target variable.

INSTITUTIONAL SUPPORT

Innovating Faculty Must Receive Institutional Support and Recognition

Initiatives such as ours require little direct administrative involvement. However, greater success and improved creativity can be achieved when innovating faculty receive institutional support and recognition. For a rigorous implementation, virtual classroom collaboration requires substantial planning and coordination that extends well beyond typical preparation for traditional courses. Instructors are required to meet internal learning requirements while extending traditional classroom objectives to their virtual partners. Managing student expectations and experiences can impose considerable demands in contrast to traditional classroom setting. Trouble shooting team issues, identifying communication methods and content, defining manageable projects, and managing partner relationships all take on greater magnitude in such projects. These demands can be discouraging to faculty without perceived support. Universities can obtain greater participation and facilitate innovative initiatives if incentives are provided in the form of course releases, monetary rewards, course development and travel funds, and other benefits to motivate faculty. Commitment can also be demonstrated by providing flexibility in curriculum development and formal recognition of innovative undertakings, particularly for junior faculty. For educational institutions mired in bureaucracy and inflexibility, this may be one of the most critical limitations to overcome in order to be on the leading edge of curriculum innovations.

V. IMPLICATIONS AND CONCLUSIONS

As the IT workforce reflects new skill needs, international collaborative projects provide opportunities to impart these skills while exposing IT students to global software development. From an organizational perspective, companies can expect to hire employees who are better prepared for global initiatives, have greater understanding work ethics and time zones, and are culturally sensitive. Greater involvement from organizations in the design and implementation of such international collaborations may further enrich the classroom environment while yielding a workforce whose skills are customized to organizational needs.

Aside from better preparation for the business of global software development, virtual project based courses may potentially renew waning interest in IT programs and majors. As the MU-MDI liaison illustrated, students view such innovative offerings positively and demonstrate high levels of motivation, comfort, and learning. Finally, collaborative initiatives provide rich research opportunities ranging from use of technologies for virtual collaboration to use of agile and rapid development methodologies in virtual settings. The challenge for educators then is to design a flexible, sustainable course offering that can provide rich enhancements to existing IT curricula. Through our case study, we demonstrate how business needs can be effectively integrated in undergraduate and graduate curricula in order to better respond to changing skill needs. We hope our lessons learned and recommendations, summarized in Table 5, provide an initial starting point for faculty considering such innovations. Additional course materials are available from authors.

Table 5. Lessons Learned during Global Software Classroom Initiative
Success Factors
Faculty Level Factors
• Faculty must have shared vision regarding teaching and research outcomes. • Faculty must define and freeze class design prior to start of the semester. • Faculty must experience virtual work to relate to student experiences. • Face-to-face communication is essential for continued and sustained relationship. • Communication between faculties must be defined, frequent, and clear. • Faculty must complement each other's competencies and roles.
Student Level Factors
• Faculty must facilitate student buy-in and manage expectations. • Students must balance social and task cohesion. • Provide opportunities for self-reflection and self-correction. • Cultural and time zone similarities/differences should be an active part of class discussions. • Individual characteristics can impact on team cohesion and motivation. • Find an engaging anchor for graduate business students.
Technological Factors
• Allow students to negotiate technology to fit task and work styles. • Anticipate and mange technological risks. • Train student mindset to use technologies for task accomplishment.
Class Constructs
• Design manageable projects. • Virtual team roles should be complementary not competitive. • Create an environment of partnership. • Grading structure should reflect client/vendor interdependencies. • When using the classroom for experimentation, faculty must plan for alternate measures in experimental design
Institutional Factors
• Innovating faculty must receive institutional support and recognition.

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ABOUT THE AUTHORS

Monica Adya received her Ph.D in Management Information Systems from the Weatherhead School of Management, Case Western Reserve University. She conducts research in the area of IT workforce, women in technology, and knowledge management systems, particularly for business forecasting. She was a co-recipient of a grant from 3M Foundation to examine influences of offshore outsourcing on IT workforce issues. Her work has been published in *Decision Sciences Journal of Innovative Education, Human Resource Management*, *Journal of Managerial Psychology*, *Information Systems Research*, *Information Technology & People, International Journal of Forecasting*, and *Journal of Forecasting,* among others.

Dr. Dhruv Nath is the Chair and Professor of IT Management at MDI, Gurgaon, India. He obtained his Ph.D in Computer Science from the Indian Institute of Technology, New Delhi. Before his academic career, Dhruv obtained more than 20 years of industry experience and is consultant to large multinational organizations such as Air India, Gillette, Glaxo, Indianoil Corporation, and Nestle among others. His research interests include VLSI technologies, IT management, and global virtual software teams. His work appears in journals such as the *IEEE Transactions on Computers*. Dhruv has written two books on *Managing Information Technologies*. His teaching interests are in the area of IT management, IS planning, software engineering, CRM, data warehousing, and e-business.

Varadharajan Sridhar, received his Ph.D in Management Information Systems from the University of Iowa. Sridhar's primary research interests are in the area of telecommunication management and policy, and Global Virtual Teams. He has published his research work in *IEEE Transaction on Knowledge and Data Engineering, European Journal of Operational Research, Journal of Heuristics, Telecommunication Systems, Information Resource Management Journal, Journal of Global Information Management,* and *Annals of Cases in Information Technology.* He was awarded Nokia Visiting Fellowship by the Nokia Research Foundation for his work on telecommunications. He is associate editor of *International Journal of Business Data Communications and Networking*.

Amit Malik is a doctoral student in IT Management at MDI, Gurgaon. He has done bachelors in computer engineering from National Institute of Technology (NIT). He has more than three years of professional experience spanning software design and development , process designing and implementation. Amit's research interests include virtual teams, offshoring, software development lifecycle and knowledge management.

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