CHAPTER 4

PROPOSAL OF A METHODOLOGY FOR INTERNATIONALLY DISTRIBUTED PRODUCT INNOVATION

4.1 Introduction

So far the two roots of this thesis -innovation and distributed work- have been presented separately in a theoretical manner running through their history, their definitions, their present applications and the related works that have been developed up to now.

Then, the Dojyo project, which was the inspiring event for writing this thesis, was described in order to establish a general understanding of the advantages, disadvantages and implications that developing an internationally distributed product might bring along.

After that, based on a seminar presented by one of the most experienced professors in the innovation area (Dr. Moritz), a process for systematic innovation was detailed with a description of every step involved on it. Finally, it was given a description of two essential topics for making distributed work: virtual teams and the communication problems.

The present chapter far from being a one-topic oriented research is more a compilation of several techniques and methods exposed by several authors. Those techniques are closely related to all the subjects discussed on this thesis and are ordered in a way so that the distributed innovation can be achieved in the best manner. This methodology is generally focused on university-level engineering projects on which students, professors and research institutions jointly participate. However further

extension of some of the points discussed here might be done in order to apply similar processes to the industry which is a broad area too and will not be the focus of this work but not less important to take into account by future thesis students.

4.2 Initial steps: project preparation

Before fully entering into the process through which a distributed team will go to innovate it is important to know what comes at the starting point of every project, in other words, the requirements that must be fulfilled to place a project on the right way.

There are many aspects taken into account, among the most important ones in the sequence are:

4.2.1 The existence of a core idea for an engineering project

Anywhere anytime can originate the perfect situation for proposing new ideas to start projects on product innovation. An idea may come from an individual or from a talk between several people. It does not really matter how; the fact is that there will always be someone proposing things for technology advancement. In the case of college/graduate-level projects these core ideas generally shall come from professors whose interests may vary from one engineering field to another.

4.2.2 The type of project: decide on team and philosophy

Once the general idea is “put on the table” it is time to sketch a configuration for the project. This means to decide if the characteristics of the project require to form a small-project team, a general-work team, a distributed-work team; among others. In this

case we already know we will focus on distributed teams. It is important to remember (as it was mentioned on last chapters) that there are different types of teams, each one having its own features and work modes. A collocated team may be compared with a distributed one but try to avoid generalizing both into a particular concept and thus making the mistake of enclosing distributed teams in the process frame of a local one.

Knowing the type of team then it is recommended (not so strictly) to choose a particular philosophy on which the future work will be based. A philosophy for a distributed team might not be applicable for a local team. For example, on chapter two, it is explained the Dojyo philosophy which in just a couple of terms (Do and Jyo) illustrates very well the way the team will be working through all the project time. Therefore it might be a good idea to choose some easy-to-understand quotation that the prospective members can use as a remembrance of the context on what they should be working.

4.2.3 Getting sponsored

This is a little more complicated when talking about distributed teams because it means not to think only on the product research and product development expenses, it also implies to think about an extra effort put into getting at least once the team in a face-to-face meeting. Some examples of sponsorship are traveling expenses, food, housing, communications, etc. This will vary according to the specific requirements of the team. Sponsorship sources might be governmental agencies, research institutions, universities, public/private companies and in some cases the own.

4.2.4 Pre-planning

The person or persons that got the core idea for the engineering project start contacting a few more people with special characteristics that will play a key role on the organization and further development. They can take the role of main leaders in the team and are usually a small group of one or two professors and two or three assistants (those may be students).

This group will be initially in charge of:

- Choosing a specific task to be developed during the project time, in other words, to define the product that is desired be developed (an innovative one in the case of this thesis).
- Deciding what engineering/scientific areas (multi skilled team) will be more convenient to have involved and to think what countries should be participating according to the necessities (multi cultural team).
- Generating the initial information about the project and making available an invitation at different points in the globe.
- Keeping always several international contacts (e.g., one or two professors that are aware of the relationship between students and organizers).
- Establishing the guidelines for choosing prospective members (which might be done by a direct invitation as written before or by a contest).
- Starting thinking on the configuration of the project: place, time, date, size of the team, activities, etc.
- Leading the overall process through the duration of the project.

This group of people should have some special characteristics as leaders of the team. Charles Conrad (2002) differentiates three types of leadership (traditional, relational and cultural); when applied to a distributed framework all of them relate and all become important in the same degree. For example, three essential characteristics of traditional leaders are: they must be organized, they must be good commanders, and they must be able to coordinate people and to control them.

When handling with relationships leaders should communicate descriptively and objectively rather than evaluative; they should focus on working together for solving problems; they should try to be spontaneous, open and honest and finally to encourage members to initiate communication.

Team members can believe, feel and act in different ways; that is why cultural leadership recognize this problem and must deal with it and get a balance between cultures in their groups.

4.2.5 Pre-organization

Before talking of pre-organization, it should be mentioned the importance of selecting a team and some hints when doing so. But, since it is a wider topic, it will be treated separately on the next subchapter.

The pre-organization task assumes that all the former points have been already covered plus the team is already built. It mainly consists on scheduling the activities that are to be done during the face-to-face meetings. A good idea is to organize all the data in a single easy-to-carry document containing not only the schedule but all the necessary information for those that are not familiar to the place, local contacts, transportation

system and maps. By the time of the meetings every member should have got one of those. Table 4.1 is an example of one of the several ways this information supplement can be done and how the activities are organized there.

Table 4.1 Documented plans

7:00 P.M.	Transfer to Hotel
8:00 P.M.	Bavarian Dinner at Hofbraeuhaus
9:30 P.M.	Reflection (30min)
SATURDAY, FEBRUARY 22	
12.00 P.M.	Departure to DLR, Oberpfaffenhofen
1:00 P.M.	Workshop, session 1: international systematic innovation, brief statements regarding the different "innovation styles" from Motohide Hatanaka, Stanford University, and Christian Henneke, TU Muenchen
3:00 P.M.	Workshop, session 2: international and intercultural cooperation in innovation; input speech "Introduction on shared mental models and coordination in geographically distributed work teams" by Carlos Acosta
5:00 P.M.	Development Environment: getting started with hardware and software to be used in the project, like BSCW, SolidWorks, Human Interface Design and Force Feedback Systems
7:00 P.M.	Transfer to Hotel
8:00 P.M.	Dinner, enterTANEment
SUNDAY, FEBRUARY 23	
10:30 A.M.	Transfer to Garmisch-Partenkirchen, Schneefernerhaus
3:00 P.M.	InnovationWorkshop, session 2: project settings, definition of core functions and perspectives
5:30 P.M.	Preparations for Dinner
7:00 P.M.	Intercultural Dinner, prepared by participants from stanford, Tokyo, and Puebla
8:30 P.M.	Reflection
9:00 P.M.	User oriented testing of international spirits (open end)
MONDAY, FEBRUARY 24	
9:00 A.M.	InnovationWorkshop, session 3: creative concept development
11:00 A.M.	Test of Innovative Winter Sports Equipment
4:00 P.M.	InnovationWorkshop, session 4: selection of a solution, optimization, first thoughts on details
6:30 P.M.	Preparations for Dinner
8:00 P.M.	North German Dinner, prepared by participants from Siegen, Magdeburg and Bremen
9:30 P.M.	Reflection
10:30 P.M.	Night Excursion
TUESDAY, FEBRUARY 25	
09:00 A.M.	InnovationWorkshop, session 5: diving deeper in project work, clarification of open questions, further project settings
11:30 P.M.	Sports activity, to be defined
3:00 P.M.	Intercultural Lifestyle Skills
4:30 P.M.	InnovationWorkshop, session 6: definition of the further project proceedings
8:00 P.M.	Farewell Party
WEDNESDAY, FEBRUARY 26	
10:00 A.M.	Departure from Schneefernerhaus

2

4.3 Building an international team

To choose people for a distributed team is not an easy thing. In preceding chapters it has been written what a virtual team is and what differentiates them from other type of associations. It is important to remember that a group of individuals who compete for the same goal is not the same as team members moving toward a shared goal. In a true team there will always be task interdependence, shared responsibilities, shared processes, relationships and trust (Haywood, 1998). I personally participated in a team building activity organized by Dr. Moritz on which some of the points mentioned just above are included plus some more. In the next table (4.2) it is shown what is needed in every individual to be part of a true team. Dr. Moritz activity will be detailed on chapter five.

Table 4.2 Features that are commonly present in good work teams

Team members…
Always join and participate. They are not passive at anytime
Try to balance (mediate) the work-conflicts but they never put them away
Trust each other without being totally dependent
Experiment during certain periods but they never loose the long term vision
Present the results as a team without highlighting only one person
Act but do not feel more powerful than everybody else

I personally would say that *participation* and *trust* are the most essential requirements when being part of a geographically distributed team. Since most of the time, team members will not be facing each other and checking directly what tasks are

doing each, there must be a good level of confidence among all them that the objectives will always be accomplished.

4.3.1 General procedure for building a distributed team

Creating a distributed team involves more that just establishing a vision. This is somehow related to the paragraph of sponsorship. When building a virtual team, it is necessary to think of the infrastructure which is not necessarily money but technology, software, hardware, etc. Building a team is a process that should be kept in "constant maintenance" so the team be stable through all the time. That is why I considered four steps proposed by Martha Haywood and placed them into a cyclic diagram (Fig. 4.1). This means once a team is conformed, leaders should keep it in a constant rebuilding process and should be aware every step in the cycle is always conforming to the others.

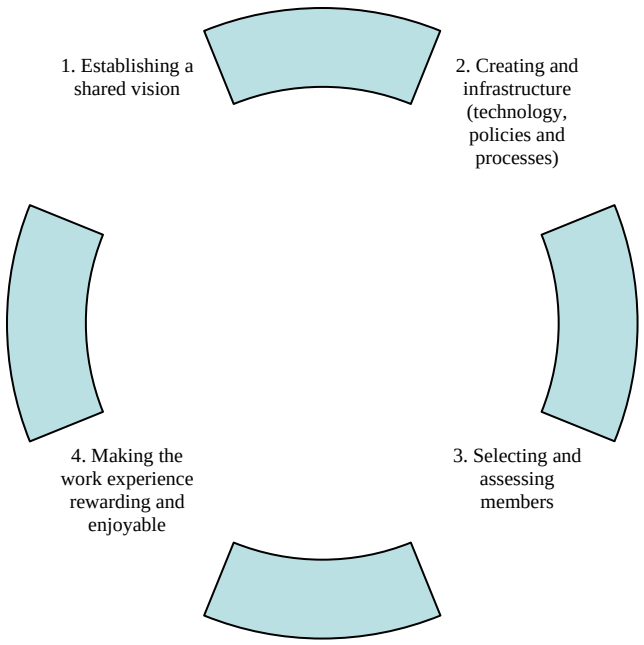

Figure 4.1 Process for building a team (Haywood, 1998)

Remarking step 3 (fig. 4.1), the fact that the diagram is cyclic does not mean that every cycle members will be thrown away and new ones will be brought up. It means that new members are always welcome to join the old ones through the project time.

Point 2 in figure 4.1 suggests that creating an infrastructure will facilitate communication, workflow, relationship building and corporate memory. I already mentioned the importance of this in the antecedents' chapter.

4.3.2 Predicting if a person will be effective in a distributed team

It is always better to prevent problems than to pay the price for solving them at the moment. Not every person will be adequate for a specific project within a specific team, so the more success a distributed team wants to get the more selective they must be when choosing their people. Here, it will be discussed two evaluation tools that can help team leaders (managers) to handle the situation of selecting individuals: The alignment model and the maturity model.

- **The alignment model**

It is designed to help managers to select and assess people who will allow them to get the best performance with the current infrastructure (Haywood, 1998). Basically it represents every member as "blocks" consisting of four areas: goals, processes, tools and skills; in order to fit individuals into a team they must be "aligned" in all four areas. Figure 4.2 is more explicit on this.

The alignment model does not necessarily mean to look for the perfect fit, instead, teaches a manager to understand and establish the minimum criteria he will be requiring in his teams and to make plans for helping members to reach the "alignment" so desired.

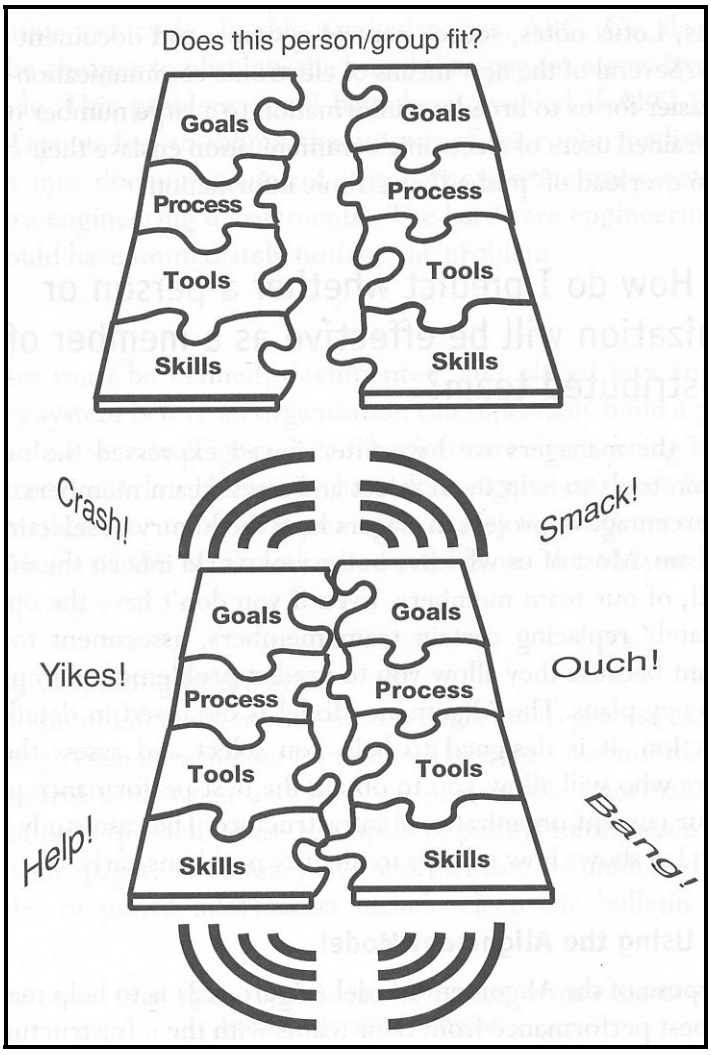

Fig. 4.2 The alignment model (Haywood, 1998)

It is logic to think that to get acquainted with a team member's goals, processes, tools and skills; the project leader should ask for the information directly. Actually, the way the alignment model works is through a series of questions (checklists) made to every team member which can be evaluated afterwards by the managers to make the final decision (Haywood, 1998). Based on the objectives of this thesis next there are the checklists that should be included in every internationally distributed team working on a mechanical engineering project.

- Assessing goals

It is recommended that leaders define and communicate the goals of the project; if possible they should have a written statement before making the evaluation of each member. Leaders are encouraged to create a common definition of values to avoid differences among multi-cultural teams. The checklist is shown below.

  - Their reasons for participating in the project
  - Their attitude toward processes, tools and skills
  - Their competing priorities
  - Their level of commitment to schedule and quality goals
  - Their attitude toward decision making
  - Their attitude toward communication

- Assessing process

In the case of mechanical engineering a particular team may be used to work with some specific process, for example to write specifications, making rigorous design reviews and executing testing. Then the project leader will prefer searching people accustomed to work that way. Next are some points to be taken into account.

  - To know what a process is
  - Experience with similar processes to owns
  - Willing to adapt
  - Commitment to the availability standards

- Assessing tools

"It means that all the team members have equal ability to access shared resources and communicate information to the team" (Haywood, 1998). For instance, mechanical engineers find very useful web-based systems where they can share HTML or PDF documents. One application is when team members use different CAD programs but they apply PDF files to visualize each others drawings. Here is a helpful checklist:

- What CAD tools (software applications and hardware platforms) they have available and if there is a common data-interchange format?
- What tools they will have available for communication and if these tools are compatible?
- What tools will be available for documentation?

Before continuing I would like to answer the question about the CAD problem orienting it to the case of institutional projects (professors and students) as the dojyo case. On one of his publications, Acosta (2002) studies the case of four companies working together in a global environment to design, assemble and produce a power train for a vehicle. He points out the problem of CAD data exchange between the companies (use of different platforms) and the consequences that created. Acosta concludes that CAD incompatibility needs to be addressed from the early stages of project formulation. For teams one solution (but quite expensive) might be to purchase the same license for all which I think is the most viable solution for groups like TANE. An alternative for teams is the use

of neutral formats like STEP, IGES, VDAFS, and DXF. Finally, one more option is the use of translators which is not so reliable when everyone is using different platforms.

One of the actual problems in Mexico with respect to the available design hardware is that the data exchange is made through physical media such as print outs or cartridges because the rejection to invest in high performance networks. Another problem is the main use of PC's (which is not advantageous at all) for platforms like CATIA, Pro/E, Unigraphics, IDEAS or ICEM which were originally conceived for robust systems such as UNIX (Acosta, Switek, Calderon; 1998). So, although the dojyo is not an industrialized project at the time, one should consider this information.

- Assessing skills

A distributed team member is evaluated also on his communication skills and the way he manages his own work alone. Some important points are written below.

- Level of technical skill
- Records of quality work, work meeting specifications
- Level of management
- Record for delivering on time
- The strength of communication skills

- **The maturity model**

The maturity model is all about the "effectiveness" of a virtual team to meet project and organizational objectives on time and on budget. The team goes through four levels each one having specific characteristics and problems. Figure 4.3 illustrates the path teams follow when applying the maturity model.

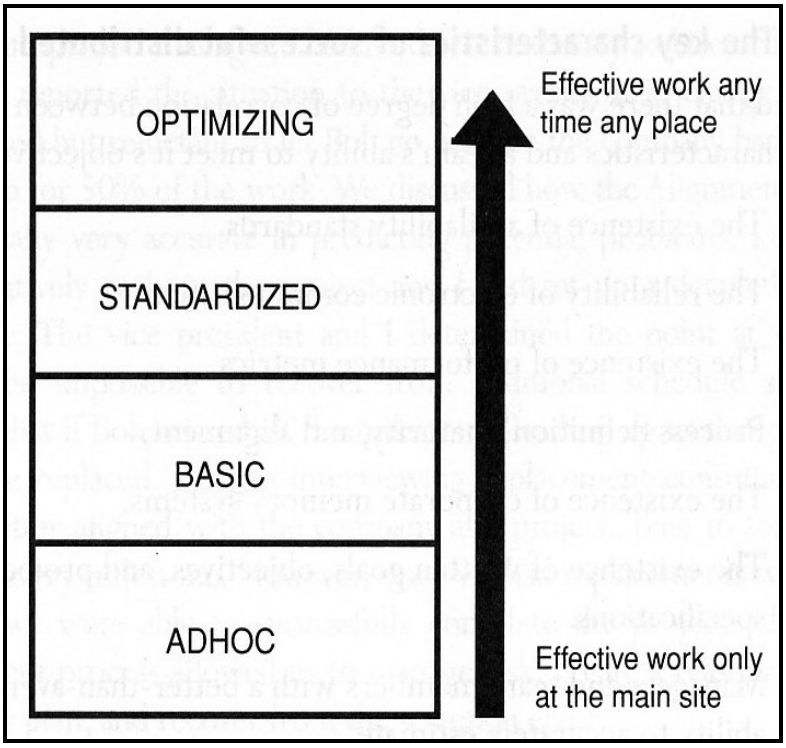

Figure 4.3 The maturity model for virtual teams (Haywood, 1998)

Now, I will present some characteristics/problems at each of the levels from figure 4.3 that may be present in a distributed team when working on a mechanical engineering project. These are taken from the recommendations proposed by Haywood (1998) and are organized in charts for easier comprehension.

- **Adhoc level**

Table 4.3 Characteristics and recommendations to the adhoc level teams

	Characteristic/problem	**Recommendations**
Goals	▪ Unclear objectives	▪ Develop a mission statement ▪ Write specifications and objectives
Processes	▪ No availability standards ▪ Communication is push ▪ Management by observation	▪ Institute availability standards
Tools	▪ Unreliable member's access to electronic communication ▪ Incompatible tools	▪ Stabilize the electronic communication
Skills	▪ Inexperience for communicating electronically ▪ Communication is not prioritized ▪ No principles of distance communication	▪ Develop member proficiency on e-mail, voice-mail and fax ▪ Institute training on distance communication ▪ Senders should prioritize communications

- **Basic level**

Table 4.4 Characteristics and recommendations to the basic level teams

	Characteristic/problem	**Recommendations**
Goals	▪ Specification and objectives not clearly defined	▪ Develop details on project specifications and member objectives
Processes	▪ Availability standards are in place ▪ Processes misaligned ▪ Communication is primarily push	▪ Define, document and align processes ▪ Analyze information flow and transition from push to pull
Tools	▪ Communication is reliable and all members have access ▪ Applications still need alignment	▪ Select translation mechanisms ▪ Select tools for transitioning information flow from push to pull

Skills	▪ Members have been trained in basic communication ▪ Members understand the basics of distance comm.	

- **Standardized level**

Table 4.5 Characteristics and recommendations to the standardized level teams

	Characteristic/problem	**Recommendations**
Goals	▪ All objectives are aligned	
Processes	▪ Processes and systems are installed ▪ Information flow is better	▪ Optimize processes ▪ Continue analyzing information flow
Tools	▪ All tools are in place and reliable	
Skills	▪ Good practice of distance communication skills	

- **Optimizing level**

At this level, teams are able to work any time, any place and new members can easily be integrated (Haywood, 1998). The team should keep improving and optimizing itself from now on.

4.3.3 Do you feel belonging to a team?

Although work is already being done by a distributed team, sometimes there is the need of something more than just being there doing what one has to do. As in any society a team member is not exempted from the need of belongingness. This is better illustrated on the Maslow's hierarchy of needs (fig. 4.4).

The need of belongingness becomes stronger when distance is present; there is no direct physical contact, there is no face-to-face communication, there is no watching of

daily real context and it becomes harder for team members to get along with the others. However, some useful techniques may be used in order to achieve and maintain always the feeling of belongingness. Then it is essential to build *relationships and trust* among remote members.

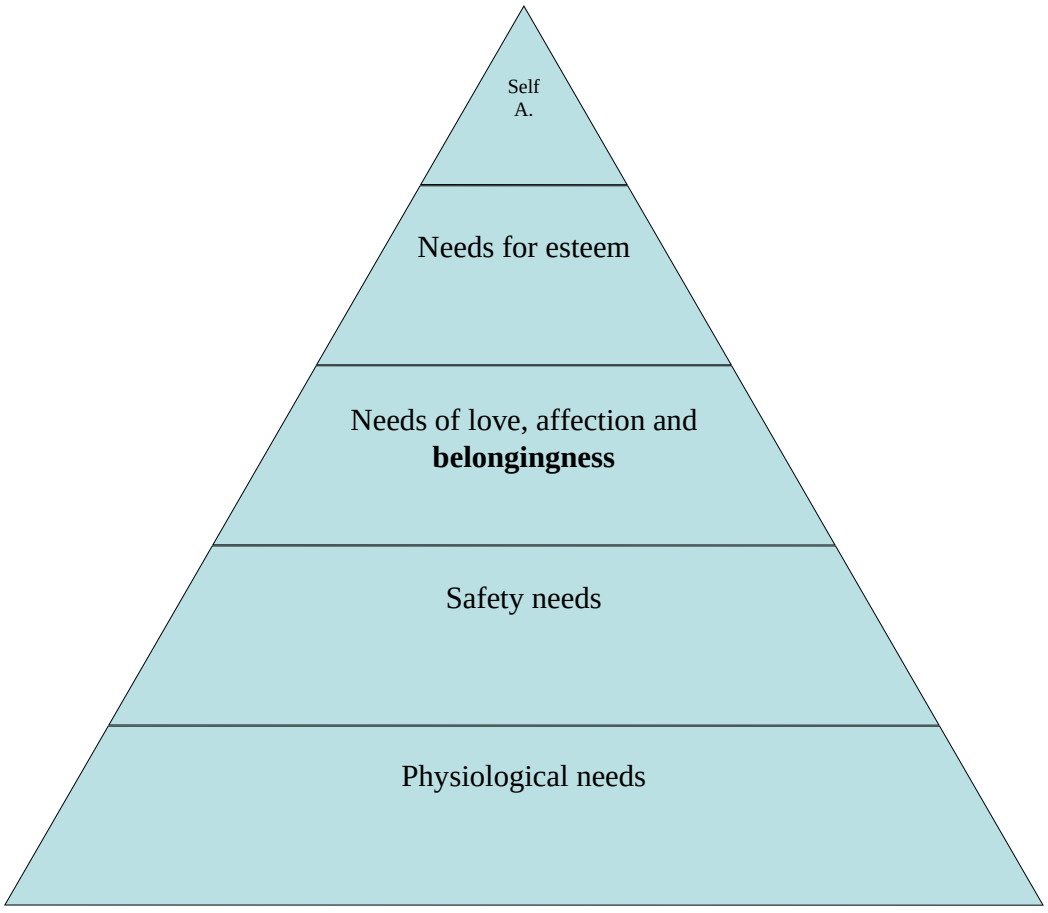

Figure 4.4 Maslow's hierarchy of needs

The first thing a team can do is to generate its *own identity*. For example:

- Get a name
- Use symbols (logos or pictures)
- T-shirts or mugs

Through this entire thesis the concept face-to-face meeting has been pointed out and it is because actually it plays a very important role on building relationships. Face-to-face meetings are absolutely necessary in every distributed team project. It is recommended that there are face-to-face meetings several times a year; also at the beginning of the project, when there are personnel changes or when there are complex problems to solve.

Fun is a must! Fun is a key factor for releasing stress and getting people closer to each other. Leaders should try several activities that are culturally accepted by most members and everyone can be involved. A culturally accepted activity means that it contains combined cultural backgrounds but up to certain degree that no specific culture will trespass the boundary of the others and shade them or affect them. In other words it is an activity mediated by an equilibrated management of each culture involved.

For example Mexico's culture is great and complex, although it would be a hard task to understand deeply our culture it is possible for foreigners to get a general horizon of it in order to change the way they make relations or handle situations when working with Mexicans. This can be done the opposite direction: Mexicans should try to get a general panorama of other cultures before getting involved with people. So I would like to share to others (for having a basic understanding of the Mexican culture) some of the most popular activities among our people which are available for foreigners whenever they visit us: touring, shopping, food, and fun.

Touring in Mexico is nice since our country has so many fauna and flora, so many kinds of weather, so many kinds of geographical configurations which allows people to do almost everything. Just to mention some examples of places one can find

archeological ones, beaches, mountains, jungles, colonial cities, small villages, ethnicity, modern cities, etc.

Shopping is a great deal in Mexico, not only the usual mall-shopping but wherever one goes one can find such a big variety of traditional products original from the region one is visiting. Clothing, shoes, figures, body artifacts, craftsmanship are just a few examples of shopping products.

Mexicans have a very particular way of making commerce with traditional/non-traditional products which was initiated by our ancestors and is still used: the “tianguis”. The tianguis is a kind of big street (outdoors) supermarket on which merchants trade a diversity of products that range from clothing, food or personal belongings to cars and other expensive goods [13]. Mexican people no matter their social status enjoy very much this activity since one can find the right product one is looking for at a really good price. The tianguis activity is not as simple as it sounds, it is a tradition, it is part of our culture and that is what makes it interesting and funny. In a tianguis, customers get involved with some Mexico’s roots for example dealing with the merchants who in some cases come from the ethnic groups still alive, buying old-fashioned products like devices for cooking from hundred years ago, traditional hand-made clothing, Mexican “antojitos” (original Mexican food), etc.

Why the tianguis tradition is so deep in Mexican culture? Because it is a heritage from our ancestors and started several centuries ago. The first groups such as the Aztecs based their lifestyle on agriculture, commerce and war. Their cities had always an intense activity of peregrines, merchants and craftsmen through the “good-exchange” trade system. Tlatelolco, the second Aztec capital, hosted the biggest and most important

tianguis of ancient Mexico on which people from the entire Mesoamerican region meet to merchandise mainly food and weapons (Aula Encyclopedia, 1993). This is how the tianguis was created.

Food, what a big topic to make a thesis on itself! Mexico is one of the countries with most variety in original delicious recipes. Sea food, meat, “antojitos”, vegetarian, typical, bakery, candies and much more exist in our country for delight.

Fun in Mexico is not excluded of course. Our country is full of nightclubs and fun centers so people of any age can enjoy having a nice time and doing what they like to do. But fun also includes activities like sports, museums, concerts, etc. Thus, knowing about Mexican culture will help a team to orientate the working way and the product.

4.3.4 Other suggestions

Up to now one may say that working a distributed team has certain degree of complexity and that is true, there are too many aspects surrounding this topic. From my own experience I will make a few more suggestions for a better performance of virtual teams:

- If it is to be called distributed work for product innovation, the team should be conformed by more or less the same number of members from each location (e.g., five members from Australia, five from Taiwan and so on). When the circumstances do not allow this exact configuration leaders must make sure there are at least two members from the same location each to avoid isolation.
- It was mentioned that in the starting process of a project, the team initiators are a small group of people who will be leading the new members. In fact it is correct

to assume they will be the main leaders through all the project time but having team members around the globe requires establishing local leaders. They will be managing and keeping track of the work done at every location and reporting the advancements to the main leaders.

4.4 The innovation activity

Chapter three covered the innovation concept and the innovation process deeply; it is a good theorical base and by understanding and following those systematic procedures the difficult path for product innovation opens, especially in the mechanical engineering area. The method proposed by Dr. Moritz (2003) is a very complete one and with many strengths on the creativity stimulation. It is an excellent tool for working with distributed teams since it allows everyone to be part of the innovation process. Now it is time to talk about the aspects that support and make possible the innovation process to be a success, those ones that have to be present and accompany product innovation in virtual teams [9].

4.4.1 Face-to-face meetings

Absolutely necessary for building strong relationships among team members face-to-face meetings are the perfect framework for realizing the innovation process. It is almost impossible to imagine that product innovation is done by a team whose members are just being seated at their own workplace separated one from each other. Innovation is a process of creativity, brainstorming, and continuous idea suggestion better done by a unified in-place work team in the same space and time.

A face-to-face meeting is just the “excuse” for getting members of a team together, putting them into the right path of the innovative process and carrying them to achieve the desired results. There are many activities to do during face-to-face meetings which feed the central innovation task. Take a look on the next diagram (Fig. 4.5) showing some examples.

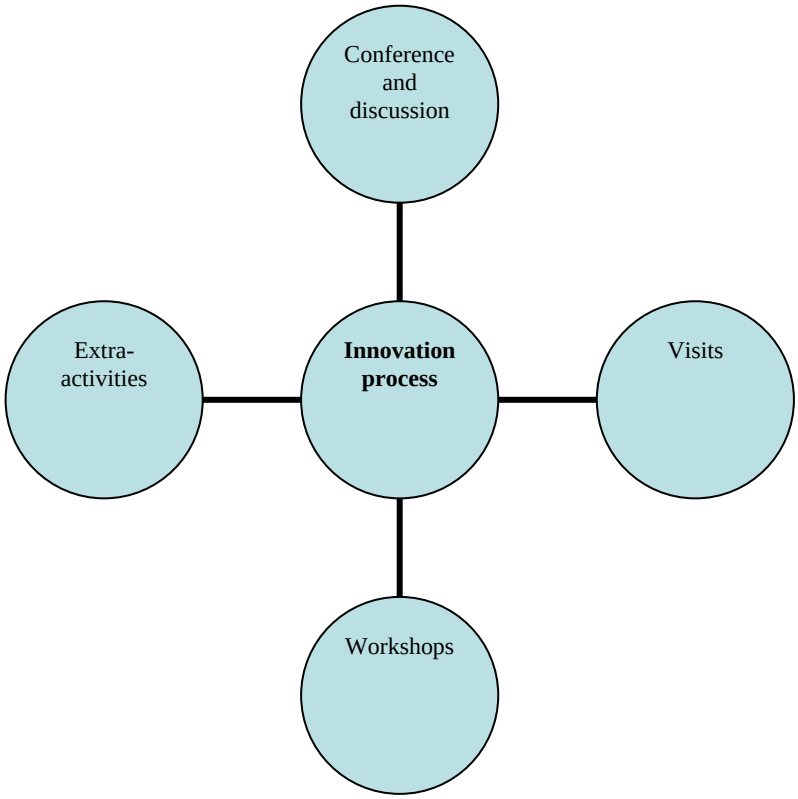

Figure 4.5 Activities around innovation during face-to-face meetings

Before starting the innovation process and defining a product, team members must be aware of the work vision, work philosophy and the mechanical engineering area they will be working on. This is accomplished by allowing people to participate in

conferences and discussions. It is one way to prepare team member's mind for innovation.

Another helpful tool is making visits either to institutions, research centers or industries so the team members expand the mental horizon and take into account more possible solutions even more they might find some of the applications from those places can be combined to generate the desired product.

Workshops mainly include team building and innovation itself. These could be the more important activities during the meeting since that is where all the innovation work is done. Characterized by long meetings during all day, brainstorming, problem-solution processes; workshops are more than a tool a foundation.

Finally the extra activities refer to those actions for distressing team members like to "give a breath to the brain". Some examples are party, outdoor activities, free time, informal dinners, test of similar products, excursions, etc.

Up to now, I have talked about the purposes of face-to-face meetings; additionally one thing that has to be taken into account when the team is international is that the meeting location fulfills their interests. Dr. Dilip Abayasekara a professional meeting planner gives five "tips" for selecting the right site for a meeting [12]:

- Purpose

Before you spend time and energy on planning the meeting, it is critical to ask yourself what is the purpose for the meeting. Clarity about the purpose will allow you to make good decisions in the planning phase.

- People

Find out who will attend the meeting. This is, of course, easier to do for a small meeting. A small meeting can have 2 to 25 people. A medium-sized meeting may have 26-100 people. A large-sized meeting may have 101-1000. Find out who the dignitaries will be and what type of seating arrangement is needed.

- Players

These are the people who will be on the program. What are their audio-visual needs? What are their table and space requirements?

- Purse

What is the budget for the event? This is a key question in order to find the location that will work. Find out whether the budget is inflexible. If there is some flexibility in the budget, find out by what amount you can exceed it.

- Place

The location needs to be appropriate for the function; have the necessary space and audio-visual support; be conveniently located for all or at least a large number of the attendees; and fit the budget. Appropriateness is affected by the expectations of the type of group that will meet (professionals, church, civic, etc.) and what they look for in terms of neighborhood of the meeting site, parking, quality of rooms, food and beverage, reputation, etc. Many modern hotel rooms have the accessories and electrical connections needed for audio-visual equipment.

4.4.2 The creative spark

Innovation needs creativity, because of this it is important to know some key concepts that contribute to a team's ability to build an environment of creativity (Fisher, 1998):

- The act of creation is a social rather than an exclusively independent activity; the process of innovation needs the sharing of stories and experiences.
- Creativity is a result of continuous experimentation.
- Willing to learn in public is necessary for creativity (sharing partially developed ideas with others).
- Standardized work processes and methods allow creativity to flourish.

4.4.3 Advantages of collocated work

Face-to-face meetings bring back team members to work in a collocated fashion. Actually, when one understands some aspects of collocated work it could be found that those aspects may be duplicated for distributed work. There are some key concepts that might be helpful to obtain the best results from every meeting (Hinds, 2002):

- Team room process

  Team members have a common work place which supports interactive and continuous communication. Some of it advantages is that team members develop a common ground engaging in standard methods; the team members know each other and they can use aspects of the context to assess what is going on at any moment; members have control over what they attend to so responses between them are immediate; people learn by imitation of others; people may work individually or as part of the whole team.

- Team artifacts

  The special arrangement and order in a room is important. People can use artifacts to clarify their understanding and make changes; artifacts are constantly visible so team

members are able to look for necessary information at anytime; as an example of a mechanical engineering application (automobile industry) some teams use to put complete models in the walls so they can examine each piece; common images generate common understanding.

- Tools

Distributed teams working in collocated fashion put into practice the use of:

- Shared electronic objects
- Large high-resolution, editable objects
- Virtual collocation, digital and virtual reality

4.5 Organizing a distributed team

Now I want to refer to the organization process that emerges after the innovation has been reached and the product is on its way of development. We already talked about the maturity levels on a distributed team, depending on the maturity of the team it is the way it can be best organized. Figures 4.6, 4.7 and 4.8 show organizational structures for three different maturity degrees.

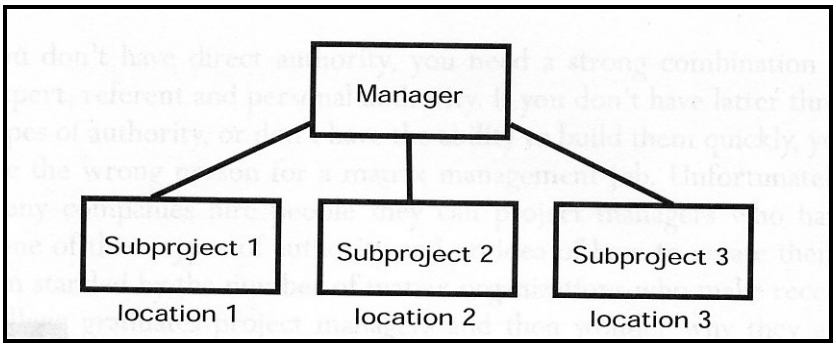

Figure 4.6 Project-oriented organizational structures are best for organizations at low maturity level (Haywood, 1998)

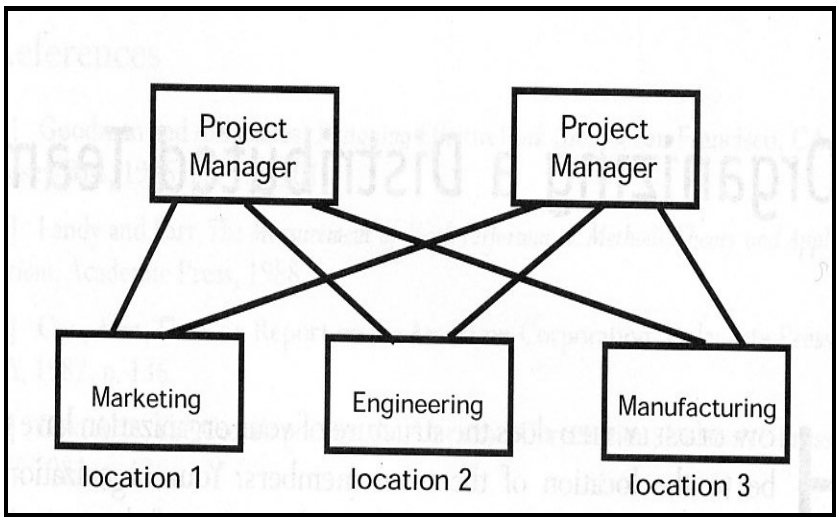

Figure 4.7 Functional or matrixed organizational structure can be used for teams at a higher maturity level (Haywood, 1998)

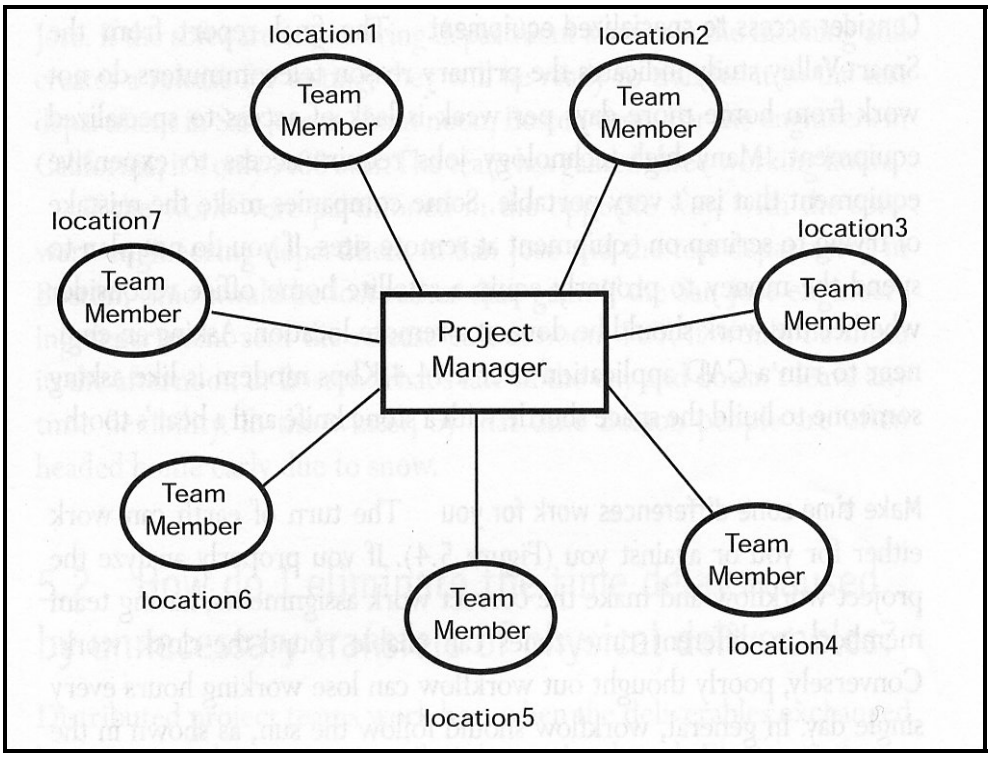

Figure 4.8 A location independent team (Haywood, 1998)

4.5.1 Partition and location of work

Some recommendations are:

- Keep people that communicate with each other (close collaborators) in the same time space. They will maintain a high level of availability.
- Many jobs require access to specialized equipment so take into consideration the expenses.
- Work flow should follow the sun to gain time instead of loosing it. (e.g., from the east to the west). Look at figure 4.9.

4.5.2 Remote leaders

For a successful operation of geographically distributed teams, leaders are encouraged to develop additional skills. One of the most interesting questions they can ask theirselves is: how do they know team members work?

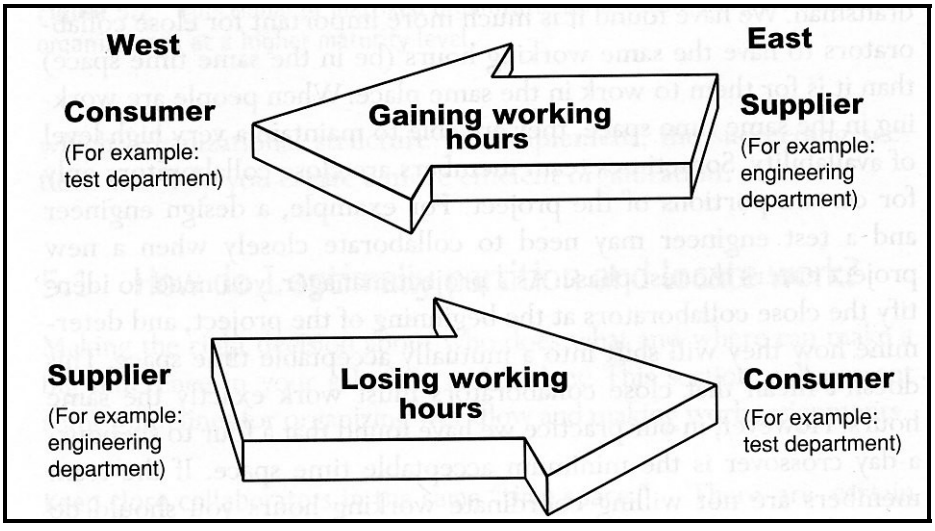

Figure 4.9 It is recommended that the workflow follows the sun (Haywood, 1998)

To get the answer the following practices may be useful:

- Develop practical performance metrics

- Refine estimating skills of both leaders and members
- Increase visibility
- Define project reporting mechanisms

The first point mainly discusses the establishment of two performance indices: behaviors and outcomes. Leaders can rate by ranking in team or by units, time, errors, etc.

The second consists of a series of actions that benefit both managers and members. Understanding the objectives, giving a date for date, starting with familiar parts of the project, estimating the whole job, allowing time for vacation are the most recommended actions.

Increasing visibility is parallel to the process of verification; a good idea is to use early integration, concurrent testing, prototyping and simulation.

4.6 Work in geographically dispersed teams for product innovation: conclusions

In the present chapter, there were presented general procedures and recommendations in order to give rise to a useful methodology for product innovation within an internationally distributed project frame. However there is no one right or wrong methodology, its effectiveness will depend directly on how the team uses it and how many applications they can find for their work.

When compiling techniques I proposed theorical statements of what should be put in practice but the reality is always different, that means not everything will work as “smooth” as presented in any methodology, there will be some disadvantages. But in general teams will find significant improvements on their performance.

Finally, let’s make a review of the outstanding concerns for innovative distributed teams:

Distributed leadership

Communications and technology

Management of distance and time [7]

Knowledge transfer

Culture-discipline

Solving conflicts

Continuous maintenance

Chapter 5 will be a case study on which finally one is going to be able to see clearer the application of all this to mechanical engineering areas.