Collaborative Innovation in a Global Research and Development Environment

Michelle A. LaBrosse
Alexandra Schneider
United Technologies Research Center
411 Silver Lane
East Hartford, Connecticut, 06118
USA

ABSTRACT

This paper documents the collaborative innovation techniques and technologies used by a global research and development project team. It illustrates the values and limitations of various communication media, addresses the various socialization aspects of those media, identifies the efficacy of using assorted communication technologies at various project stages, and addresses factors that led to successful collaboration of a global research and development team.

ENVIRONMENT

The global R&D team discussed in this paper works within United Technologies Research Center (UTRC) of East Hartford, Connecticut. UTRC marries market pull with technology push for the United Technologies Corporation business units (which include Carrier Air Conditioning, Hamilton Standard, Otis Elevator, Pratt and Whitney Aircraft Engines, Sikorsky Helicopter, and United Technologies Automotive). UTC has a presence in all but six countries around the world. UTRC has relationships with research institutions around the world and has field offices in Germany, China and Japan. The members of our collaborative innovation team were based in the Aachen, Germany, and East Hartford, Connecticut offices – with collaboration with other researchers at institutions in California, Massachusetts, Switzerland, Germany and Japan, and business unit customers in Germany, France, Canada, New York and Connecticut in the States.

This paper documents the techniques a UTRC team used to stimulate collaborative innovation in the global R&D environment. Collaboration and innovation were stimulated by creating natural communication protocols and by bounding the innovation in a project management framework. Team building was natural based on common interests and experiences in the R&D environment. Additionally, research and emerging technologies in the different geographic regions stimulated innovation of the overall group because of access and awareness of locally "grown" technologies. The papers shall give an answer of how to be successful in a global team.

The team worked on three projects. The first project was developing an in-house capability for process modeling, including the selection and training of a process modeling computer tool driven by a backend database. The second project was developing a strategic planning process to create research opportunities with the UT business units in the aftermarket arena. The third project was creating a systems dynamics modeling capability to understand the variables affecting the performance of the UT aftermarket service businesses and an exploration on the efficacy of developing "business flight simulators" using systems dynamics modeling

COMMUNICATION PROTOCOLS

The team was formed while the European members were visiting the US operation. During that visit, the team went to a conference together off site and developed a proposal together for future work. This was a crucial development of the teaming relationship and provided a context and a need for further communication when the team members returned to their respective locations. Additionally, research has shown that "physical proximity supports frequent opportunistic conversations which are vital to the planning an definitional phases of projects." [1] When they returned to their home offices, communication from their respective locations was a natural outgrowth of the work that had started when they were together. The communication protocols were daily email updates and bi-weekly, or often daily phone calls. The team members adjusted their schedules and their work locations to accommodate the time zone changes. For example, the team members on the East Coast would take phone calls from home at 6:00 AM and answer their e-mail to start the day at that time. The German team members would routinely take short calls in the evening up to 11:00 PM and answer email prior to turning in for the evening. This was a spontaneous interaction, again that was needs driven and not mandated by management. We found that

communication was actually more disciplined when the team was in different countries than when they were sharing office space.

In the world of ever expanding communication opportunities, people try to replicate what they perceive as the highest value form of communication – that of a face to face meeting. Yet the research team found that there was unique value and applications for a variety of communication techniques.

The following figures show the various method of communication the team used, their values and limitations, their applications and utility at various program management stages, the frequency and duration of each style, and the preference of the group environment for different communication techniques. Figure one gives a summary or our global project team and the issues that drove our communication preferences.
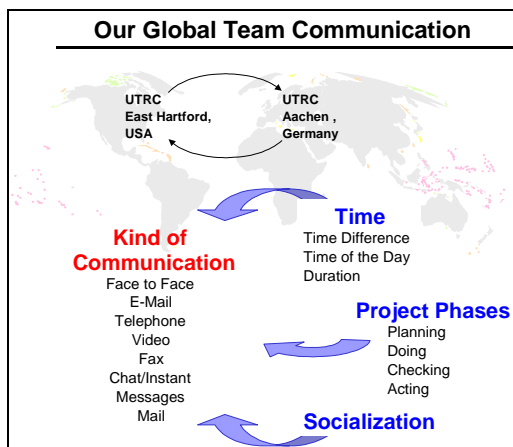

Figure 1

Figure two shows the value we received from each type of communication, the limitations we experienced using that communication medium, the applications where we found the communication medium useful, and the socialization level of the communication medium. The highest socialization rating is four stars, the lowest is no stars Figure three shows the groups communication preferences. The preferences were based on the distinct personalities of the group members and the dynamics of their interaction. The members of the group were all engineers with advanced degrees and were comfortable using the standard technology tools to communicate. Also, as engineers, the members of the group did not have formal training on how best to interact on video, therefore the use of video teleconferencing was not a preferred mode of communication.

Figure 2 - referenced in the Appendix at the end of the document.
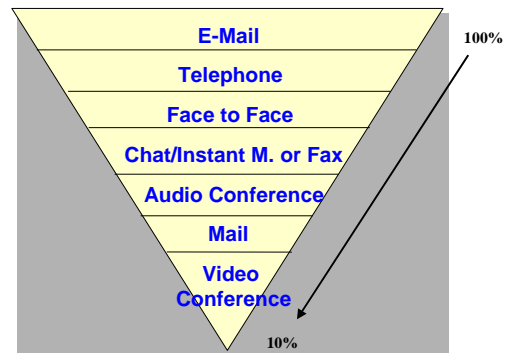

Figure 3

Figure four shows how often the group used different communication mediums and for how long in duration those mediums took to communicate. Email was the preferred method of communication because it could be done asynchronously – it didn't matter if the other members of the group were available or not at the same time. Also, it helped transcend the language barrier for the English as a second language members of the group.

Frequency of Communication

E-Mail	x-times/day	10 min/e-mail
Telephone	3x /week	15 min - 1hr
Chat/Instant M. or Fax	2x /month	15 - 30 min
Audio Conference	2x /month	15 - 30 min
Mail	1x /month	overnight - 6days
Video Conference	1x /quarter	30 min - 3 hr
Face to Face	2x /year	1 week - 6 months

Figure 4

Figure five shows the type of communication that was used at various stages of the project. In the planning stages of the project, it was important that the team got together to create the proposals and establish the norms of performance for the team. At the later stages, meeting face to face was not required. Also, in the planning stage, the telephone was not used since it didn't facilitate the planning document preparation – it was difficult to capture the planning information needed on the telephone. During implementation of the project plan, the group had much more dynamic, informal conversations. They found chat to be especially useful since the system they installed enabled them to see if each other were at their desk so they could get quick answers and make decisions faster than if they were to play voice mail tag or wait for answers to emails. During reviews of the project progress

where people outside the team participated, more formal means were used to communicate such as audio conferencing and video conferencing. The final deliverables of the projects were done through highly non-interactive communication mediums – the fax machine and the mail.
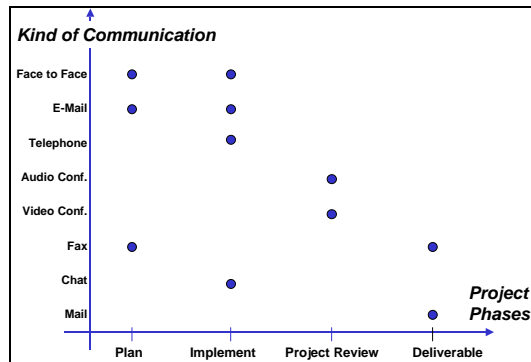

Figure 5

TEAM ROLES AND RESPONSIBILITIES

The team members at the parent corporation in the US were responsible for securing project funding, management support of the activity, and technical tools to facilitate the collaborative effort. The team members in the German operation were responsible for getting the University resources, interacting with the companies in Europe who were both suppliers and customers of our project, and testing the efficacy of collaborative tools available in the parent company in the States for use in Europe (example – efficacy of using NetMeeting on a slower Internet Connection). The roles and responsibilities were defined for each team member - depending on the member's personality and the environment he was working in. For example, the environment of a satellite office compared to the headquarter office misses the day to day interaction with people in the hallway, the physical interaction with people at meetings, and the socialization with other groups. But the satellite office has access to external resources not available at the main site. By leveraging the strengths of these two locations and understanding the limitations, we minimized the competition issues that have plagued many other teams that were formed between the two locations.

PROJECT MANAGEMENT

The project was arranged with tasks that could be done autonomously and tasks that required the team operating in a co-located environment. The entire team worked together for two months in the United States – participating in training together, refining the project scope, and coordinating the inclusion of other part time resources. One member

of the team was co-located for a six-month period to the States and another team member spent two, two-month periods with the team, with a break of two months back in Europe.

Task Sharing – The team did things that made sense based on their experience and the resources at the specific locations. For example, one of the tasks was to select a process mapping and improvement configuration management tool. One of the German colleagues had experience in doing software needs and features analyses. She started the software study in Germany, participated in a conference in San Diego where many of the software vendors were present, and was instrumental in making the final selection of a product after a worldwide industry search. She found other examples of German companies under the corporate umbrella who were using the product. This enabled the American members of the team to secure the capitalization to purchase the product and the training. The German colleague managed the relationship with the German software company and set up a customized training program in Germany with the company for the team.

COMPETITIVE ADVANTAGES

The world operates in a global marketplace. The different world views and expertise in specific regions of the world give a global R&D team significant competitive advantage over one that operates exclusively in one location. Operating from the perspective of synchronicity and synergy based on our differences enabled the delivery of much more diverse set of research solutions for the project.

KEYS TO THE TEAM'S SUCCESSFUL GLOBAL TEAMWORK

Team Building- Roles & Responsibilities - Commitments - Motivation - Task Sharing - Relationship - Personality

- The team was formed naturally. Management encouraged the organization of the team by supporting travel and proposed plans to work together. The synergism of working styles came before the proposal formulation for the project. The team members had an opportunity to get to know each other before making a commitment to working together long term on the project. Natural fit seems to be the basis for a long-term and purposeful relationship amongst the team members. There needs to be a

desire and a common vision - a giving and taking.

- The team started by creating a common project or goal to work on. This initial project plan created a natural interdependence. So, the team members had a common vision with respect to both the teaming relationship and the project.

- The team members had a strong, long term commitment to the team and to the other team member's professional development. They didn't see the project engagement as a one-time thing, but as the basis for ongoing professional relationships.

- The team created a team based career development plan and therefore saw and acted upon a more long-term view of working together than just accomplishing the project. Each team member was encouraged to choose his destiny. The team supported the person in finding their niche in the operation.

- Team members were self-motivated and worked in an environment of mutual trust, not fear. Each team member was encouraged to make his own decisions based on the balance between their personal needs and the needs of the project.

- The team members decided as a team the tasks to be accomplished and then each team member got to choose the best method for performing their tasks. They encouraged each other to pursue areas where they had a passion.

- The individual roles were defined based on the team members personality, their background and their experience (see C.A.R.E. = Creator, Advancer, Refiner, Executor, + Facilitator). The criteria of a natural fit were core team values.

- The team shared leadership based on their natural skill domain. There was a high level of respect, acceptance and enjoyment of each other 's natural talents and differences.

- The team treated events as discoveries and learning experiences – there was not a focus on events as mistakes or personal failures.

- The team enjoyed working together and had fun.

- Since the team was studying collaborative techniques, they naturally fostered an environment of collaboration, not competition.

Socialization

- Team members took the time to get to know about each other – they took time to exchange personal information and have social events together to maintain a strong relationship (e.g. hike up Mt. Washington, kayaking, happy hours, parties). They took this as an opportunity to get to know about each other's cultures and participated in normal day to day life with each other - attending children's school plays, cultural events, etc. Again they did what came as a natural enjoyment to the team.

Communication & Team Interaction

- The team created an environment of open communication - no fear to speak-up, to tell each others opinions, and to face problems.

- Team members had a common belief in the open sharing of all information and created a website as a shared space area for common information.

The Perfect Global Team Player

Action-Taker

Risk-Taker

Decision-Maker

Understand social use of technology

Good communication skills

Does not work with limitations or restrictions

Mobile

Good sense of humor

Ability to learn fast

Ability to experience new things

High interest in different cultures

Self-confident

Independent

Self-controlled

Self-motivated

Sociable

Flexible

- The team used a variety of techniques to communicate frequently. They were open to trying various technologies to communicate such as e-mail, Internet, NetMeeting, chat rooms, instant messages, newsletters, telephones, fax, videoconferences to support global communication.

- The team members did not bring a on the best interaction method. They were creative with no limitations or personal constraints.

Culture & Time Difference

- The team came to understand language barriers and cultural differences. They were flexible in communication. The non-native English speakers maintained their sense of humor when making a language faux pas. They used their time in the US as an opportunity to improve their language skills and sought out correction from their American counterparts. The American team members made sure to include the non-native English speaking team members in conversations and to encourage their self-confidence with the language.

- The team members became sensitive to the time differences. There was a focus on not disturbing the team members every night at home or in calling early every morning.

Use of Technology

- The team made it a priority to have the technology and resources they need at the right time and the right place, e.g. laptops, computers at home, phone cards, cellular phones, fax, intranet access at home, software, etc.

- The team members were given the time to learn and to experience the social use of this technology. The team was not only linked electronically, but also physically through business travel, conferences, etc. The team found that many businesses place constraints on the interactive use of Internet technologies due to lack of trust in the employee's ability to use the technology responsibly. This made it very difficult to collaborate in a global environment with people outside the research center.

OPPORTUNITIES TO ENHANCE COLLABORATION

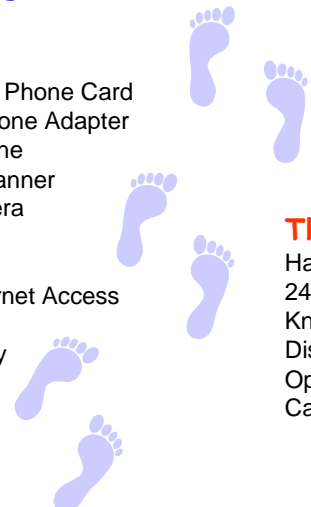### …. using emerging technologies

- Team training can happen in a virtual environment over the Internet. There are business development games on the market that teams who work apart from each other can use as a training ground and as a basis to develop shared experiences and a framework for how they will work together in the future. For example, Marketplace, from University of Tennessee, is one such game that is creating a version that can be played by team members in various locations. Marketplace is an opportunity to bring people together who have not previously worked together in an environment where their joint decision making skills can be developed without the outcome of decisions affecting the bottom line of the business. But just interacting with the simulation isn't enough, people have to meet face to face either during the simulation period at some time or after the simulation to put a face behind the faceless Internet persona.

- Use a program such as Conversoft to collaborate real time via the Internet. One of the challenges we had with Netmeeting was the connection speed and the size of the program. Conversoft is a much smaller program so the communication moves faster. This means that people who connect through a modem can have as good as an interaction as people who connect through a fast T1 connection via their companies internet connection. Additionally, it allows creation in a shared space amongst team members from anywhere in the world who can access the Internet. We have been beta testing this product and it will be released for sale in the Fall 1998.

**The Ability to Work Remotely
- the Working Survival KIT -**

- Backpack
- Laptop
- International Phone Card
- Adapters/Phone Adapter
- Cellular Phone
- Printer & Scanner
- Digital Camera
- Software
- Web Design
- Intranet/Internet Access
- Fax Ability
- Electronically
  Signature

The Virtual Researcher
Happy Self-Contained Unit
24 hr. Office Set-up
Knowledge Worker
Discoverer
Open Minded
Carries the Working Survival Kit

…. changing the culture of your organization

CONCLUSION

We found there were both technological and sociological factors that facilitated collaboration in a global environment. You need both aspects to create a successful team. People who like to interact with people from other cultures and who are comfortable using emerging technologies are best suited for performing the multiple tasks in today's global team. Additionally, technology drives the type of social interaction a team has and different types of interactions are necessary at different stages of a project. Therefore, it makes sense that different types of technology will facilitate different interactions depending on the needs of the project team. An enjoyment rather than simply a tolerance of both technical and social diversity are the keys for a successful global collaboration.

ABOUT THE AUTHORS

Michelle LaBrosse is a research scientist in Systems Engineering at United Technologies Research Center (UTRC). She holds a B.S. Aerospace Engineering from Syracuse University, and an MS Mechanical Engineering from University of Dayton. LaBrosse is well published in the fields of reliability, reengineering, and business development. She ran a business development practice for ten years prior to joining UTRC.

Alexandra Schneider is a Research Engineer in Product Development and Manufacturing at United Technologies Research Center, Aachen Germany. She holds a Masters Degree in Mechanical Engineering from University of Aachen, Aachen, Germany. Alexandra has lived and traveled in many regions of the world, speaks three languages fluently, and is adept at cross cultural communication.

Phones: 860-610-7517
Fax:860-610-
Email: labrosma@utrc.utc.com

REFERENCES

1.   Whittaker, Steve, et al, "Informal Workplace Communication: What is it Like and How Might we Support it," *Human Factors in Computing Systems*, April 24 – 28, 1994, Boston, Massachusetts, pgs 131 – 136.

ATTACHMENT - FIGURE 2

Kind of Communication	Value	Limitations	Applications	Socialization Aspect
Face to Face	you see & use body language	information recording depends on the individual	big group events & meetings	++++
	you socialize with the person better	people get off the track more often	to be creative and more productive	
	you can actually see the person	travel costs & time	to share ideas	
	you have a clear picture of the person	personal bias/judgement on others	to do group activities such as brainstormings	
	you get immediate feed-back		to negotiate	
	you can have meetings, other group activities such as brainstormings, etc.		to receive personal feedback	
	you have more spontaneous interaction with people		to discuss personal career development issues	
			to get to know each other	
			to solve conflicts or problems	
E-Mail	recordable information	people suffer from information overload	to work around the clock - no matter of time difference	++
	fast information exchange	written communication ability required - it is harder to write in a foreign language than to speak	to define tasks	
	low costs		to define projects	
	information can be sent to many people at the same time			
	global connectivity			
	ability to send attachments, internet links, etc.			
	asynchronous collaboration - you can send messages without having the people to be there.			
Telephone	you can hear the voice	just by hearing the voice, people draw a picture of the person.	for quick dialogs	+++
	you can leave messages on the voice mail	person has to be there physically to answer the call		
	ability to give immediate feedback	phone rings are distracting		
	ability to discuss issues	no time to craft your response when you answer the phone		

Kind of Communication	Value	Limitations	Applications	Socialization Aspect
	ability to stage the call, e.g. you can get prepared for it.	you don't know who is calling, if you don't have a caller id.		
Audio Conference		limited number of people	for project & milestone review	+
		hard to multitask and take notes	for project evaluation	
		hard to identify the person who is speaking	no big groups (3-4 people)	
		quality of sound		
		you can't share documents		
Video Conference	you can see the person(s)	quality of picture and sound	for presentations	None, as it is a very formal
	you can stage the setting - you only have to show what you want people to see	delay time of picture and sound	for project and milestone review	
	you can give presentations	you only can see what is on the screen	for formal reviews without the expense and time consuming face to face interaction	
		people stage the meeting - they act different		
		people are intimidated to see themselves on the screen		
Fax	recordable information	paper-based storage	not depending on software applications	None, as it is very formal
	used if software applications are not convertible	quality of the faxed information - sometimes not readable	high systems reliability	
	reliable information exchange compared to some problems with e-mails and server breakdowns		for the evaluation of contracts and legal documents	
	ability to sign the paper			
	global connectivity & accessibility to a fax machine			
Chat-Rooms/Instant Messages	online discussions with several people	limited number of people to chat with	for synchronous collaborations	(+)
	you can see people's availability for on-line synchronous communication	people need to be disciplined while chatting with each other	groups which are not bigger than 3-4 people	
	record of the discussion	time delay in information exchange		
		difficulties outside the fire wall		
Mail	to send nice cards or presents	time & costs		(+)

Kind of Communication	Value	Limitations	Applications	Socialization Aspect
	to send legal documents	resources		
	to send documents which need to be signed	storage of paper		
	to send large displays			
	to send invitations			
	to send conference information			
	to send books, articles and paper			
	to send hardcopies, if no electronic format is available			