CHAPTER 5

DEVELOPMENT OF A CASE STUDY (THE DOJYO PROJECT) AND SUGGESTIONS

5.1 Introduction

Chapter five is all about the Dojyo Project in detail since it is analyzed as a case study of the methodology explained in chapter four. Up to now all the work presented here had been mostly theoretical but what are a million ideas without a definite application? How is it possible for a team to concentrate all this methodology and to make innovative products working in a distributed fashion? How come? Up to what degree that can work? How good or bad is this methodology? Does it need to be amplified? All these questions and more can be answered by taking a look on an engineering project that is being currently run: the Dojyo. This means that one is going to be able to see directly an engineering application of all the preceding research work I have presented and of course be able to use that information to evaluate what has been done in the project, what is being done recently and what can be changed for future work by making suggestions and improving the proposed methodology. But in general, the case study will be presented according to the frame introduced in chapter four.[1]

[1] Through this entire chapter I separated facts from analysis/recommendations using two different fonts in the typing style respectively; facts are typed with "normal" style and analysis/recommendations with "**bold**" style.

5.2 A new international engineering project

On chapter two there was a brief description of the Dojyo project with the purpose of understanding its generalities. Now the entire work will be deeply detailed in order to get a better analysis of it.

5.2.1 The core idea for the Dojyo Project

Reviewing the introduction given in chapter two the Dojyo idea was generated by Professor Yoshimi Ito, a visionary on the engineering field with a wide experience in the mechanical engineering area and a large curriculum in international projects. He looked to apply the Japanese dojyo learning style to a current working mode in a geographically distributed team.

As I said before, most of the times the engineering projects are proposed by several people. In the Dojyo case Prof. Yoshimi Ito had been working very closely for the past years with one of his colleagues: Dr. Eckehard F. Moritz who is director of the Sports Creative Engineering Tank at TUM. When Dr. Moritz envisions the possibility of realizing such a project he proposes to work on the Sports Engineering area with very innovative concepts.

Let's say that the core idea of the Dojyo was from its beginning a team work which is good in terms of the basis this leaves to the desired future links that must be present among members. In other words, if the leaders are able to work as a team they will transmit this to the rest of the people.

5.2.2 The type of team and its philosophy

The type of team that is appropriate for a certain engineering project is directly related to the working style required and a nice clue for knowing this is the philosophy of work. In our case it is easy to deduce how a distributed team came into the mind.

One of the objectives of Prof. Yoshimi Ito when he thought about the way products are being developed in the present is to overcome the challenges of internationalization and globalization in order to develop a new product worldwide accepted. Then he looks at its personal culture and Japan traditions and finds that a Dojyo (the hall where one can find the way) can be magnified to be used virtually in a global team. By simple deduction to deal with all the present challenges using a virtual Dojyo produces the need of creating an international team of course without deviating from the traditional base of the Dojyo which is to work on a common task, to keep similar academic interests and to gain education.

Thus, the cycle of the project was summarized as follows: the group meets two times during a period of one year; the first meeting to clarify the conditions of cooperation, establish a team spirit, and develop a common vision of the Dojyo; the second one to jointly discuss, finally optimize and present the results of the Dojyo, to evaluate the Dojyo, and to discuss further procedures.

5.2.3 The sponsorship

Prof. Ito made available to have funding from the Japanese Government (Ministry of Education) which included SolidWorks CAD for all participants, travel costs, two times one week workshop, prototype building and others.

5.2.4 Preplanning

Dr. Moritz was mainly in charge of the preplanning part. As I presented in chapter four he accomplished the following:

- By email he sent the final decision from the Japanese (Ito and Monbusho) for starting the project and the initial information necessary for prospective participants. Figure 5.1 presents the letter of invitation for the Dojyo.

Distributed Product Innovation – Introduction and Design Contest

An International "Virtual Learning Dojyo" coordinated by the SportsCreativeEngineeringTank, Technical University of Munich

Sponsored by The Japanese Ministry of Education, Monbusho

Final Concept, Eckehard Fozzy Moritz, August 1, 2002

We invite you to participate:

The "Virtual Learning Dojyo" is a prototype of a new type of intercultural learning and project experience. Seven to ten "disciples" from universities around the world and three "Masters" will be jointly developing a new product; and will be meeting twice to clarify and jointly determine necessary procedures, reflect and intensify collaboration, and evaluate the approach.

The project will be running from August 2002 until December 2003. The Dojyo will be organized in seven steps:

1. **Selection of "Disciples" via a Design Contest; August 2002 – October 2002**
2. **Installation of SolidWorks (sponsored) and other collaboration software; Test-runs of the software; November 2002**
3. **Preparatory investigations into the task-/target area (see below); development of scenarios, determinations of potential target groups; December 2002 – January 2003**
4. **First workshop in Munich; five days; joint development of the product concept; reflections and exercises in intercultural cooperation; February 2003**
5. **Distributed product development; Manufacturing and distribution of prototypes; March 2003 – September 2003**
6. **Second workshop, Place to be decided; final testing and optimization of the product, development of future perspectives, reflections on the project; October 2003**
7. **Summary and reporting; November and December 2003**

Software, travel costs, workshops, and miscellaneous will be sponsored by the Japanese Ministry of Education, Monbusho.

Figure 5.1 Invitation to participate in the Dojyo

- Dr. Moritz, who is member of the Sports Creative Engineering Tank, chose as the team task: *the development of a computer supported cooperative sports device (CSCS).* He wrote more details about it:

a) To develop input/output devices which require physical activities in a challenging way (force, balance, coordination)

b) To use a game or an animated setting which allows the cooperation and/or competition between different players via the internet.

c) The task was chosen because:

- It is challenging, innovative, and state of the arts
- It has high economic and social potential
- It ensures motivation
- It supports the cooperation within the group by the nature of the task
- It can be jointly tested by the whole group during the development process
- It makes best use of the setting of distributed product innovation

d) Major boundary conditions include:

- The game/setting should be interesting/attractive in different cultures even "interculturally attractive"
- The CSCS device should be designed to potentially be put on the market later on
- The development process should be organized in a participatory way

- For the case of the Dojyo engineering project it is obvious that the team must be integrated mainly by engineers (sports, mechanical, electronic, computing systems) and Dr. Moritz also added several members coming from areas like the social and sports sciences whose help is invaluable also. The decision for the team

configuration was made mainly by him taking into account current contacts he has around the world and preceding work that he has made with them. For instance, in the UDLAP, Prof. Carlos Acosta (who has already worked with Dr. Moritz and Prof. Ito) is the international contact that Dr. Moritz took advantage of in order to link students and other professors from that University.

- He attached a design contest which was already included in chapter two. This contest was sent to the following international universities:

- Stanford University
- North Dakota State University
- University of Calgary
- University of Sheffield
- Universidad de las Americas, Puebla
- Asian Institute of Technology
- National University of Singapore
- Tokyo Institute of Technology
- Tsukuba University

At the end of that part I mentioned that leaders should have special characteristics and Dr. Moritz fulfils many of those exposed in Conrad's work (2002): he is organized, communicative, spontaneous, open and honest.

5.2.5 Pre-organization

After the contest, by October 2002, the initial team was integrated. Then Dr. Moritz got some students from TUM to help him with the organization before the first

face to face meeting, this took approximately a couple of months. At this point we can say that although the international members didn't know each other yet, Moritz with his assistants had one of the most decisive tasks: to prepare a good frame so the team building succeeded. **As in every relationship, the very first encounter decides the strength of the links between people, the success of their common work and the degree of compatibility/confidence among two or more individuals.**

Let's look into more detail how all the pre-organization was done by Moritz and his students by analyzing a written plan they generated for the activities previous to the first meeting:

Report about Baier Dojyo, summary of the Monthly Activities

July 2002
Preparation of Selection Contest Questionnaire; First mail and phone contacts to selected universities and other institutions to enquire about their interests for participation.

August 2002
First screening trip to Monterrey and Puebla (both Mexico).
In Monterrey we used the summer school sponsored by Siemens to invite people from Stanford University to discuss setup and participation of Stanford delegates.
In Puebla we discussed selection criteria for the students of the Universidad de las Americas (Cholula) and Stanford University.

September 2002
Second screening trip to Tokyo and Tsukuba.
In Tokyo we discussed about the selection criteria and participation of students from the Tokyo Institute of Technology and the subsequent possibilities for follow-up. Furthermore the idea, concept and planning procedures of the Baier Dojyo were presented at a meeting of the Japan Society of Mechanical Engineers.
In Tsukuba we similarly discussed support for the Baier Dojyo from the University of Tsukuba, and attendance at the face-to-face meeting. Furthermore we discussed necessities for collaboration between different countries and different disciplines and their effect on the selection.

October 2002
- *Finalization of the Design Contest*
- *Selection of the Disciples from the Universidad de las Americas*

- *Selection of the Disciples from Stanford University*
- *Discussion with partners regarding further support*
- *Meetings at the German Aerospace Centre to gain further support*
- *Backup letters and communication with Tokyo Institute of Technology*
- *Selection of partners for Software Support*

November 2002

- *Selection of Disciples from Tokyo Institute of Technology and Tsukuba*
- *Screening of Software to be used for Communication and Cooperation*
- *First trial tests of Software*
- *Establishment of a first newsgroup of the Dojyo Members*
- *Collection of information about materials to be used for the prototype*
- *Finalization of the Development Task to be pursued*

December 2002

- *Self-introduction scheme for all the participants and partners of the dojyo*
- *Small trial tasks to test the communication software*
- *Discussions about the basis structure of the homepage and web presence*
- *Selection of locations for the face-to-face meeting*
- *Selection of places for overnight stay*

January 2003

Much of the work in January was dedicated to the preparation of the face to face meeting to be held between February 19 and February 26

- *Selection of Working Schedule*
- *Determination of the Development Process to be used in this internationally assembled group*
- *Planning of external activities and workshops to enhance the educational value of the face-to-face meeting*
- *Planning of an internal and external evaluation of the Baier Dojyo project activities*
- *Planning of the travel schedules for members and experts*
- *Planning of Food*
- *Planning of team-building activities*
- *Discussion of these plans with experts*
- *Preparation of handout materials to be distributed at the face-to-face meeting*
- *Preparation of publication to be distributed at the face-to-face meeting*

Furthermore, the participants got more acquainted with the software to be used:

- *The communication software BSCW (web-presence) was structured to the needs of the project*
- *The CAD software (SolidWorks) was distributed, first trial exercises were performed*

February 2003

February work was almost completely dedicated to prepare and host the first face-to-face meeting:

- *Determination of Schedule*
- *Finalization of external activities and workshops to enhance the educational value of the face-to-face meeting*
- *Finalization of the travel schedules for members and experts*
- *Planning of Food*
- *Planning of team-building activities*
- *Discussion of these plans with experts*
- *Preparation of handout materials to be distributed at the face-to-face meeting*
- *Preparation of publication to be distributed at the face-to-face meeting*

Concluding, pre-organizing is one of the most important tasks for project success and it is not an easy one. It involves a lot of thinking and advising in order to avoid problems at the moment of the face-to-face meeting.

5.3 Analysis of the first face-to-face meeting

It is obvious that the first face-to-face meeting is not an ordinary one, in my opinion it has a very clear objective: to build the team, to make the right connections between people and to assure they keep constantly involved into the activities when back home. That does not mean that if there was a good face-to-face meeting the project will work perfectly, of course not, but at least by having the team members understand the importance of making a good distributed work, the assumption that the project will keep going in the long run may be acceptable.

In the Dojyo project first face-to-face meeting I can distinguish two approaches: the activities leading to product innovation and the activities leading to team building. Both of them were correctly applied and accomplished its purpose. They might serve as good examples for future projects of this type. But also, **I found the lack of one more approach in the case of the Dojyo: there were no activities related to learn the distributed work process.** I want to analyze this too, the consequences it brought to the

project and I want to make some suggestions according with the research I already did on distributed team/distributed work previously.

5.3.1 The product innovation approach

Having the team decided on a task to be done during the project and having thought on the task during several weeks before meeting for the first time, makes it easier to get more directly into the innovation process but still does not define the process at all. Although some ideas might have been brought by each member there are still some intermediate steps to complete the whole product innovation. In the dojyo case this is all about information and action needed to help those member's ideas to grow, to become clearer and to ignite the creative thinking during the innovation workshop.

The TANE organizers came up with two very interesting types of activities: conferences and visits; all of them related and helpful to the CSCS (Computer Supported Cooperative Sports Device) task. Let's briefly review them:

- **Conferences**
    - *Perspectives for the internationalization of engineering education*: To talk about this is essential when there is an international team as ours. This discussion was mainly to create a consciousness about the future of international education. Dr. Baier from TUM suggests that faculties should have more flexible curricula including subjects of this type in the alumni education; he says that participation with industry is very helpful and that involving students in exchange programs makes easier to create an international consciousness.

Dr. Moritz argued that internationalizing the education allows to have cultural sharing and disciplinary joinment; that products will have a more generalized social, physical, intellectual intention; that projects will not be only technical anymore but learning projects too and this two factors increase knowledge; for last he emphasised that having an international team grows help and motivation, allows to get more ideas and consequently better possibilities for good results.

Prof. Acosta touched an important point of view: why internationalization? Relating it to the industry he mentioned that internationalization helps people and teams to handle the increasing globalization tendency; he talked about the third industrial revolution that companies are facing now which means decentralization of intelligence (computer, internet), reduction of intrinsic value of raw materials, machine decision (making and control), and liberation of human beings to fully use their creativity [15].

Finally, Prof. Ito explained the presence of three simple but essential factors for internationalization: knowledge, human relations, and communication.

- *Sports, culture, and technology*: Three topics included in one discussion; engineering students together with sport sciences professors gave interesting statements to understand better the body's physiological behaviour relating it to available technology in sports. They studied also

the importance of understanding the sports culture and to have products culturally oriented, and culturally accepted.

This discussion helped students to generate a different vision of product orientation when innovating (e.g. innovating more generalized products worldwide oriented versus products just regionally accepted).

In one of his books Moritz (2003) explains the importance of taking care of culture in global technology development. First he explains why it is important? and some of his statements are:

- The driving force of globalization is expectations of economic gains and culture is generally ignored.
- Culture sums up all the achievements and developments of a collective human mind and its materializations and consequences in a certain time and environment.
- Different cultures nourish different individual or societal qualities with different success.
- From the perspective of culture, there is no self-evident common basis for ("fair") international competition.
- Globalization should advance not through equalization and competition alone, but much more so than is currently done also through mutual invigoration and cooperation.

Then the question how to take care of culture? comes to Moritz and he proposes a series of objectives of technology development:

- Cultures should learn from one another, rather than impose standards, knowledge and habits onto the supposedly weaker "partner".
- Products, technology, and work organization should be therefore compatible to a culture and not to be transferred without reflection and adaptation.
- Partners should achieve or maintain independence, instead of weaker partners being coerced into subordination.

Finally Moritz explains important actions to acknowledge culture in globalization for instance: developing empathy in the appreciation of cultures, being aware that you yourself are a product of your culture, encouraging mutual learning and discourse, and seeking "win-win" situations in which all partners benefit.

For last I would like to mention the ideas presented by Prof. Yukito Muraki which were entitled "Copernican change in sport innovation" (Muraki, 2003). A Copernican change may be explained as the modification of the mind from a current mental state to another completely opposite to the original. Immanuel Kant found a Copernican change in his epistemology "recognition does not depend on the object; the object depends on the recognition". Another example is the effect that the sunrise and sunset have on mind, the first activates the sympathetic system and the second activates the parasympathetic one.

From there, Yukito went to an application in the hi-speed jumping sport. He differentiates the old technique of jumping which was based on

standing/short run-up jumps (by hitting harder the ground as means of bouncing the body) from the new theories of increasing the run-up speed and hitting softer the takeoff board getting minimal deceleration but always controlling the body movements. He setup a new model called “the triple jump” that might be likened to “a pebble skipped across the surface of water”. The important conclusion that Yukito gives is that “the difficulty of the technical improvement of the intrinsic action or behaviour in athletics seems to depend on the stereotyped image and action put in mind and body from the long time experience”. That leaded to a recommendation to TANE which was “you may need a Copernican change to emerge innovative works”.

Figure 5.2 Sports, culture, and technology discussion. Olymipiazentrum

- **Visits**
  - *Tour through the departments of the faculty of mechanical engineering*: **For TANE members it was important to know what areas surround the development of a CSCS so leaders took us to three specific departments at TUM.** One was the light weight structures department

which is full of student projects and materials; everyday new sport devices need to be lighter, more flexible, and more dynamic; this visit was a nice source of ideas for our prospective product (Fig. 5.3).

The second tour was in the ergonomics department. Before making a sports device we all need to have a basic knowledge of the body behaviour and the possible measurement instruments that are available for body actuation (Fig. 5.4). One interesting work is what people from this department is the study of human body positions by the “potatoes model”. Basically they model every muscle as a potato in order to analyze the moment, tension and forces developed on each. **So, if we are thinking to produce a new sports device it is necessary to take into account the capabilities and possibilities of human body.**

Figure 5.3 Composites generation machine

Figure 5.4 Instruments for leg/arm moment-force measurement

- Finally I would like to mention the visit to the DLR German Aerospace Centre. We specifically were at the robotics research lab. What robot arms with aerospace applications have to do with CSCS? Well, looking at the initial information provided by Moritz it is found that the game should be controlled by force feedbacks to make possible some body action. **Then by analyzing the mechanisms DLR uses for its robots it is a good way to figure out that some of those mechanisms might be applicable for our purposes.** But not only we were shown the robot arms, they showed us some small input devices very useful as interfaces for design. Take a look at the white mouse pad on figure 5.5.

Figure 5.5 A four-dimensional mouse pad

Now, let's take a look on another simple force feedback device developed by the DLR researchers. An accelerometer receives an input force from the arm and converts it into an electric signal which is processed to play a ping pong game. One can actually feel the resistance when hitting the ball!

Finally, from my point of view the most interesting part from the DLR visit is the relation created between TANE and scientists there to cooperate in Dojyo if it is the case. Take note of the importance of

connecting the team with organizations and/or industry because of the results that brings: available support with knowledge, available support with technology, available support with research labs, available support with testing and others (see Appendix A for the DLR robots detailed information).

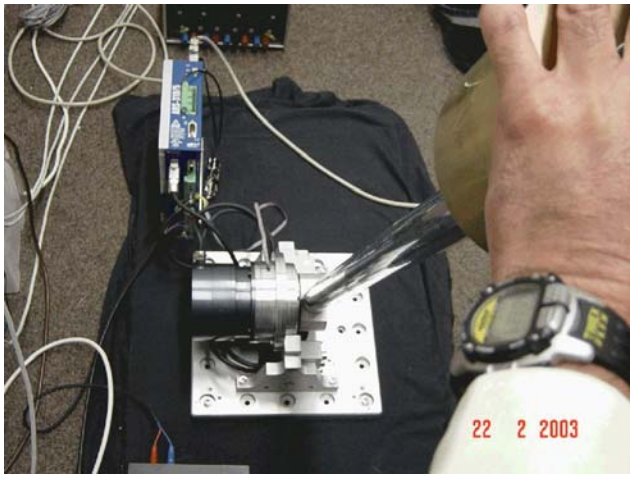


Figure 5.6 Force feedback for playing ping pong

5.3.2 The team building approach

Studying the Dojyo case the activities mentioned here can be just taken as examples of team building. However the team building approach and the success it has on the people depends on the ability and the creativity of the leaders to manage the leisure time and to choose the type of activities that best adequate to the team members.

I want to start here with my personal experience at the first face-to-face meeting. I remember the day of my arrival to Munich, at night there was a welcome dinner organized by Moritz and his assistants for all the foreigners arriving that day. Besides the

fun I had I want to remark the feeling it created on me as the first contact with the team: in few words this dinner "broke the ice" that I (and most people) might have had if a different kind of welcome had been chosen. From that moment I started feeling as part of a true team. The next day the same feelings were reinforced by the formal welcome party on which finally the team was complete including professors, students, organizers and special guests. **My focus is not to emphasise that we had a party but to notice the importance of an initial strong-funny activity that everybody knows how to do by nature which is to socialize in an "easy going" convivial.**

Later on, during the visit to the OlymipiaZentrum Moritz who is an acrobat by hobby used his knowledge to show the team members five values that are necessary in a team: to be participative, to be meditative, to trust the others, to experiment, to present the work done and to be active (performer). Please review this on table 4.2 for details.

More than analyzing what happened I am trying to describe the remarks of Moritz actions and the effects on the team. When dealing with an internationally distributed team one knows that learning style of people from Japan is not the same as the one from a Mexican. If one wants to present some topic in the old fashioned way (by having a professor in the front blackboard and the students just copying the same information) might not be the best idea for every international member to catch up concepts and to understand them the same way. This is because of the cultural differences. But what about choosing a worldwide practiced sport as is acrobatics to make sure all people have the same understanding of a concept? That is what Moritz did and it worked really well.

It is impossible to get deep into a culture that is different from the own in just one week but what can be done and I would strongly recommend if one is going to

work for a long time with people from other regions in the globe is to have at least some cultural clues, some pick-points about the cultures one will be dealing with. This helps to strength the relationships between individuals and to understand better the working style of one another. In other words one becomes more open and

a) Participate

b) Balance

c) Trust

d) Experiment

e) Perform

Figure 5.7 (a to e) Acrobatics team building

comprehensive with the others and they do the same with you. For example it is typical that Japanese use to be very polite and formal on their salutation so if one knows this one can try to imitate the same so the Japanese feel comfortable and more confident as taking part of the group. Food, sports, games, music, people's general behaviour, national days, movies (actors/actresses), and many others are good examples of the pick-points one should know about a different culture when working in distributed teams. **One recommendation to make this task easier is by talking directly to the people and learning from them.**

In the TANE Dojyo the hosts made sure that everyone took part of a typical Bavarian dinner at a restaurant in Munich; it was very interesting to learn about the "Mass" a traditional style of serving beer in Bavaria. A dinner works always well when relations between people want to be established since it is a good chance to know each other, and to have conversations in an easy environment.

How can foreigners correspond to locals? Well, in the dojyo an intercultural dinner was organized too. That was more global than the Bavarian one since everyone had the chance to prepare and to try typical food from Mexico, the United States, Germany and Japan. It also allowed people to have fun with some traditional devices/games and to listen to different types of music with their respective dances. I would like to remark here one concept playing an important role in this type of events: *participation*. **More than just trying some food or listening to some music intercultural activities promote everyone's participation; nobody is dismissed, in fact, after that the integration of the team members become stronger.**

At the Zugspitze (German Alps) we also made a kind of team building combined with the innovation approach activity: the trial of winter sports equipment which **helped us to work as team helping each other to learn how to use the devices and also to get more involved with the sports subject by having real feelings like speed, force, control, etc.**

Finalising this part, I want to show some extra examples of icebreakers to get acquainted with a team [14]:

Example 1 One short and effective exercise is “Two Truths and a Lie,” in which students share with a group two truths and a lie about themselves. Someone in the group has to guess the lie.

Example 2 In another exercise, each member writes a characteristic about self on a slip of paper and puts it in a hat. Then, each member picks a slip and tries to match it with the right person.

Example 3 For the nonverbal birthday lineup, ask everyone to line up according to the month and day of birth with no talking. This inspires interesting means of communication toward a common goal.

Example 4 For silent identification, each participant is asked to silently write words or draw pictures that describe themselves. They pin these on their shirts, walk around, and look at each other. Descriptions are then shuffled, and participants are asked to match the person with the picture/words.

Example 5 What kind of team? Divide the team into groups of 4 to 6 people. Have each group discuss and identify an analogy for their team. For example: “We are like a three-ring circus—because we have many things going on at once and it feels chaotic at times.” Allow ten minutes to discuss; then have teams share.

5.3.3 The innovation workshop for the flyguy

Now it is time to detail what the Dojyo engineering project task is all about starting by the usage of the innovation methodology proposed by Dr. Moritz which I presented already in chapter three.

Previous to the innovation itself there were three sessions. The first was titled *introduction, clearing up the vision, aims and demands of dojyo TANE*. That session’s purpose was to know each team member’s general ideas for the task to be developed. Everybody was free to talk about concepts, technology, games, sports and culture.

Then there were two informative sessions:

- *International systematic innovation*: A conference like on which two students from United States and Germany respectively stated different innovation styles although the innovation method already chosen was the Dr. Moritz one. Anyway some important points from this talk can be placed as aggregated to the main innovation process. Motohide Hatanaka from Stanford University proposes the use of brainstorming; he defines it as the creation of mental paths based on existing ones, he says it may happen on yourself as well as it may be produced on others. On the other hand Christian Henneke from TUM proposes a complex but interesting innovation method which was already shown in figure 3.4.

- *International and intercultural cooperation*: Prof. Carlos Acosta made a very interesting speech about shared mental models and coordination in distributed work teams based on the Espinosa's research. **Those ideas made that the team had more clues about how organizing itself and how to handle the distance problem. I reported some of the Espinosa's work in chapter two**. However Prof. Acosta gave some important recommendations to challenge the time and geographical distance: to have shared knowledge about technical concepts as well as to have shared knowledge about each member, a must-know before going home after any face-to-face meeting. **If detailed information is required please go back and refer to the antecedents' part (chapter 2.2.2) on which this topic was developed.**

It is time to present the activities that lead us to select the product to be developed. First of all the ideas will be shown and then the conclusions and the results of the innovation activity, this is the most important part for the readers; it is interesting to check how many ideas may be generated when working with international teams.

- *Innovation workshop: Introduction to sports.*

First a discussion about sports, games and fun was done. Everyone shared their ideas depending on cultural background and sports available at their countries.

Talking about sport characteristics, most people look for the following: speed, talent, technique/skill, spontaneity, art, coordination, excitement, physical effort, strategy, endurance, form, elegance, agility, sound, flexibility, all weather, satisfaction, vision/mental goal, nervous, explosive, power, equilibrium, acceleration, surprise, thrill, flow, experiencing nature, action, success happiness, communication.

Something that is closely related to sports is fun; one cannot get motivated to do something if there won't be fun at all. Then, the question what is fun? came to us and some of the answers were: speed, acceleration, success, satisfaction, cooperation, surprise, skill improvement, power, thrill, balance, competition, excitement, happiness, reaching unexpected states, sore muscles, strain, rhythm, body expression.

After clearing what people are mainly looking when doing sports, one more question came. It was about cooperative sports today and in the future. If they will change, how can they look like in 20 years from now? Of course there were many concepts for example: basketball with jump-enhancing shoes, soccer with an intelligent ball, zero gravity "move room", remote control robot games in stadiums, virtual reality basketball, 360° vision handball, training in space, team games with communication devices, virtual partner jogger, globally integrated tai chi.

Later since the Dojyo task was to develop a "computer supported" sports device so several types of computer games were mentioned such as: strip poker, tetris, dance revolution, myth, family games, pinball, street fighter, strategy games, sport games, simulation, role-plays, adventure, puzzles, online games, shooter games.

After this session everyone was full of ideas in their minds, and was prepared to focus specifically on the CSCS task and placing ourselves in just one common work path.

- *Innovation workshop: project settings, definition of core functions and perspectives.*

After some reflection the team started to think deeper on the task. A brainstorming about the core functions, the main perspectives and the boundary

conditions for the project was made. The *core function* definition was already presented in chapter three. From the brainstorming the team came with several ideas: Fun, exercise/health, team/friendship building, sharing physical excitement, change way people think, competition, meditation, creating a lifestyle, motivation for movement, new experience, inspiring creativity, meeting point, self expression, self experience, time efficiency, cultural communication, interaction, satisfaction, and fascination of technology. After that all members decided to choose just three ideas as the main core functions: *Fun*; because it is part of any sport and a motivation factor, *Exercise*; when doing a sport one asks it to provide with competition (individually or team) and to enhance health. *Sharing excitement*; during and after sporting one wants to feel satisfied as a team by means of a good communication.

The *main perspectives* refer to what one has to take into account in a general way when developing our product. There were several interesting ideas such as: user friendliness, synchronous/asynchronous, security, tailorability, cultural difference, transportability, maintainability, application locations, target group, intensity of physical coupling, positive societal influence, affordability, user elegance, upgrade ability, updateability, group friendliness, and business plan. The most important ones for us were: *User-friendliness*; since it has to be easy to use, attractive, with a good environment. *Target group*; is looking for a specific group of persons on which the product can be applied. One must take care on selecting an international target group. *Group friendliness*; similar to the first one, it refers to have a friendly environment for working in teams. It comes together with good communication devices.

The *boundary conditions* are the limitations; one has to adjust the project to realities like: project money, time available, time zones, certification, patents, laws of physics, bandwidth, and availability of media access.

As a conclusion, having on mind the selected main perspectives and core functions (and taking into account the boundary conditions) TANE was now ready to concentrate on the development of a concept using the preceding ideas and applying them in a direct way. **In other words, everyone was on the same innovation path and no matter if their game concept was different from each other the foundation for developing that concept and prospective product was going to be the same among all members.** The next chart summarizes the decisions made by TANE:

Table 5.1 Core functions, main perspectives and boundary conditions for the CSCS

Core functions	*Main perspectives*	*Boundary conditions*
Fun	User friendliness	Money
Exercise	Target group	Time zones
Sharing excitement	Group friendliness	Media access

- *Innovation workshop: creative concept development.*

Taking into account the core functions chosen, the main perspectives and the boundary conditions; each member generated a concept which was analyzed and judged by the others (see some examples in fig. 5.8). A sketch of a concept and written explanation were developed. All of them were really interesting and different from each

other; after all the comments the ones that agreed more with the project settings were chosen. Two groups worked on one concept each in order to improve it, to generate more detailed information and to adjust it to the core functions.

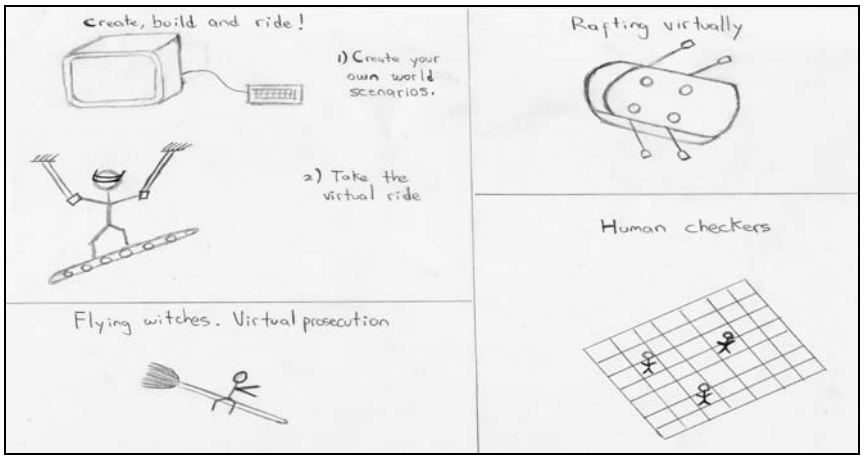


Figure 5.8 First ideas for CSCS

Analyzing more this part I would like to remark some right points of the innovation method used by Moritz:

- **The location for the innovation workshop is not as essential as other aspects; however leaders are encouraged to choose the most appropriate places to have a workshop. Since innovation is thinking, creativity use and idea generation process the place requires some features such as: enough working space, quiet place, provided with the necessary materials, well communicated, accessible for everyone, that stimulates creativity. So, as I wrote on chapter two, Zugspitze was a nice place to work on innovation the only disadvantage is that it was not as accessible as other places (like in the city) then if something is missing (materials, people) it would be hard to get them fast.**

- **During the workshop a few minutes were dedicated to introduce the BSCW to each member. Since it is a very accessible platform the presenters did not need to waste too much effort, their only job was to make sure everybody got registered and to explain the main features of the program. Later on members tested BSCW at home and got accustomed to it.**
- **Individual production of solutions: In my opinion 20 minutes is not enough time for any member to produce a solution. I find out that TANE made a mistake when assigning time to this activity. One needs time to concentrate on the core functions and main perspectives, to review them, to rethink them and then to generate a specific concept. Mind needs a little less time pressure so it works clearer.**
- **The gallery-clustering-combination of concepts method used by Moritz is quite good as one can see the ideas of the other team members placed in a paper or in a document and it is easier to understand them. But it does not work that well when the team is big and everyone has a different idea of a product to be developed. I do not mean that leaders have to reject the ideas of everyone but because of the time available and the complexity of the task a better and more direct method for selecting a product would be to construct bigger and fewer sub-teams who take care of developing one concept each so at the end there will be not that much difficulties when selecting just one.**
- **Another remark is about the thing I just mentioned, after individuals showed their work the selection of one of those prospective products was made virtually as simple democratic votes. It is surprising that after dedicating so**

much effort, time and care to the innovation process the last part, the final selection was just decided by in a few minutes and by a question that who likes more this or the other? I mean, it is understandable that decisions at the end have to come and someone has to do it; what I want to point out here is that the last part of the innovation process is not as less as important as the other steps so dedicating more time to the final selection phase should be encouraged: more time for the whole team to talk, to analyze the available solutions and to choose the best that fits most aspects the team wants and that agrees with the feelings of those who are going to make the product.

There are many methods for project decision, one that might be helpful in the dojyo case for selecting the solution in a more systematic way than it was done it is the *simple rank ordering* which it is very easy to implement. Briefly, it consists on: a square matrix is developed, with rows and columns corresponding to the projects under consideration. The engineering manager compares the project in a column with the projects in the rows one at a time. If he prefers the project in column *j* to the project in row *i*, he places a plus sign in the cell *ij*. When the matrix is completed, the number of pluses in the columns is counted. If the comparisons are consistent, the pluses in a column equal the minuses in the corresponding row and their sum determines the ranking of the projects. The number of pluses under a project indicates the number of other projects to which that particular project is preferred. The project with *n-1* pluses will have the highest rank; the others will follow it (Cleland,

1981). TANE members might have used as the ranking criteria the core functions/main perspectives they have selected fitting on each solution.

P_i \ P_j	P_1	P_2	P_3	P_4	P_5	Number of minuses
P_1		−	+	+	−	2
P_2	+		+	+	−	1
P_3	−	−		−	−	4
P_4	−	−	+		−	3
P_5	+	+	+	+		0
Number of pluses:	2	1	4	3	0	

Figure 5.9 Matrix evaluations for ranking projects (Cleland, 1981)

Thus TANE team selected as a final product to be developed:

A device that gives human being the sensation of flying by using movements and body exercises which allow him to play or manipulate scenery simulation software (cooperatively and/or competitively) through the use of force feedback equipment. We named it Flyguy.

After this decision the team dedicated a few hours (but not enough) to organize the future work to be done at distance. Having defined the solution it was time to establish the elements of the flyguy to work on, TANE members proposed four: human body framework, conversion of body movement to electric signals, visuals, and game plan. The team discussed then come with general approximations of what devices/software/games should be thought and applied. Next, each of them is detailed or illustrated:

- Body framework

The idea was the search and implementation of hang gliding equipment such as ropes and harness plus a design of the framework. The next sketch exemplifies the first team thoughts.

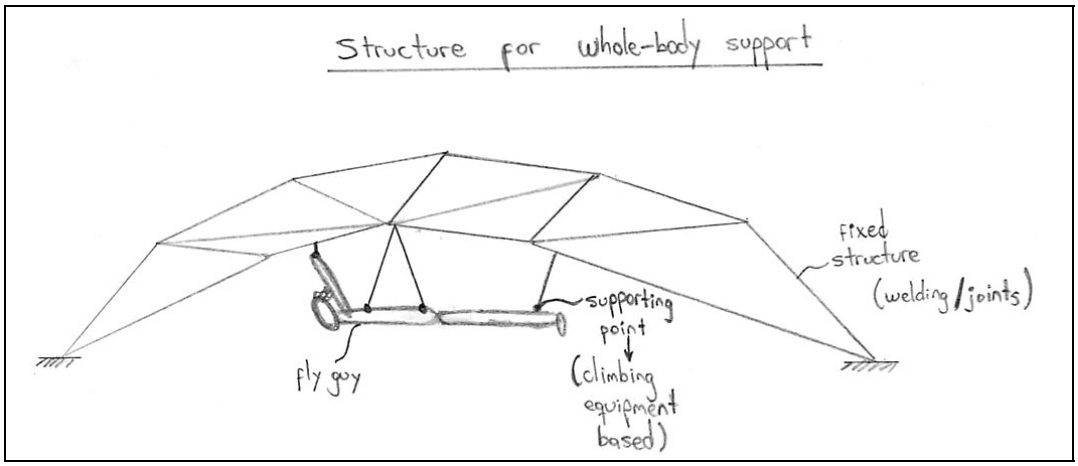


Figure 5.10 First ideas for the flyguy framework

- Conversion of body movement into electric signals

The most feasible idea was the use of 3D accelerometers, equipment which is not that expensive and complicated as others. Most members agreed with using accelerometers to measure the movements of the arms and legs.

- Visuals

Realizing that in the team there is no one specialized on computer graphics design and having in mind that creating a whole new computer game is even a hard job for big companies like Nintendo TANE members proposed to better use existing software/games that are 3D graphics-based and provide with a realism experience. One example is flight simulators.

- Game plan

Looking at the flyguy definition one realizes that TANE was trying to make a game that can be played either by teams cooperating or by persons who look for competition. The next drawings illustrate interesting ideas of game planning that the team members should look for.

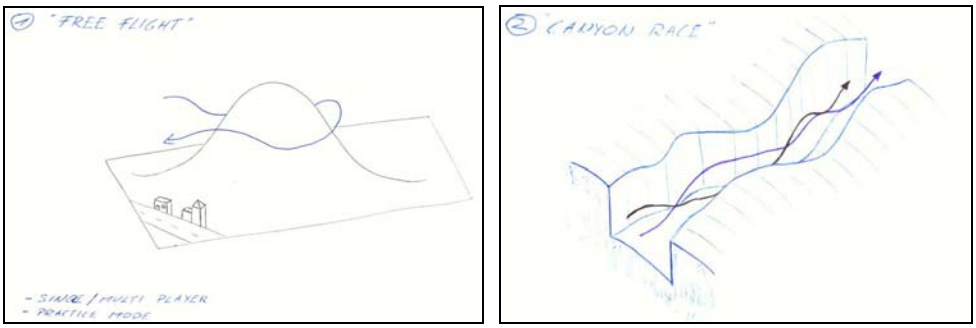


Figure 5.11 First thoughts on the game plan

Before I continue giving more details on the flyguy and its realization, the next part is a short statement about the lack of a very important aspect that had to be taken into account during the first face-to-face meeting, a factor that has been central on my thesis and from which I have already researched. I refer to the work of leaders for preparing the team to make distributed work and how to cooperate and organize as a distributed team.

5.3.4 Knowledge about distributed work in the Dojyo

During our first meeting all the team concentrated on the innovation task and leaders made an outstanding job that achieved excellent results at the end of that week (the selection of a solution). **Leaders made also a great job on team building, but they focused on preparing the team for working in-place, face to face. Almost zero information and activities were given as preparation for the following step which**

was to work on the development of the product *distributelly*, which caused some troubles later. This is reported below.

Managing time is important when working with teams either collocated or distributed. Then, as a suggestion here, besides from doing the innovation task and collocated teambuilding task, organizers must take into account to dedicate some time or some sessions to teach members at least the basics for distributed work: What it means? What it implies? What obligations/responsibilities come with it as a member of this type of teams? What alternative communication tools could be used by determined people in certain regions? What are some rules for working distributelly? What are the advantages and disadvantages? What are the problems they might expect? What are the fundamentals for coordination within these teams? Questions that were already answered on the theorical part of this thesis (chapter 3.3) but that if they are not taught in real projects it will be kind of hard to people that are not used to distributed work to understand, to learn and to use it as work methodology. That is why it becomes very important for leaders to include this topic on the very first meetings to assure all the team members catch the idea of working in a geographically dispersed way. After doing that, organization of the team will be much easier than you can think and everyone will be doing what they are expected to do.

For instance, one recent trend that has a lot to do with the trends and theories already presented in previous chapters because it actually includes many of them on its premises is the *collaborative e-work*. E-work is defined as any collaborative, computer-supported and communication-enabled productive activities in highly distributed

organizations of humans and/or robots or autonomous systems. E-work is based on e-activities, namely, activities based on and executed through information technologies (Nof, 2004). E-activities require collaboration between humans, machines and computers. Nof suggests that information technologies can perform better some functions. **Learning how to apply information technologies in the dojyo might help to have: better connectivity and ability for farther, global reach; enhanced communication and coordination; acceleration of knowledge sharing and distribution; better interactivity; flexibility, customization-ability; higher velocity of work tasks and exchanges; and reduced communication costs. I think it is important to create a culture of using information technologies more frequently.**

Some features of e-work that I mentioned are inclusive of others already presented in my thesis are: integration; collaboration; coordination; networking; e-learning; and e-training. Of course there are also challenges that emerge with collaboration such as: greater work complexity; limitations caused by increasing inter-dependence; issues of integrity and trust; greater need for coordination, cooperation and synchronization; communication challenges and failures; problems of mismatch; and new users training requirements (Nof, 2004).

According to the new models, tools and theories of work systems there have emerged some design principles for effective e-work: the principle of cooperation requirement planning, CRP; the principle of e-work parallelism; KISS: “keep it simple” system; the distributed planning of integrated execution method, DPIEM; and the principle of conflict resolution (Nof, 2004). All of them are simple and they might be

very useful if they are taught during face-to-face meetings in projects like dojyo just as suggestions for team members to work more effectively.

The CRP principle states that effective collaboration requires advanced planning: a plan of “who does what, how, and when” and during execution, the plan is revised in real time and adapted to changes. The principle of parallelism is concerned with how to optimize work to advance in parallel. In other words, e-work systems cannot be constrained by linear (sequential precedence of tasks). The KISS system deals with making more complex, autonomous systems that work for humans optimally and interface with them in an easy manner to avoid frequent human retraining.

The DPIEM system is part of the parallelism one and includes five guidelines to support e-work: a) formulate, decompose and allocate problems; b) enable applications to communicate and interact under administration protocols; c) trigger and re-synchronize independent entities to act coherently in making decisions and taking action; d) enable entities to reason about actions, plans, and knowledge with other agents and coordinate with them; e) develop conflict resolution, error recovery, diagnostics and prevention.

The principle of conflict resolution addresses that with a greater rate of interactions (increased with the number of collaborators), there is also a greater occurrence of conflicts. Therefore e-work must be designed to overcome quickly and inexpensively as many errors and conflicts as required to be effective.

Concluding this part, if leaders make some time space to prepare their team on working at distance issues; they can then evaluate deeper each member to see if he or she has clear consciousness of being part of a distributed team and to predict how well they might perform and what would be his or her weaknesses. Please refer

to chapter 4.3.2 which details this too and contains good recommendations using two interesting models: the alignment model and the maturity model (Haywood, 1998).

Now it is time to analyze what happened after the first meeting and how the distributed work developed in the dojyo, its pros and cons, and finally its results. This is detailed in the next subchapter and the case study ends with the formal termination (as stated in the invitation letter by Moritz and Ito) of the dojyo project at a second face-to-face meeting in Munich.

5.4 Analysis of the distance work done by TANE team

There is not an exact point in a project where distributed work starts or separates from collocated. Why I say that? **Because distributed work does not start alone or by itself, a team cannot initiate distance work without first organizing and dividing their tasks.** Analyzing the dojyo case, the team's face-to-face work practically switched from collocated to distributed fashion at the point of the solution choosing; this, in my opinion, was a very fast change (in other words, there was no smooth transition). Then we went back home after the first meeting with specific tasks to do but with many doubts on how to organize time and how to work effectively.

As one of the first generation teams, TANE lacked experience and as mentioned before not really too much training (at least theoretical) on managing work at distance was given. Time was getting shorter to end with the first meeting in Munich. Despite of that a final session could be handled to organize the team before going back home solving the question of how-to-proceed? Then a short reflection of the work done during

that week was done. The next information is a cluster of ideas recorded from the TANE team.

5.4.1 Organization previous to the distributed work

The first point treated during this session was the prototype building. Obviously an engineering project of this magnitude as the flyguy cannot stabilize just in a conceptual phase; it needs to be realized, to be tried and to be tested. That is why the team discussed the best way more specifically where would be best to construct a flyguy prototype? Basically two ideas were given: to make it globally or to make it locally. The first one refers to produce only one prototype in one place for the whole team. The second idea reflects an interest of producing two or three prototypes and placing them at local points in the globe where team members can use them.

Table 5.2 Advantages and disadvantages of having global prototypes and localized prototypes

	Global prototype	**Local prototype**
Advantages	-Less expensive -Selecting the most adequate location -Availability of most materials, technology and technical support	-All team members can test it physically and contribute more for improvements -Try to adaptate it to the own culture -The existence of local user design centers
Disadvantages	-Difficult for non-local team members to try -Harder to adequate to different regions/cultures	-More expensive -Non-availability of some materials/technology

Unfortunately as in most student-level engineering projects the dojyo had also a limited amount of money for funding which was still to be distributed between prototype

building, research, trips, another face-to-face meeting, etc. So TANE team decided to build only one prototype in Munich based mainly on the funding aspect.

The next point in the session was the tasks split-off which was well managed by the leaders since they gave freedom to every member for choosing the flyguy development aspects they would be dedicating to the next months based on their skills, time availability, support, and contents. Those aspects were shown previously (body framework, converting physical movement into electric signal, game plan, and visuals/creating environment) plus two more aspects that were added: processing signals to change environment and creating an exchange network. First the activities inside each of the six aspects were specified for the team's immediate research and actions:

- Body framework
    - To search for a solution
    - To try the solution out
    - To write thoughts for structure optimization
- Converting body movement into electric signals
    - To search for a solution
    - To make a table of pros/cons and to make a selection
- Creating an environment (visuals) and processing signals to change it
    - To look for existing software
    - To look for partners (computer games/software developers)
    - To try an alternative simple solution
    - To compare hardware solutions
- Creating an exchange network

    - To identify several interfaces
    - To make a java preparation
- Game plan
    - To identify a game plan
    - To work with partners (computer games/software developers)

Then everybody was asked to freely propose theirselves for any of the activities. This is better illustrated in the following table.

Table 5.3 Flyguy's tasks split-off

Task	**Member's name**
Body framework	Adrian Chris Ingo Kathleen Martin Moto
Converting body movement into electric signals	Moto Yusuke Kathleen Wendy
Creating an environment (visuals) and processing signals to change it	Wendy Chris Yusuke
Creating an exchange network	Kanan Daniel
Game plan	Daniel Martin Adrian

But the information provided above is not enough to assure that a team member will be doing well on the activity proposed by him/her so Moritz asked everyone to be specific on how skilled they are?, how much time they would dedicate?, and what type of support they (or their institutions) would be able to give? Look at the next chart.

Table 5.4 Possible individual/institutional contributions

Member's name	**Time**	**Skills**	**Support/Contents**
Fozzy	10 hours/week	Innovation research	Product development, teaching
Chris	Full time	Ergonomic, CAX	Product development
Gunter	Few hours/week	Working platform	Process moderation
Adrian	Full time	Design, CAD	Product development
Kanan	5-10 hours/week	Working platform, sensors for computer	Homepage
Ingo	1-2 days/week	Graphic design	Product development, project management
Moto	1-2 days/week	Mechatronics, building small things	Communication process
Yusuke	3 days/week	Biomechanics, measurement of human motion, controls	3D CAM, machining facilities
Daniel	5-10 hours/week	Internet, electric signals to computer	Cooperative work process
Martin	Little time	Sports science, media, communication	Computer games
Adoracion	Little time	Communication, multicultural work, teams	Expertise team cohesion
Carlos	Part time	Manufacturing, CAX, design, global teams	Advising, mechanical workshop
Kathleen	5-10 hours/week	Sports engineering, industrial design	
Wendy	Little time	Mechanical engineering, mechatronics, little graphics	Experimental research method
Klaus	Few hours/month	Sociology, cooperative innovation	Evaluation, knowledge emergence

After determining the approximate contributions by everyone the team entered the organization phase for working distributelly which is quite interesting to analyze since it leaded further conflicts and successes too. The topics treated there were the way communications would be used, the design of a homepage, the project and process management, the search for additional funding, the use of SolidWorks^{R} software, and the public relations aspect.

Starting with the communications aspect, TANE talked about two specific tools: the email and the BSCW; both of them are mentioned and explained in previous chapters. What I want to mention here is the ideas given by members to use the tools like using the email as a forum function and the BSCW as a private data saver/backup element. Here I would like to point out again the lack of information and training for team members about the implications of communicating at distance and the alternative communication solutions available for distributed teams. Referring to chapter 3.3.4 and 2.2.4 there are much more than just two communication tools for projects like the dojyo; that does not mean that email and BSCW aren't good but some tasks might be solved easily and faster trying out alternative methods. For example, in the Dojyo the majority of members are German so for them is possible using tools like local telephony.

The homepage idea was proposed in order to let the world know what the Dojyo is and to make public some information about the flyguy development in order to get people interested and to attract partners. That was a great idea since making a webpage is not expensive and two team members (Kanan and Daniel) have expertise on information systems so the skills started to be used.

Very little was talked about management, some professors proposed themselves as advisors but nothing was really defined for project management and leadership, in other words **it was not clear who would be in charge of guiding the team through the entire development process and as a consequence there were no rules or working guidelines provided to the team members.**

The SolidWorks^{R} is CAD software was sent to every participant of the dojyo and during the first meeting an agreement was made so everyone should try it when back home, should learn it and then use it as a common platform for the design tasks. **This was a good point as I commented in chapter 4.3.2 where it is emphasized the necessity of teams for having a common CAD exchange data base in order to avoid design and production conflicts.**

The public relations point was mentioned as a necessity of getting others interested in the Dojyo project and to search for possible extra-support from institutions, companies or government.

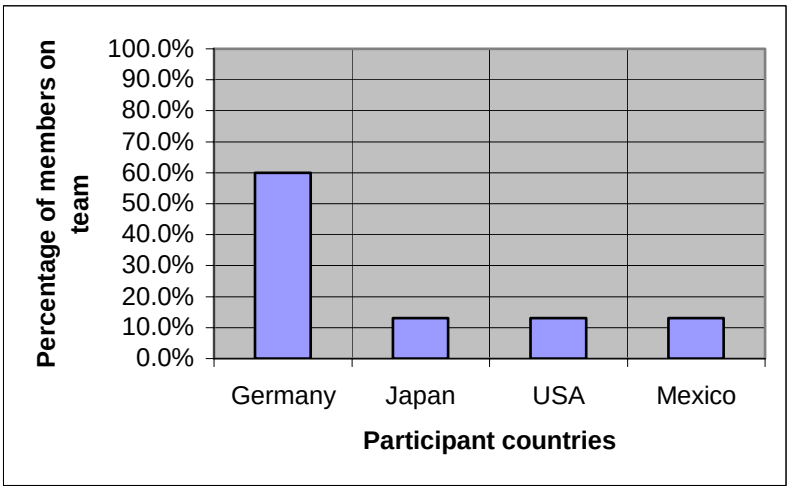
Finally, the last part of the first face-to-face meeting was a reflection about the meeting itself the comments presented next are as they were said by team members and are helpful for improving future projects of the same type. They are listed below:

-*It is needed more time for project development.* This refers to what I mentioned before that the innovation workshop was fabulous but **there was not enough time for organizing the distributed work after the solution. It was kind of difficult for most members to get the real clue of what exactly they would have to do at home and the commitment they acquired in the Munich workshop.**

-*Less leisure, more work time.* Although it is proved that fun is an important factor when integrating teams, even more if they are going to work at distance, it is not that important to overcome the work activities. **Then a balance between both fun and work must be accomplished and if there was some lack of time for project development, take into account a reorganization of time for further meetings so that fun is not lost but its activities can be compacted a little.**

-*Balancing the amount of members per region.* It is easy to deduce by the words "distributed team" what it means referring to the amount of people in the group and how they should be distributed in the globe. Maybe the amount is not as important as the distribution is. One of the problems I found in the dojyo was the unequal localization of individuals among the participant countries (USA, Japan, Germany and Mexico). The TANE team was mostly integrated by Germans (9 people) and the rest (6 people) come from the other three countries. This is better visualized in the following graph.

Table 5.5 Number of dojyo members (percent) by country



The problem here is that when having only one member in a country for example the distributed work exists but without the support that a local member (if available)

could give. There is also the “team feeling” factor that as one member commented during a TANE chat **“having two members or more in the same region diminishes the feeling of being isolated and stimulates the work activity”.**

-*Having smaller sub-groups.* This is in some way related to the preceding point because actually **by equating the distribution of members per region, groups become smaller in each city/country then work and decisions are easier to handle** even when working face-to-face.

-*Knowing more each other/team feeling.* On the other hand some members felt that they needed more time to know everyone. Much of this depends on the characteristics of the person and the level they can socialize. In the Dojyo it was difficult to get more time to be together in a common place because most members have other activities such as school or work and because from the beginning the funding available clearly included only two one week face-to-face meetings. But **the team feeling can be improved by maximizing the time spent with all members in several activities that help team integration for example during meal times try to have conversation equally with everyone and not only concentrate everyday to know just one member in special.**

-*Elaboration of rules from the beginning.* More than strict rules I would say that members refer in this point to their **need of a controlled freedom of working so they do not feel completely alone with their task but they feel supported at any time and they feel leadership, authority and guidance exerted by the one or the ones the team assigns as directors.**

-*The objectives of the Dojyo.* Team members agree that the **Dojyo is not only a product development project but it is also an educational project and an experimental project in the area of cross disciplinary/cross cultural work.**

5.4.2 Communication in the Dojyo

After one week in Munich everyone was back home with assigned duties and the most important thing: a product to be developed and to be pushed forward. What is the only difference with traditional teams? Members were sited on a virtual work table running from the ancient oriental world through the old European earths to the new American continent. Here it is presented a recapitulation of the jobs done by TANE team at distance, the advantageous facts and the disadvantageous ones, the successes and the conflicts, the lack of some aspects of distributed work and recommendations to improve the process in further projects. I will follow chronologically all the activity in the Dojyo.

The first meeting in Munich was from February 20-26, 2003. It is logic to think that international members need a time to recover the lost activity or work at home after traveling back, maybe 2-3 weeks it's ok, but during the first workshop nobody defined an initial time schedule let's say at least for the next two months (march and april). It is also logic that after having a successful first meeting in the aspect of team building members started working together almost immediately after getting home but that did not happen in the Dojyo so quick. Actually, it passed two entire months before the first works began. After February's meeting there was a "silence" among most TANE members on which almost nobody communicated and did anything for the flyguy development; there was only some activity by few members from Munich which actually are the initial organizers

who were always concerned on keeping things going on. **From my perspective the problem was not lack of team feeling or a failure on building a team spirit; the conflict here was that never, during the first meeting, the team neither defined and selected a real "fixed" leader or leaders nor stated their specific functions like the commitment of always pushing the team forward and being aware everybody is working. The team was left free and nobody formally established the working terms, limits or even rules and that caused the team did not have a clue on what or how to start working in the flyguy.**

By May Moritz and Chris realized that no advancement was being achieved so they tried to get the team back from their long "holiday" by getting them to use the email as the main communication way in order to be actualized of recent events, to share knowledge and to keep the team interconnection belt. But that was not yet a formal statement of organization, that was just a way to recover the communication and it did not have too much success; besides the organizers and few more people, the rest of the team rarely sent emails. The forum function proposed for the email did not work so well; in a team, people most time need to be pushed to participate and that was not being done in the Dojyo by that time.

Then an option for solving this problem was proposed by Moto. He suggested that using the email tool but from a different perspective all team members would be participating more constantly so he created the TANEWS. The concept was simple; tanews are biweekly news about the work done by TANE, the achievements, the conflicts and the further procedures. The way TANEWS pushed all members to participate was creating a list of all participants with an assigned publication date each so that every two

weeks one new person was in charge of writing the news; this would continue until the cycle was completed and so forth. This worked much better since it created a consciousness of commitment/responsibility on the TANE guys for keeping informed theirselves although tanews did not solve at all the problem of accomplishing the tasks. Appendix E contains samples of the news published. In the end of the project, if one analyzes them, most did not pass from being proposals that did not end in real things. For example, the first issue of TANEWS was a proposal for making experiments with a simple sensor-feedback system in order to decide or at least get a better idea of what could be implemented for sensing the body movements; after that members commented the idea by email or by further TANEWS and they gave suggestions or opinions; everything was ok except that the experiment was never realized. **What probably happened here was some level of disorganization and lack of decision (because information never lacked) for action from the members in charge of that task.**

The other communication tool used by TANE was the BSCW (already explained in previous chapters). What it is important here is to talk about the role this tool played on helping Dojyo participants to work. The BSCW is a great information platform, it is flexible, it is easy to use, it is not expensive, it has many functions and it can be accessed by everyone; it was not really a big deal for the team to get acquainted with its usage. After TANEWS started to be issued team members became more active therefore the necessity of filing all the emerging information and work increased. TANE created a diversity of folders to place the data depending on the aspect to be developed of the flyguy. Anytime a member accessed the information it is possible to read it, download it, make comments on it, even modify some of it or make contributions. This is similar to

the TANEWS-email method of reviewing information with the advantage that BSCW is a common unique platform for everyone and the issuing task is not cyclic but it can be made at anytime by any member. Other advantages of BSCW are: there is no restriction on memory space, there is a calendar included inside, managing information and files are better organized, people can acknowledge when others are participating since BSCW provides information on what user has read the files and when, it is presented in English or Deutsch for the case of foreigners (Japanese, Americans, Mexicans) or Germans respectively, email can be handled from there. Now, for the purpose of this thesis topic I will show how the TANE information was organized as an example but because of confidentiality reasons stated from the beginning by all members and leaders I cannot show detailed information of the whole flyguy development.

Figure 5.12 Organization of the dojyo on BSCW

The division of project aspects in BSCW reflects the aspects with stronger emphasis and success treated during the first face-to-face meeting such as team

building and flyguy technicals; actually these two aspects were, in the end, the ones TANE team took as primordial and worked out the most. On the other hand there is one folder in BSCW named "project organization" which also reflects some weaknesses of the team's knowledge and practice on distributed work as commented before. On the next figures one can notice this phenomenon.

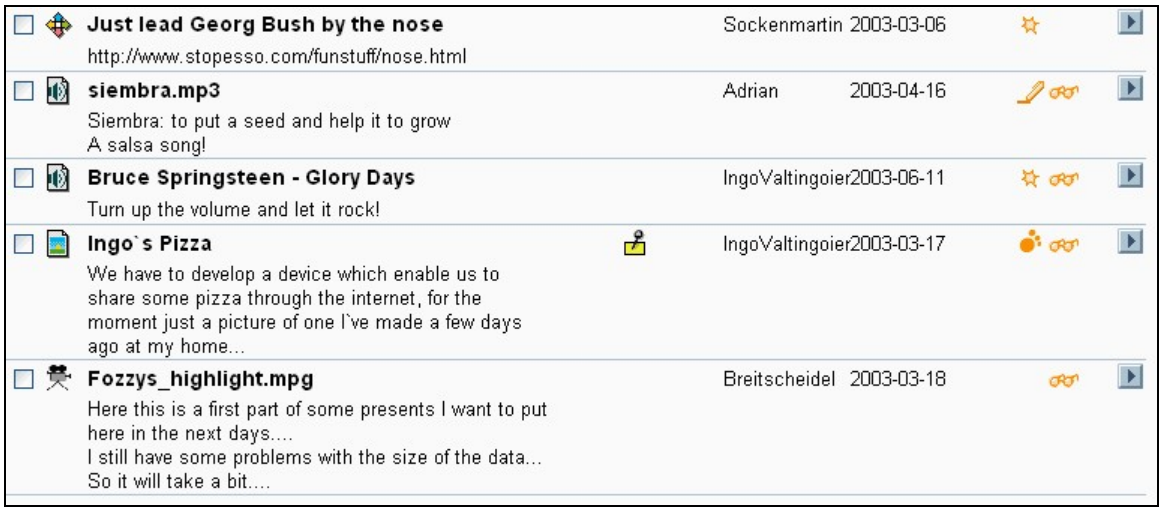


Figure 5.13 Leisure folder on BSCW

A leisure folder was created so members could share all the funny things they want such as pictures, movie files, song files, even jokes. **That was a good aim of Dojyo for working at distance because these types of things create a "breathing" space in a hard environment like working far apart is. Leisure folder was a fun factor but also a good pretext for getting users to visit BSCW more frequently and get aware on what it is new on the project.**

The Dojyo project was not exclusive from having new members or cooperation partners in the future so a good idea was to create a space where all the participants placed their personal information. This way everybody is aware of the characteristics of

the crew; their interests, their skills, and more. There is no fixed shape on how members must present theirselves in an internet page but a good outline is the one proposed by Daniel which contains the essential information everybody would like to know about a person called “the wanted poster”.

Wanted Poster

Name: Efrén Adrian Moreno Ramirez.
Nick: Adrian.
Uni/Country: Universidad de las Américas Puebla/ México.
Study course: Mechanical Engineering.
Hobbies: Arts: music/piano; Sports: soccer, volleyball; Traveling.
Team member: why? I like to be part of the Dojyo because it is an outstanding internationally-distributed-work project; I like the idea of developing a new product in conjunction with other people around the world using the present technologies. Working with students and professors in an international environment is for me a great experience academically, culturally and socially. Since this is a chance to share information and knowledge with others, I am learning many useful things not only for my career but also for my own life. I like always working in teams and finding new ways of solving needing or problems by exploding my creativity at the most.
I am a very competitive person, creative and cool to deal with.
Finally I was curious about how Germans and Japanese dance Salsa…I got surprised they learn quickly and they do it well. So, don’t get stock on the snow guys, keep moving your body!!!
Position in our Team: Mechanical design (mainly). Building of the framework. Research on distributed work.

Figure 5.14 The “wanted” poster

Finally, let’s look at the shape of the organization folder. In one way, the Dojyo organization was done well with respect to the following aspects: scheduling distance-meeting appointments and scheduling the tanews publication. But one aspect that was not given too much importance was **to create a general working schedule containing definite times for researching, definite times for experimenting, definite times for**

designing, definite times for building, deadlines for each of the TANE tasks groups, deadlines for assembling the activities/advancements done by the tasks groups up to a certain moment (namely theoretical knowledge or practical/buildable things), scheduling all the tasks groups at least several times to meet together and to get aware of the degree of project development, etc. And although distributed work must provide members with more flexibility for action since it is not a table-job, that flexibility must not be so big that members loose the fixed root-outline of the project. I do not say that all the time people in teams shall be pushed but if there can exist a mainframe schedule leaders can organize the points on time when the project need to be actualized and the team refreshed. People is always moving by time, so fixing in some way the project activities in time periods makes it easier to get the desired results. If a general schedule results difficult to produce at least a general communication schedule can be made to have every member always working on time (remember from previous chapters that communication is one off the most important aspects of distributed work).

Table 5.6 Suggested chat timetable for TANE

Chattimetable	*Monday*	*Tuesday*	*Wednesday*	*Thursday*	*Friday*	*Saturday*	*Sunday*
Time: 9:00-12:00	*FreeforChat!!*						
Time:							
Time:							
Time:							
Time:							
Time:							

I just fill in an example!

Please note the times in Europeantime:
Stanford +9h
Puebla +7h
Tokio –7h

Table 5.7 Suggested deadline table for TANE

Personal Deadlines
Please fill in the fields:
0 I don't now yet
1 Full time (more than 30 Hours for TANE)
2 Part time (15-30 hours for TANE)
3 Little time (5-15)
4 Reachable by mail etc but not really time (exams, other important things to do)
5 Not reachable (holiday etc).

Week	*How much time do I have?*
9-15 June	
16-22 June	
23-29 June	
30 June –6July	
7-13 July	
14-20 July	
21-27 July	
28 July –3August	
4-10 August	
11-17 August	
18-24 gust	
25-31 August	
1-7 September	
8-14 September	
15-21 September	
22-28 September	
29 September –5 October	

BSCW worked nicely for the purpose of the dojyo as well as the email but those are asynchronous communication tools and after some time the team felt the lack of proximity or to be able to talk directly as everyone does in collocated teams. That is why the information system specialists (Kanan and Daniel) added a chat tool accessible from the BSCW. The chat relieved BSCW from its asynchronous "forum" function and allowed TANE to participate directly on the project discussions which made a little faster the process of developing the flyguy. Again the idea was good and actually Daniel invited all members to register in a time chart (see table 5.6 and 5.7) indicating their possible days and hours available for chatting during the week; more than half of the

team did not show any interest and that was one of the reasons of the flyguy development delays since not all of the tasks groups participated constantly to keep going the project on time. The rest (the ones involving the chat discussions) could keep track of their activity and got better results on their assignments.

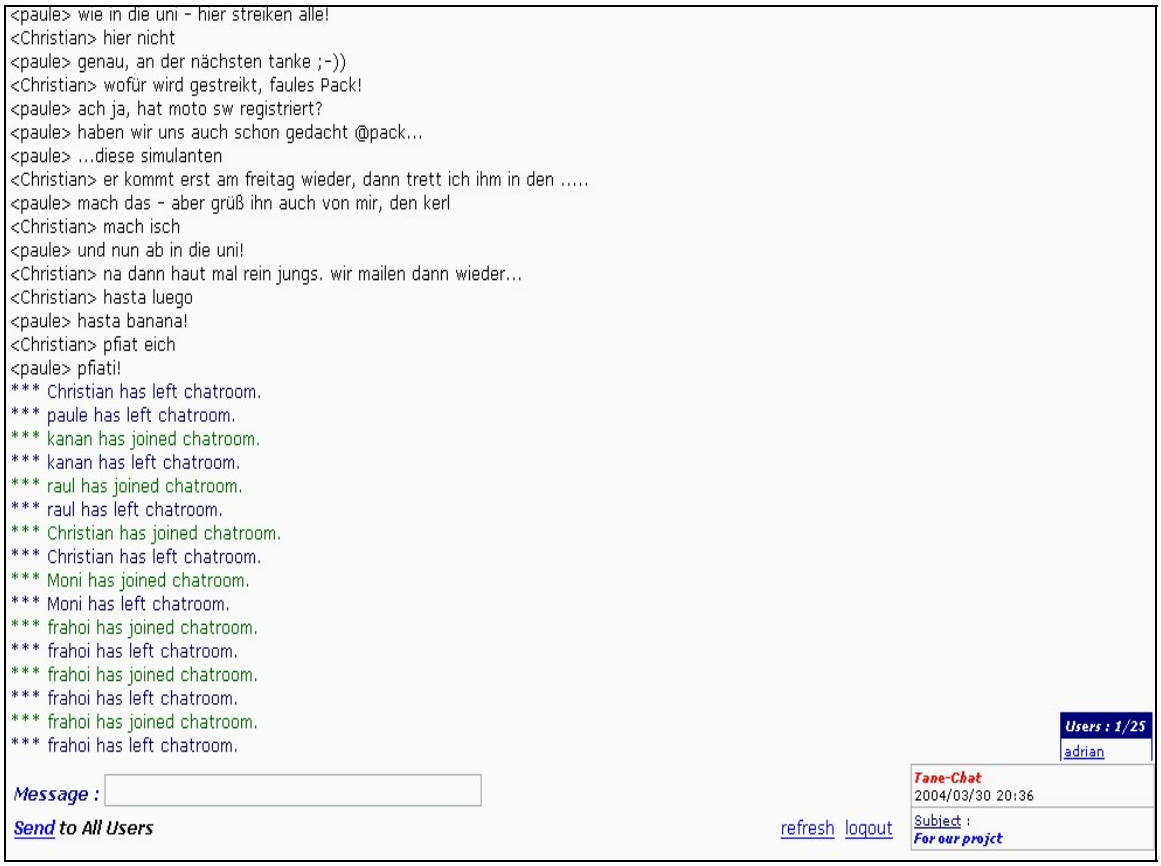


Figure 5.15 BSCW chat tool

Next, it is explained in general terms the actual work done for the development of flyguy and later it is shown a recommendation for better planning the work in further projects similar to the Dojyo and for complementing the good aspects of the dojyo to continue having nice results in the future of the flyguy.

5.4.3 Development of the flyguy: technicals of the body framework

As I said before, it is not possible to present all the information of the flyguy works since it is property of not just me but all the TANE team. But I was allowed to talk about my own activity which was designing the body framework. In fact this task was the only one fully developed among the five assigned after the solution in Munich (if one measures the realistic results achieved). The realistic results were the prototype building in October which will be more detailed on the last part of the present chapter. For now I want to show chronologically not only some of the technical work but the organization and the distributed job input to accomplish the objectives of the body framework team. This is the best and most complete example from the Dojyo case supporting the statement that distributed work can lead to good results too as collocated work has done by many years.

The body framework team (BFT) made their first distance jobs communicating through TANEWS. We started giving a sort of ideas about devices and body positions and commenting about their realizeability; some examples are shown below.

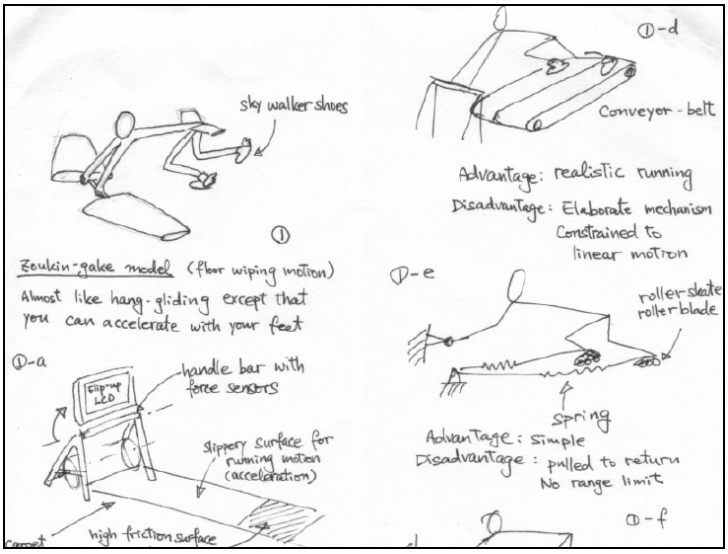


Figure 5.16 Ideas for modeling flight

By that time (during May) a group of students from Magdeburg joined us providing a design for the framework as part of their engineering design class. This solution was very interesting and was kept by BFT as the first option to be built for the prototype (fig.5.17) but later it was replaced for a more feasible one because of the materials availability and the short time before the second face-to-face meeting.

BFT decided to make several experiments on body positioning and its effects on the feeling of flying using available sports equipment/devices in Germany and Mexico. On one hand Chris tested the horizontal position of the body using climbing equipment (fig.5.18) On the other hand I tested the horizontal and vertical position of the body with a kind of hang-gliding device and a parachute respectively (fig. 5.19).

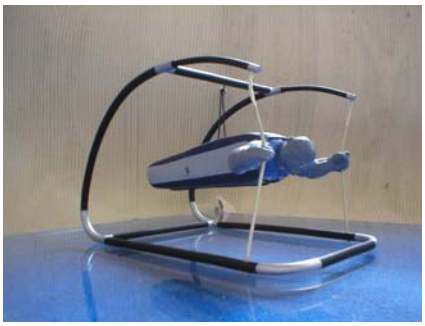


Figure 5.17 Madgeburgers concept

Figure 5.18 Testing equipment in Munich

Figure 5.19 Testing equipment in México (Skycoaster and Parachute)

Just for the record, all this processes were managed through email (as a forum) which allowed BFT members to keep informed on time and to know the goals achieved. One example of these forum discussions is the following on which Chris and Adrian present the results and comments on their respective experiment.

Chris experiment (reported on BSCW):
Goals:
- *Get a first impression of the flight position and the possible movements*
- *Create new ideas on how a first prototype might look like*

Stuff used:
- *Climbing equipment*
- *Elastic thera bands*

*These are the main **results** of our experiments:*
1. *The horizontal flight position is really cool and for most persons a new experience.*
2. *Game plan is absolutely necessary to define which movements must be possible.*
3. *A first prototype should be fine without using any force feedback device. A final solution could become more attractive by using one.*
4. *Climbing equipment is really uncomfortable. The next evolutionary step will be the equipment used in a hang glider.*

Adrian experiment (reported on tanews):
<u>The Sky coaster.</u>
One is put inside a bag which goes from the chest to the knees. On the bottom part there is a harness. The bag is made of strong polymeric materials and in the middle it has some cushioned thing.
The body is suspended on the air by one rope which joins all the belts from the bag.
This device is very comfortable since it supports the center of gravity of the body and most of our weight. Arms and legs are free to move and the head is maintained without effort.
The feeling of using this is very realistic, like a bird on free flying.
The best and most exciting position is approximately at 30 degrees head down-toes up and also the most comfortable for us when watching the display on the floor.
I strongly recommend this type of support.

On July some chats took place between BFT members with two purposes: to recover the team cohesion which was getting a little weak and to decide the solutions for the prototype frame and some other aspects. The first thing was we decided that the best position for the body is to lie horizontally and to use hang-gliding equipment because it is cool, it is more comfortable than climbing position, it feels almost like flying even without a simulation, it matches best the flying situation, it is a new experience for most persons, and it allows flexibility of arms/legs movements. Then an email was sent to the whole team to inform of these results.

After that Ingo informed BFT that a German company, MayTec (http://www.maytec.de/mainframe_e.htm) which produces extruded aluminum profiles, was donating materials for building the frame. Then I was in charge of making a simple design adaptable to those material conditions and adjustable to several new objectives for the prototype (we redefined some goals after realizing the team situation and development level of the project; they will be summarized later). This is how the distributed work was done on this task:

1. In Puebla, I first make a 3D CAD drawing of the framework and placed it on BSCW and allowed the others one week to check it.

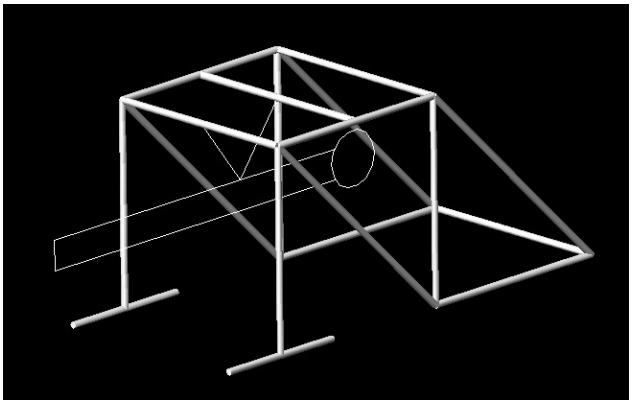


Figure 5.20 Framework concept from Puebla

2. At the end of the week BFT had a chat session for discussing the design and everybody agreed with the solution.
3. From Munich, Ingo clarified the design conditions (to use MayTec profiles) and got me the necessary information for doing the design job.

Adrian

Thanks for the drawings you sent. The general concept of the frame, as shown in the 3D and 2D sketches is ok. Our agreement is to use "MayTec"-profiles. I need to know which kind of profiles and in which sizes and lengths I have to order, and I need to know what kind of joints you want to use. Please take a look at MayTec-website, there you will find an online catalogue with the elements we need, and a database with CAD-library you can use for the drawing too…

4. I entered the MayTec webpage and used their catalogs and formulas for calculating and selecting the type of profile to be used. Then I confirmed the data analyzing the structure through finite element software (Algor^{R}).
5. Finally I summarized the information by sending Ingo an email with the parts needed just by catalog (to make easier the request). This is the example of my email sent to him.

   Ingo

   I just changed a little bit the original frame but still conserves the same shape.
   PROFILES 40x40, 4E:
   1. Six pieces, 1250 mm length, 2 connector bores (left and right, 1 each)
   1.11.040040.43-AA1AA1/1250
   2. Four pieces, 1750 mm length, 2 connector bores (left and right, 1 each)
   1.11.040040.43-AA1AA1/1750…

6. Ingo requested the materials to MayTec to have them on time for the second workshop.

Note: please refer to Appendix B for details on the design and calculations of the framework module.

5.4.4 Summary of activities at distance of the other flyguy modules.

- *Converting body movement into electric signals*

Several members in Germany, Japan and the USA looked for available devices and during those months some of the suggestions were:

- Trying an experiment with simple sensor-feedback system in two remote locations and try data communication.
- Using potentiometers and DC motors.

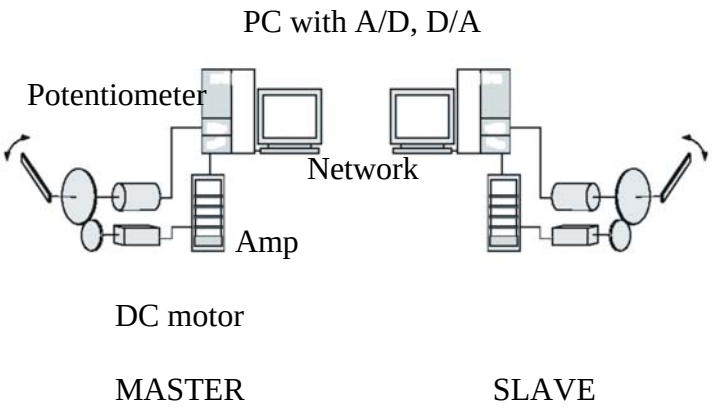


Figure 5.21 Experiment for mechatronics and network

- Trying already existing hardware/software. For example using A/D board plus labview or microcontroller plus computer. Also the exploration of games such as Lego^{R} mindstorms or Gate^{R} master.
- Using DLR motors.
- Sensing the motions through electronic-optical sensors.
- 3D cameras system, ultrasonic sensors, magnetometric sensors, parallel wires system.

- *Creating an environment (visuals) and processing signals to change it*

Not too much was done about this task, only to look for existing developments. Remember also that there were no game programmers in TANE.

- Visiting companies with expertise on signal processing like SIMI motion which works mainly in the field of digital animation and simulation and were willing to cooperate in some way.
- Testing flight simulators and computer games that could be adapted to the conditions of the flyguy.
- "Spying" other projects or products similar to ours.

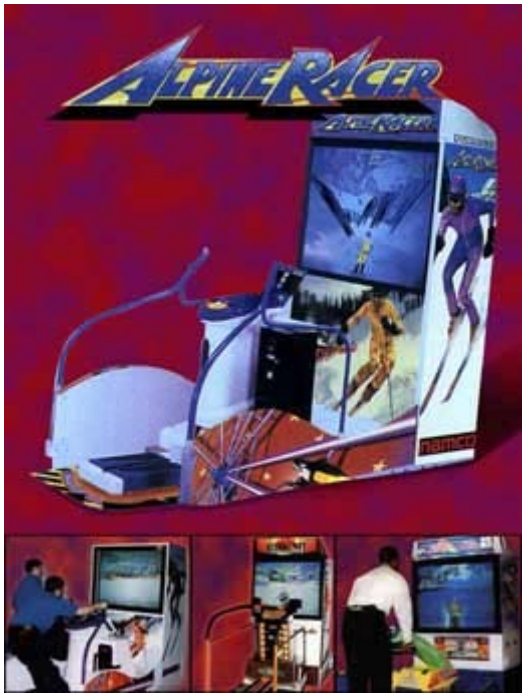


Figure 5.22 Similar projects to flyguy

- *Creating an exchange network*

Since there was actually no decision on the configuration of the game and its electronic devices, the data exchange topic was almost not treated. Ideas were left on the air like application of java.

- *Game plan*

Only sketched ideas were given by few members, the next figure illustrates some.

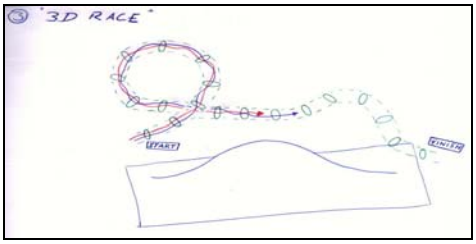


Figure 5.23 The 3D race game by Chris

5.4.5 Conclusions of the flyguy development at distance

By August time was ticking away for the next meeting (on October); and factors like poor chat attendance by most members, not too much email response, and the non-existence of fixed solutions and decisions from the other flyguy modules created the necessity of changing some of the initial goals for the flyguy. Here are some things that TANE concluded for the project continuation:

- TANE thought it would be difficult to build something really detailed before the October meeting so they better used the time to find out who was still motivated, what the resources (money, people, time, facilities) were, and to prepare the workshop better.
- BFT decided to use part of the workshop to build a primitive experimental prototype to play around, to make the first trials, to redefine the aspects of the flyguy, and to decide on a really detailed concept.
- After trying the first simple prototype TANE would be able to think on better technical solutions, a project schedule and single tasks for everyone.

- Being only few members with enough time for the project it was proposed to recruit one or two new participants from Japan or Mexico (in the end only new people from Germany joined).
- TANE found that it was necessary to differentiate between two goals in the project: the vision of the high end “flight simulator fitness device” from the explorative prototype to be used in October to collect first experiences in computer supported sports and the simulation of flight feeling.
- If there were any ideas on sensors or how the physical demand could be created they might be added for discussion in the workshop.
- To think on possible body exercises using the frame, in other words, what a user is able to do in such a structure as fitness work to control the flight simulation and to suggest ideas on feedback/resistance systems.
- To think on game design, simulation software selection, mechatronics system interfacing with game software, and network solutions for playing in distributed locations.
- All the things mentioned before leaded TANE to their final concept of the first prototype. The results are shown next.

5.5 The end of a cycle: the second TANE workshop and results of the Dojyo

As the dojyo started one day, the first generation of the Dojyo project ended its work cycle at the second face-to-face meeting in Munich. In this part one will see the activities in the workshop, the jobs realized, the realistic results obtained by TANE on the development of the flyguy, and the perspectives of the project.

5.5.1 General activities

TANE's second face to face meeting took place during the first week of October. Once again, there were plenty of activities planned to achieve the desired results. Compared to the workshop in February, **it was more flexible on the time schedule and quite different from the first one because the goals were more specific and more technical-oriented (to build the first experimental prototype).** Despite of the difference among the two workshops, in both we gained so much experience and knowledge on other engineering fields.

During five workshop days, the team faced different tasks and visited interesting places to help the mind to get a better idea on what technological applications can be used in flyguy. One interesting experience was the visit to the Ars Electronica Center, Linz. Here team members found an apparatus similar to flyguy and tried it out; as well, looking at the different projects on the museum, participants discovered that some of those had applications that could be put into the flyguy: electronics, visual/graphics, computer animation, etc. TANE met the developers of Humphrey II and actually talked to them about the importance of the Dojyo project; they showed us the Future Lab at Linz and the best thing was the **establishment of a new relationship for cooperation** between them and the dojyo members for future works.

Figure 5.24 The Humphrey (www.aec.at/humphrey)

5.5.2 Prototype building

Remembering chapter 5.4, BFT and team members made the agreement of building an experimental prototype which may be taken as the practical result (in the technical field of the Dojyo's core objectives) from the distributed work done by BFT module. The prototype construction was the most important activity of the second meeting. The sequence it is explained and illustrated next:

- Revision of framework schemes and small adaptations. Check out the materials.

Figure 5.25 Starting the prototype

- Structure assembling.

Figure 5.26 Building the prototype

- Integration of sports equipment (harness and elastic ropes).

Figure 5.27 Assembling other elements

- Preparing for the flight

Figure 5.28 Fixing to the frame

- Testing body movements and postures.

Figure 5.29 Testing the flyguy

- Testing a simple bar-rope system as possible input device for controlling the game (direction and pitch) using own body mass (exercising).

Figure 5.30 More tests

- Integration of computer (flying) games to simulate flying (controlled independently by other member).

Figure 5.31 Flight simulations on flyguy

- Trial of simple force feedback devices such as wind and sound for an "emotional" flying sensation.

Figure 5.32 The force of the wind

- Commenting the results.

Figure 5.33 Reflections

Test report of the prototype

The prototype was tested focusing on:

- Body support and comfortability.
- Equipment that produces the best and the most real feeling of flying.
- Computer games and software that is interesting and funny for people.
- Possible input devices for making exercise and controlling the action.

The summarized results from testing the prototype were:

- The body sport equipment is comfortable but needs to be adapted to allow a faster collocation.
- The strongest sensation of doing sports was caused when elastic ropes and bars.
- It is more interesting to play in group (cooperatively/competitively, online) then playing alone.
- To implement a rope-pulley system as the input devices and to send signals through accelerometers.
- To create virtual sceneries of cities in the world.
- To improve framework design.

- To use a virtual reality system like the “cave”.
- The prototype built could not be more than a partly function-equivalent prototype; realizing some important functions while neglecting others; however, it represented a good means to test the core functions.

5.5.3 Reflections of the TANE workshop in October

Here is a summary of some thoughts given by TANE members with respect to the work done in October:

Location and general thoughts:

- The location was better for working but too small (loud).
- Possibilities to do sports were lacking.
- Better weather next time, please!
- The workshop was good to get to know the other members (especially for those who haven’t been on the first workshop).
- It was good to try Humphrey to get concrete ideas (and it was also fun); it’s important to make visits which are related with our projects.

Time management:

- Workshop was too short (2 or 3 days more/one month; time for consolidation.
- Free time should be shifted to the middle of the workshop (efficiency went down in the middle).

Prototype building:

- It was good to build something (the prototype) now; idea and chances of cooperation get clear and you have feelings of success, satisfaction and/or pride.
- Tools and facilities for prototype building were lacking; it was difficult to do practical work on the weekend with limited resources.
- There’s more motivation to continue because of the more specific work and ideas.

Teamwork:

- The work in small groups was more efficient but the groups should be re-integrated.
- The long distance work has to be more organised.
- Similar projects need to be part of the curricular activity.

Party:

- Good: work hard – play hard (but partying was voluntary, not forced).
- It was nice getting involved with German culture such as the Oktoberfest.

5.5.4 The future of Dojyo

The second face-to-face meeting was the conclusion of a work cycle but it was not the end of the Dojyo since the project itself was an inspiration to continue working on it. So most team members willing to continue organized a meeting to talk about the future of the dojyo and several topics were pointed out.

- To search for funding possibilities (very important for organizing more meetings).
- To fix the prototype concept, that is to decide on the final look of it and the devices and software which will be used on it.
- To improve project management in order to keep track of everyone and put into the same line of work of every participant.
- To define timelines and tasks.
- To create a homepage (first a fast version, later the final setup).
- To define the roles of participants.
- To develop a concept for marketing, it is very important to get attention from people, companies, institutions and other parties.

Other aspects were: to organize parallel work, to find a balance between synchronous and asynchronous coordination, to try video conferencing, to establish one to two managers per location, to find new team members, to search for more working modes rather than just email, to open up to other universities, to change locations for the workshops, to establish at least one developers lab.

5.6 Conclusions

This chapter, the longest of all, apparently covers just one case study but it is so meticulous and elaborated that exemplifies perfectly what the thesis is all about. Chapter five is kind of complex because it is conformed of practical facts (illustrated by the Dojyo overall work cycle); an analysis of the processes in the case, the advantages and disadvantages of the methodologies applied; and recommendations for improving the effectiveness of these type of projects based on the methodology outlined in chapter four and the theorical research given in the first two chapters.

I want to remark that my own analysis and suggestions to the dojyo case do not try to criticize the project at any moment; in fact all the work done in this thesis emerged from the new experience that the Dojyo offers, the challenges, and the nice panorama it provides for the future of engineering. Thus all my work aims to provide elements, tools, methods to projects like this or even future Dojyos.

A conscious reading of this chapter offers a step-by-step example of an international distributed project for product innovation taken to reality plus a panoramic view of the pros and cons a theorical methodology may have when put into practice. All the advantages and good facts but also the mistakes are shown in the dojyo case study so it is a source of learning for future members of international teams to organize manage and handle in a better the work at distance.

Finally, this case is a good example of how innovation is enhanced by having not only local members but a mix of cultures and disciplines; of how ideas come up easier; of how direct collaboration can lead to nice concepts and its respective results; and the rich experience one gets by participating on projects like this.