This book is the outcome of the Euro-Workshop \{ACCOLADE\} which took place from 28th of August till 1st of September 2000. The Euro-Workshop was funded by the European Commission through the Fifth Framework of Research. Young and senior researchers worked together on the theme of Architectural Collaborative Design.

The set of traditional papers is supplemented by a report on the brainstorm and working sessions which produced a lot of materials for future research directions. They are summarized in a ‘research agenda’. The ‘global scheme’ gives a structure for the different sub-themes ranging from communication language, communication behaviour, communication environment, goals and roles and education. The combination of technical reflections and human aspects makes this book a unique position in the field of collaborative design.
ACCOLADE
Architecture . Collaboration . Design

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DUP Science
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A group of around 29 people experienced the {ACCOLADE} Euro-Workshop in August 2000. This 5-day event turned out to be something completely different from a normal 3-day Conference. A lot of intense discussions, brainstorming and working sessions stimulated the exchange of ideas between people. This organisation could only take place with the help of a lot of people and organisations. First of all, we want to thank the European Commission for funding {ACCOLADE}. Without this support it would have been impossible to bring together young and senior researchers in the field of collaborative architectural design.

The Hogeschool voor Wetenschap & Kunst, Sint-Lucas Architecture provided the location and organisational support. The Delft University of Technology, Faculty of Architecture and the Delft University Press supported the organisation and the publication of these proceedings. It is thanks to both universities that this event and these proceedings could be realised. The authors also thank the Scientific Committee for their helpful comments and support.

Next, we want to thank all participants for contributing to the {ACCOLADE} workshop. Discussions were held in an open spirit, young and senior researchers worked together and exchanged ideas in an open way and did set the scene for future research. We felt a great enthusiasm between participants and we heard several subgroups continue to work together. The results and ideas formulated in the introduction need to be seen as a result of all participants. During the workshop and also after it, communication between participants continued and led to the ideas formulated on the next pages.

Finally, we want to thank all the people behind the organisation: Tom Provoost for the continuous support and the help in solving numerous technical problems, Jan Bruggemans and Jan Apers for their help in organising the architectural tours, and last but not least all people of the staff in Brussels who solved a lot of details and contributed to the success of the event.

It is the belief of the organisers that this workshop will lead to further collaborative research activities of the participants in the field covered by {ACCOLADE}. The discussions during and after the Euro-Workshop look very promising. The topic list and research agenda give a lot of ideas for future research activities. Most participants expressed their intent to participate in future network activities.

Delft, 15 May 2001

Martijn Stellingwerff
Johan Verbeke
introduction

This book is the result of the {ACCOLADE} Euro-Workshop, which was organised at the Hogeschool voor Wetenschap & Kunst, Sint-Lucas Architecture Brussels in collaboration with the Delft University of Technology, Faculty of Architecture. The Euro-Workshop was supported by the European Commission within the Fifth Framework of Research and took place from 28th of August till 1st of September 2000.

The name {ACCOLADE} is an acronym for Architectural Collaborative Design. The association of this name is positive because the accolade sign brings a number of different words together in a group. E.g. {England, Belgium, the Netherlands, Italy, ...}. The meaning of the word in English is ‘a mark of honour’ and the French meaning of the word is a ‘solemn embrace’. It also refers to the multi-disciplinary design process. These connotations can be useful for a collaboration project in which many different people and parties plan to make a joint design effort.

Twenty-nine researchers from all over Europe participated in the {ACCOLADE} Workshop and worked together during five intense days. Before the event, all participants communicated through e-mail and the ideas were known before the Workshop started: papers and future scenarios were exchanged.

During the {ACCOLADE} Workshop, four keynote speakers contributed from different fields related to the {ACCOLADE} theme. Peter Johnson {UB} introduced the participants to the important aspect of the human-computer interaction in collaboration and communication. Ranulph Glanville {CE} focussed on computing and collaboration. Lesley Gavin {UCL} made the link with virtual worlds and environments. Finally, Arne Winkler {VU} introduced the participants to the state of the art from the technical point of view.

Participants presented their ideas. These were elaborated and tested during workshops and working sessions. Brainstorming and informal discussions between the participants complemented the collaborative work. After the Workshop all papers were updated and new ideas were added. Conclusions were drawn and discussed in a collaborative process. These Proceedings are the outcome of this collaborative process.

During the first cultural tour the exclusive Royal Glass houses of the Belgian King were visited. During the second tour the Stocklett House and the social housing of Kapellekesveld and Logis Floreal and the student housing of Lucien Kroll were visited. This further inspired the participants in their reflections on the collaborative design process.
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originally, the project was formulated as follows:

“Architectural design offices, contractors and specialised engineering offices become more and more internationally active. The partners and parties in the building industry need to be provided with methods and techniques for multi-located collaboration to support their activities. Moreover, design offices become multi-disciplinary working groups needing new methods for multi-disciplinary collaboration for e.g. architectural design, urban planning, engineering, interior design and building physics design. These methods and techniques are currently lacking.

Current activities of design offices ask for an initiative and methods to support their demand for multi-disciplinary and multi-located virtual collaborative architectural design. They need new methods and reflections to support and enhance their economic international possibilities and activities.

Current technological developments provide basic techniques for group-work (collaboration between architects and/or designers) in a limited way. The most important limitations are connected to aspects, which are typical for the domain of architectural design. Human Computer Interfaces do not provide efficient tools for communication of spatial problems and tools for virtual collaborative work do not provide good synchronous working methods. The general collaboration software needs to be enhanced and refined in order to meet the specific and complex conditions for usage in architectural design and in order to support the creative architectural design process in an appropriate way.

Architectural design can be denominated as a non-linear process in which many parties take place. It is well known several design cycles are needed to refine initial ideas. Architectural design is a highly creative design process, which asks for a sophisticated system enabling the representation, manipulation and communication of three dimensional (3D) information. In order to collaborate during an architectural design process there is the need for a system, which provides for synchronous work sessions of multiple design parties.

New research should be initiated to study these parallel work processes and to create intelligent Human Computer Interfaces, which streamline the demands of synchronous work in multi-disciplinary and multi-located design groups".
The Workshop tackled the conference theme from different angles ranging from philosophy, cultural and technical aspects, methodologies and even social interaction through sound. This enabled input from different scientific backgrounds and stimulated participants. It helped to get a good insight in the field and to rethink old concepts. This diversity is kept throughout the book: papers, software tests, future scenarios, afterthoughts, results of brainstorming, future task lists, reports on real-time experiments, discussions…

**papers**

In his paper Ranulph Glanville {CE} focuses on the mutual impact of computing and collaborating. He points to the fact collaborating is more than co-operation and co-ordination. It also includes novelty and the unexpected. Exactly those aspects imply that the field of collaborative architectural design needs more than technical evolution. The human aspects of collaboration play a very important role.

In the paper of Peter and Hilary Johnson {UB}, the human-computer interaction perspective is explained. Different types of collaboration, of goals and of interaction are discussed. The concept of information brokering is discussed including design metaphors, design analysis and design evaluation.

Lesley Gavin {UCL} concentrates on 3D multi-user environments and the experiences with such environments so far. She also gives reflections on issues related to the architectural design process.

John Heinz {TUD} introduces a Design Coordination System, a tool for achieving more explicit and effective forms of design co-ordination. The system consists of a design project network and a series of coordination games. The tools enable to make the process of continuously rescheduling explicit. It is hoped the tool helps to reach a more successful project outcome and a better coordinated architectural design process.

Jonas af Klercker and Jan Henrichsén {TUL} focus on the possibilities offered by virtual environments. The current experiences are used to detect the problem field and to propose intentions for future research.

Gernot Pittioni {PIT} brings in the experience from the current way of working in a large engineering office located in two towns. He investigates aspects that are important for successful collaborative architectural design. Starting from the way of working in the past, he describes current technologies and gives his views for the near future. Exchange of digital photos and design files through networks and mobile connections are described as important aspects for remote work of building engineers.
Andy Brown and Phil Berridge {UL} deal with three aspects of the collaboration process: encouraging collaboration, the use of 3D worlds as meeting and discussion places and how architectural models and man-machine interfaces can improve the effectiveness of game environments in an architectural context. Their work shows that a broad spectrum of social- and technical-developments is needed to achieve fruitful collaboration.

Tom Maver and Jelena Petric {SU} give insight in the young historic past of user participation in the design decision-making process. They indicate a 10 year period (from 1972-1982) in which many case studies on this topic were performed. Thereafter, the subject of computer aided design participation virtually disappeared from the scene for a decade. Now they indicate hope for the future as multimedia, virtual reality and internet technologies allow new developments. One of such developments, described in another paper, comes from their own Virtual Environment Laboratory at the Strathclyde University. Gareth Ennis and Malcolm Lindsay {SU}, propose a set of design criteria for deploying multi-user software. The authors illustrate this by using a VNET server program as interface to their VRGlasgow model.

Ernst Kruijff and Dirk Donath {BUW} describe how architects could use the strengths of an immersive or semi-immersive virtual environment to create a shared understanding about a design problem. They give an overview of particular factors and requirements that need to be considered before multi-user environments can be made. A major focus in the paper is at the transfer of spatial knowledge about architectural space.

Henri Achten and Bauke de Vries {TUE} present DDDoolz, a desktop-VR voxel sketchtool that could be extended for use in shared sketch sessions. Henri Achten proposes a number of features that are needed for software that supports collaborative design. Amongst other features, he mentions: good multi-user sound quality, shared views, capturing of gestures and a dynamic lock that allows partial changes of the design data.

Leandro Madrazo {URL} presents NETWORKING: a web environment for collaborative education that is used for the course "Sistemas de Representación" at the E.T.S. d'Arquitectura La Salle, Barcelona. The web-based environment promotes the exchange of ideas among students and their capacity to work collaboratively. The presentation of NETWORKING gave many new insights of a structured way of exchange and articulation of design concepts in the form of text, shapes, objects, images, space and light. The work shows a careful and innovatively developed pedagogic model that raises a new understanding specific to the new media.

Adam Jakimowicz and Jaroslaw Szewczyk {TUB} provide an important overview of problems that have to be solved when the current CAD systems are extended...
with a multi user interface. They indicate the loss of functionality of CAD programs by the overwhelming amount of tools and the amount of icons that comes along. The 'battle for space on the screen' goes between the workspace and the rest of the graphic user interface. As a solution they see the need and the chance to create a new design paradigm. The paradigm already appears in collaborative design networks, with understandable, reduced and easier interfaces.

Martijn Stellingwerff {TUD} proposes 'the concept of carrying' in collaborative virtual environments. He indicates the need for new interfaces that allow multiple users to exchange their opinions when they are 'immersed' in a shared 3D environment. The metaphor of carrying can be used to give visual cues about what other people in the shared environment are doing. The tools that are carried by avatars (virtual puppet representations of the collaborating people in a virtual environment), and the gestures (such as pointing) of the avatars can be seen as quite natural representations to inform the people about each other's intentions.

**experiments**

Besides the paper presentations and the discussions, there were four actual experiments in which the whole group participated.

The first experiment was titled: 'design in context - a shared review'. Martijn Stellingwerff {TUD} set up a 'shared virtual environment' for an experiment that focused on an architectural review process in which two critics explored several design proposals for a virtual urban context. Both critics worked with a personal computer which showed the 3D models of the designs placed within the context. Both critics created their own 'point of view' in terms of viewpoint, model settings and opinion. The critics argued with each other about the quality of the design and its appropriateness in the surroundings. The behaviours of the critics were observed by the others.

Then in a second experiment, Arne Winkler {VU} introduced the participants to the state of the art from a technical point of view. He showed software that allows engineering companies to share complex product-models over the Internet. The 3D - models can be annotated and viewed in collaborative sessions. A special data-stream algorithm allows the quick exchange of very detailed geometry.

A third experiment consisted of a comprehensive presentation of the NETWORKING environment that is used for the course "Sistemas de Representación" at the E.T.S. d'Arquitectura La Salle, Barcelona. Leandro Madrazo and Francesc Duran {URL} showed the features of their impressive collaborative education project and they showed the first results of students who worked with the system.

Finally there was a sound experiment organised by Ranulph Glanville {CE}. Each participant had to walk around in a room and sing a monotonous sound. By listening, capturing and imitating each others sound, we ended up with a very rich choral sound.
During the brainstorming session, the participants were asked to give input to four questions:

- What do you see as an important quality of a good collaborative design process?
- What do you think is an important aspect of collaborative architectural design, which needs to be developed in the future?
- What is an aspect that hinders good multidisciplinary collaborative architectural design?
- What is an aspect that hinders good simultaneous collaborative architectural design?

This led to an extensive list of items, covering the field of collaborative design and giving aspects of quality, aspects to develop, hindrances to multidisciplinary and to simultaneous collaborative design. The different items were structured during the session and during the rest of the Workshop as an ongoing process. Later on it was further refined during e-mail discussions leading to the lists on the following pages.

This list was the input to another working session to develop research tasks and project ideas for future development and research. Also in this work the collaborative work of the participants was very important. Small groups developed clusters of items and developed general ideas that were further elaborated by other groups of participants in order to confront ideas and exchange viewpoints. In a plenary all this material was presented and discussed. The results are given as a 'possible research agenda for the future'.

All this material was the input to a further step-taking place late October in Poland, when the 'Bialystok structure' was developed. This gives a general structure of the field of collaborative design with the main aspects for future research. It was complemented with a scheme developed by Leandro Madrazo {URL}. These schemes can be considered as important steps in the development of future research projects covering the field of collaborative design in Architecture. They are included as 'global scheme' for collaborative architectural design.

During the session part of the items was ordered. The ordering process continued during the rest of the Workshop. Some weeks later Jo Pletts {CE} suggested a reordering of the items of the brainstorming session. This was the start of a regrouping by Johan Verbeke {SL}. Finally the participants adjusted this by e-mail communication. For each of the four questions, it was possible to distinguish the following main groups: communication language, communication behaviour, conflict of interest between participants in the collaborative design process, communication and working environment, education. These main themes come back later on. The final ordering of the items and topics can be seen on the next six pages.
create delight
surprises
improvement of result
better final product
gain of overall financial and timing interest
support for risk taking
educational aspects
improving inter-human interaction
a will to hear
ambition
unexpected discovery (eureka)
honesty

ability to see the design evolve
unexpected reframing of the whole problem
preparation
information
concentration
focusing on design process rather than design outcome
free flow of ideas
not trying to replace/supporting natural communication
you learn and design at the same time

difference
different point of view about = problem
enjoyment of difference
joy in participation and discovery
ability to assess contributions
flexibility

communication
behaviour

language
exchanged data
exchange platform
ability to share viewpoints
good borrowing from each other
common understanding
tasks, object / entities, acts / processes
effective participation of user-client bodies
group momentum
appropriate ways of describing the problem
recognition of valuable contributions
leadership / roles
clear definition of roles of collaborators
nomination of a co-ordinator
socially a group
conversational understanding of communication
general awareness of others
social people
designing apart together
it encourages inter / multi / trans disciplinary thinking
awareness of others’ point of view
expression of unshared (private) goals
have broad basis knowledge (know bits of other disciplines)
learning from each other
willingness
co-operation
trust
public / private domains
having public and private data repositories without "disturbing the design process"
needed data needs to be available
careful and discrete management
mechanisms for the right / best forms of communication
well-organised information structure (keep overview)
access to related information repository (database)
current tools (appropriate)
saving of time for the achieved goals
adequate tools
within time access be able to get and receive needed data in time
easy exchange of information
seriously high bandwidth
enough time
rigorous analyses design evaluation of the system
modelling and VR – software development
simply language of modelling software
clear visual information transfer in modelling only
multi lingual
get added value
constructivist approach and ethic

communication environment

QUALITIES
what do you see as an important quality of a good collaborative design process?

conflict of interest between parties

a goal
goals consensus
clear goal
clear purposes
goal agreement on common goals
understanding of goals / intentions of other collaborators
continuous goal revision
clear understanding of aims / goals
real need
complex tasks
the aim to produce one final product
unforced collaboration and task assignment
ability to make contribution
communication language

new pedagogic frameworks
what and how to teach with new media
integration of media into education
new roles for educators and students
education in collaboration

meaningful learning environments well
integrated into the teaching philosophy

education

communication
behaviour

ability to have a normal conversation, man to man
both talk and listen
communication skills of architects
transfer of ideas
more informal means of collaboration
facilitate contributions
accessibility to contributions
social relations good before collaborate
delight
listening in contrast to speaking
insight in the other one’s goals
recognition and enjoyment of the act of collaboration in its own right
devoting more time to collaboration
understanding and accepting of disciplines other than mine
improving skills in interacting
abilities to share
understanding and information
differences
analysis of procedures

establishing a way of devising common frameworks
for discussion in a variety of design scenarios

live human interaction should always engage computer as just another collaborator

computer should not replace direct human communication in any form of collaboration
virtual should never replace real no matter how fascinating it might be
real meetings
interfaces – real or virtual
what do you think is an important aspect of collaborative architectural design, that needs to be developed in the future?

**ASPECTS TO DEVELOP**

**communication environment**

- procedural flexibility
- development of communication structure allowing lead figure (chairperson)
- establish the optimum levels of human-human-negotiated interaction and human-computer negotiated interaction: frequency, length and nature of meetings
- methodology
- bandwidth and security of networks
- cad- and communication tools
- appropriate communication tools
- speech integration
- better voice chat
- the (task specific) 3d environment
- real 3-d interfaces
- clarity of transferred project data structures
- skills in use of tools
- guidelines for setting up the system based on analyses
- good info-structure overview
- more rigorous approach to the development and testing of tools we already have
- asynchronous exchange of information
- co-ordination of information and activities
- improving of methods
- HHI
- improved sketching/ drawing software
- user interfaces
- better media integration (technology)
- better representations integration (design representations)
- single metaphor for the interface design
- ubiquitous captures of design reasoning process

**conflict of interest between parties**
MULTIDISCIPLINARY
what is an aspect that hinders good multidisciplinary collaborative architectural design?

**communication language**
languages differences
shared language
definitions of terms/words
people speak different languages
lack of knowledge in many disciplines
wrong tools
language barrier between various disciplines

**conflict of interest between parties**
conflicts of interest
sometimes widely differing interests
different values / goals in disciplines involved in design

**communication environment**
adherence to traditional procedures and expectations
quite specific and PC are not standard
lack of the effective exchange platform

**communication behaviour**
lack of understanding of other participants reasoning or motifs
not recognising and respecting differences
snobs
lack of trust
lack of commitment
disciplines and protectionism
lack of interdisciplinary education for the building profession
there is a strong culture in the construction industry of preserving professional boundaries
SIMULTANEOUS
what is an aspect that hinders good simultaneous collaborative architectural design?

communication language
language difference

conflict of interest between parties
too much of it
local time of day/schedule
interruptions
not knowing why you are supposed to be doing it

communication environment
communication tools
text chat
anything that blocks the natural speed of thinking or acting while collaborating
mainly a combination of connection speed and interface
time is important in design process
simultaneity might not be necessarily a goal
it must be synchronised
bad data access
current low bandwidth networks
currently computer media and computer mediated communication is significantly inferior to human-human communication supported by person to person interaction
inhibition
wrong setting
unconditional faith in technology

communication behaviour
differing mental and/or educational basis
understanding of people
communication abilities of the team members
the architects ego
lack of common ground; lack of purpose
prevention of making contribution
lack of preparation
being late
MEANINGFUL LEARNING ENVIRONMENTS, WELL INTEGRATED INTO THE TEACHING PHILOSOPHY.

(4) MEANINGFUL = INTELLIGENT, SIMPLE, COMMON SENSE AS OPPOSED TO NAUSEOUS, COMPLICATED, USELESS.

LM

MAKING SURE

DEVOTING MORE TIME

TEAM WORKING
In eight small working groups the ‘Topics lists’ were used to group items together into themes. These themes were shifted to other groups for discussion and finally it was asked to develop research tasks related to these research themes. A list of formulated tasks follows. They are the result of a collaborative process of different small working groups where junior and senior researchers worked together. This must be seen as one of the joint outcomes of the conference workshops. The themes and tasks were presented and discussed during a plenary.

The following list of 16 themes and tasks must be seen as a list of possible sub-tasks to be researched in order to obtain better insight in the field of collaborative architectural design and to stimulate the creation of an appropriate working environment (with focus on the technical as well as human aspects involved).
THEME 1: Accepting difference
Learning to benefit from difference.

TASK 1: Exercise, design a building
Let a multi-disciplinary group design a building (e.g. an architect, a civil engineer, a contractor, a quantity surveyor). Each member of the team has to play the role of another member. E.g. the architect has to think in terms of the civil engineer, whereas his task is still to design the building and not the static.

THEME 2: Design problem defining for multidisciplinary sessions

TASK 2: Design: predesign -> sketch design -> scheme design -> detailed design
Looking at how to make simultaneous design more effective at the sketch design phase. Instead of having ‘cultural differences’ at the sketch design phase (and resolving them afterwards): Look at the sketch design meeting; Look at differences between the disciplines in design problems – such as everyone wanting to focus on their own discipline; Analyse what could be given to collaborators in advance to make meeting effective; Test this on a new design team.

THEME 3: Breaking down the boundaries between the participants
Partly as a result of the education of professionals in different parts of the construction industry members of multidisciplinary teams come to the discussion with only a partial view of the requirements and different design tasks that are undertaken across a whole project. Professional protectionism, company structures and traditional management of contracts reinforces the divisions.

TASK 3: Synchronous design courses between the different faculties (engineering, architecture, social, art) in order to make the students understand each others points of view and approaches
This is needed because misunderstanding between practising architects and the others really harms the final results. The task/topic for the researchers in this theme is to formulate such a course and actually enhance the awareness of teachers to focus on the problem.

THEME 4: The greatest uncommon denominator
Effective exchange requires the ability to express discipline specific values, data and concepts. Thus tools to support multi-disciplinary collaboration should preserve differences (in language and belief) while assisting the participants to understand each other. Issues: openness and effective expression.

TASK 4: The design of a tool for simultaneous collaborative design:
Start with collaborative design exercises and observations; Analysis and synthesis based on discipline specific (DS) values, DS values, DS concepts and openness; Formulate a framework of qualities needed for multidisciplinary collaborative design; Develop prototype based on the following qualities: preserve differences (in languages and beliefs), effective expression, stimulate participation, enhance mutual understanding.

THEME 5: Asynchronous support for simultaneous communication, collaboration and co-operation
Communication tools, inhibition, not knowing what doing, wrong setting, lack of purpose, common ground, lack of preparation, time is important in design process, understanding of people. Asynchronous: increases knowledge environment in which collaboration takes place. Knowledge richness. Preparation.

TASK 5: Planning tool for preparing simultaneous communication
Basic: time planning tool combined with to-do list -> the need of information for different partners. Identification of conflicts.
THEME 6: Simultaneous and multi-located data management
Working with various information structures could be managed in such ways: so that each partner keeps aware of all changes. Input: design experiments (to be set up) and input/experience from practice.

TASK 6: develop new information and data structures (which make the goal of collaboration clear)
Qualities: keep track of changes, real time (connection speed), enable different cultures and formats (communication abilities and enable to contribute); enable multi-locatedness.

THEME 7: Design information organisation in support of synchronous teamwork

TASK 7: A three stage approach:
- Review of relevant research on information management systems to establish best practice and paradigms;
- For a range of disparate projects, map the information flows established when synchronous and asynchronous communication is required;
- Propose a prototype for how the information and information flows can be presented in a computer-based environment as a way of defining the software/hardware requirements to make an effective system work.

THEME 8: User interfaces and modes of operation and communication should be as natural and effective as possible
Anything that blocks the natural speed of thinking or acting while collaborating. Develop tools in ‘it’ that are as easy to use as the items or things as architect usually uses in everyday life (e.g. speech integration).

TASK 8: Design a human-computer interface for the early phase of design:
Look at how architects are doing early phase design; Investigate current processes; Make means and processes explicit; Make computer tool with emphasis on usability (HCI); Test with architects and consultants; Evaluate effectiveness; Report.

THEME 9: Awareness of others’ point of view
It is required to be open-minded and to listen and try to understand the others’ point of view. Even if we share the same point of view, we sometimes mean different things. Collaborators should be aware of these problems and try their colleagues’ specific language.

TASK 9: A two part review of different practices across Europe
A review of the different education systems in the different areas of Europe and in particular how the interdisciplinary is dealt with in the different areas; A survey of different multidisciplinary practices across Europe comparing how each works effectively to produce a review of best practice. We might also take an approach that takes good buildings as an example and look at how integrated multidisciplinary work has enhanced design at an international level.

THEME 10: Understanding the goals of collaborative design (and individual design)
We need to understand how and why people decide what their goals are. These goals change over time so we need to see how people make decisions and co-ordinate their individual and collaborative goals. Then we can see how people shape their design activities to meet these goals.

TASK 10: An interview based study to ascertain multidisciplinary team participants in design processes to expand their goals.
Problems of protocol, anonymity, scale, no difference between virtual and real.

THEME 11: Abstract flexibility
By means of abstract representation we could find a common language for reforming the whole problem. This could also lead to unexpected discovery and provides a more flexible communication.

TASK 11: Abstract representation as a communication and emergence platform in design collaboration
THEME 12 : Information
Be able to interpret in multiple ways;
Ability to make contribution;
Awareness of others’ point of view;
Flexibility;
Free flow of ideas;
Serious bandwidth;
Well organised info structure;
Not trying to replace natural communication;
Access to related information repository;
Needed data needs to be available;
Within time access be able to get and receive data;
Easy exchange of data exchange platform.

TASK 12 : Testing and evaluating of different media configurations for efficient design information management

THEME 13 : HHI
- Real meetings
  Computers should not replace
  Live human interaction
  Establish optimal levels of HH negotiating interaction
  More informal means of communication
- Communication skills of architects
- Delight
  Ability to share
  Recognition and enjoyment of the art of collaboration
- Improving skills in interacting
  Communication language
  Appropriate communication tools
  Listening in contrast to speaking

TASK 13 : Try to establish informal meetings between architects in which they have to explain their ‘design thinking’ to make others understand the overall design process

THEME 14 : Applicability Collaboration factors -- Hardware -- Social
Develop a framework, which defines in which cases technology can deliver an added value in the social process by NOT replacing functional, traditional techniques.

TASK 14 : Testing and evaluating of different media configurations for a successful social interaction in collaborative design

THEME 15 : Conditions : environment for collaboration
In order to be able to collaborate well there should be an awareness of the conditions for good collaborative design. Conditions include informality, good framework, and attitudes of participants, taking time and rewards.

TASK 15 : Comparing simultaneous and not-simultaneous collaboration in order to find out if there are differences in the collaboration environments
The environment can be judged by informality, good framework attitude of participants, taking time and rewards.

THEME 16 : Technical framework
Given that the conditions are well met, it is necessary then to have a technological framework within which effective collaboration/ co-operation/co-ordination can take place.

TASK 16 : Multidisciplinary capture and interpretation of multidisciplinary design practices
Collaboration with sociologists, tool developers and designers to develop capture and interpretation techniques:
- Use existing data from previous virtual studios, analyse and interpret; Evaluate BOTH data capture and analytical/interpretative techniques;
- Capture multidisciplinary design practices: Run a multi-disciplinary virtual studio (and face to face comparison) using capture techniques developed in 1; Capture practices; Expressed captured practices in terms suitable for further development and evaluation of tools.
The Topics List and the Research Agenda of the Workshop were the input to further discussions by e-mail. These ideas were used when Adam Jakimowicz \{TUB\}, Johan Verbeke \{SL\} and Aleksander Asanowicz \{TUB\} met in Bialystok (Poland). The five important headings in each of the four discussion themes of the brainstorming session (quality, aspect to develop, multidisciplinary, simultaneous) became working fields. This was the start of discussions in Bialystok with distance input from Martijn Stellingwerff \{TUD\} and Ranulph Glanville \{CE\}.

The five main headings were summarised as follows:

**Communication Language (CL)** (this field covers aspects such as shared language, language differences, knowledge of other disciplines): this involves all aspects of the communication language used during collaboration activities; this partly includes the problems of representation (representation language), but the technical side of representation forms a part of Communication Environment (see below);

**Communication Behaviour (CB)** (aspects such as effective participation, group momentum, awareness, willingness, trust, sharing viewpoints, listening and understanding, openness, generosity, concentration, enjoyment, flexibility, surprise, honesty, communication skills, informal communication, sharing, commitment, ...): this involves all those aspects of human behaviour, which directly relate to the design process and activities;

**Communication Environment (CE)** (aspects such as data structure, access, available communication tools, exchange of information, bandwidth, software, procedural flexibility, user interfaces, co-ordination tools, media integration, effective representation techniques): here focus is on all aspects influencing and creating the right environment of working and collaborating;

**Goals and roles (GR)** (aspects such as goal consensus, result consensus, clear goals and roles, understanding and agreement of other’s goals, goal and result revision, ensure collaboration, goal acceptance, conflicts of interest, interruptions): this concerns all aspects of conflicts between parties, agreement on goals and ways of working towards the final result;

**Education (E)** (aspects such as pedagogic framework, learning to collaborate): the project will benefit from information gained during educational experiments. On the other hand, after the research project will have developed concepts and tools, it will be important to use them in learning environments.
The five headings are summarised in the figure below. Communication Language, Communication Behaviour and Communication Environment are placed in the centre as they form the central part of the project. The CL task is smaller because it is more psychological and however important, a bit less the scope of the project. The results of the analyses of CL and CB parts should help develop the CE. On the other hand, Communication Environment, through a well-developed Language, reinforces Communication Behaviour – understood as an overall sphere of design activities. Goals and Roles are of a different nature and interrelate with each of these central themes. Education is placed in an outer grey circle as on the one hand it is creating input to the project and on the other hand a way of confronting the research ideas with and spreading them to a broader public.

Using this structure the following (new) tasks are proposed:

**Communication Language** (use of tasks 2, 8 and 13)
Set-up and analysis of design case studies. These should focus on common language aspects in design thinking with special focus on:
- Sketching;
- Early design stages;
- Informal means of communication;
- Use of human-computer interface.

After this, the following activities should take place:
- Development and formulation of formal and informal means and processes of communication;
- Development and formulation of criteria for qualities and effectiveness of a communication language;
- Development and formulation of a general framework (terminological and operational) for communication language.

All the above research should relate to the design process and activities. These results will help understand communication behaviour and develop communication environments.
Communication Environment  (Mainly use of tasks 4, 5, 6, 7, 11, 12, 14, 15 and 16)

There are 4 sub-tasks for the communication environment task:
- Architectural representation (task 11). Based on the outcomes of the CL task, this sub-task develops a design representation concept and technique;
- Time-planning tool, to-do and results list (task 5);
- Information management system (task 12);
- Information flow tool (task 7).

All these tasks need an intelligent information data structure (which is another task and which is a requirement for the 4 sub-tasks).

The prototypes/tools should support the following qualities:
- Informality (task 15);
- Preserve differences (task 4);
- Effective expression;
- Stimulate participation;
- Enhance mutual understanding;
- Keep track of changes (task 6);
- Real time processes;
- Enable different cultures and formats;
- Enable multi-locatedness.

Communication Behaviour  (mainly use of tasks 1, 3, 10, 13, 14 and 15)

The task here is to investigate the differences in behaviour between a) simultaneous and non-simultaneous, b) individual and group design methods.

The Communication Behaviour task covers all practical activities of the design process, from the point of view of both, individual and group approaches to the design task.

Activities include:
- Analysis of existing research on multidisciplinary and simultaneous collaborative design;
- Implementation of different design experiments;
- Analysis, structuring and synthesis of the previous two items;
- Development, formulation and implementation of a prototype methodology for effective collaborative design. This prototype methodology should include the following values/qualities:
  - Informal behaviour;
  - Social interaction;
  - Authorship;
  - Leadership;
  - Accepting difference;
  - Mutual understanding.
### Goals and Roles (Use of tasks 1, 2, 10, 13)

1. **Set-up and analysis of design case studies.** The studies should focus on goals and roles of the partners in the design process:
   - Role playing;
   - Interviews.

2. **Analysis of the influence of design protocol, anonymity and scale on roles, goals and mutual understanding.** The outcomes should support and mutually influence the CL, CB and CE tasks.

### Education (Use of tasks 1, 3, 9, 16)

This task is divided in three sub-tasks:

1. **Collecting information which is already available:**
   - How are currently multidisciplinary and simultaneous collaborative design covered in the current architectural educational systems?
   - Analyse case studies of successful multidisciplinary practices;
   - Analyse existing data from past virtual architectural design studios.

2. **Educational experiments**
   - Virtual architectural design studios with special focus on multidisciplinary and simultaneous collaborative design;
   - (Role-playing) games between different parties involved in the design process in support of mutual understanding.

3. **Development of a prototype course**
   - A comprehensive curriculum with focus on multidisciplinary, multi-located and simultaneously collaborative design.
Ranulph Glanville {CE} added the following insights about the proposed research framework:

"Just a few comments on the new proposal.

I think you're trying to get rid of conflict, and to end up with a unanimous resolution. This is very concerned with the idea that there should be no conflict. Everything by agreement.

Let me point out the following:

1) Conflict is often thought to be a basis for imaginative action and interaction. We rarely get novelty, for instance, when everyone's comfortable and there's no disagreement.

Therefore, I think it's important to support difference, we don't need agreement other than the agreement to disagree.

2) You seem to turn into rules, set techniques etc what I think should always be open for negotiation. We do not need a language: we need a mechanism by which we can generate conversation and sharing. This, on occasion, may lead to a language of convenience, but we must be wary. Languages mean we hand over our personal meanings in favour of agreed meanings we subscribe to. By doing this we let go of our own understanding.

So, we do not need language, we need a means for discussion. We do need an environment, but do we need pre-determined technologies? Perhaps we need to think of providing support so we can find, define, make, whatever what we need as we need it.

I am afraid that in formalising everything as you suggest, you are restricting to the conceivable. I cannot conceive of the value of collaboration which reduces differences and surprise de facto: the best collaboration leads to the completely unexpected result: and the completely unprecedented technique.
For example: we need to be able to converse. We do not need a language to converse in. If necessary we may make a language. If not necessary we can just converse. If we make a language, we should make sure the convenience does not replace the "accuracy".

It's what differentiated me form the others, really: that we don't need agreement, specially we don't need the sort of agreement this comes through flattening. The point of collaboration is not to find the lowest common denominator, but to improve and increase the range of what we do. Efficiency is only an improvement if measured against savings. The savings do not give us something better unless we benefit from the extra time or money. If we lower our sights, we are less liable to benefit. "
Later on, Leandro Madrazo {URL} suggested to distinguish between the real and virtual worlds and proposed the following ideas:

"The prospect that computers would perform more efficiently than the human brain has been often invoked during the second half of the twentieth century. The widespread of Internet during the nineties, has given rise to speculations over virtual communities existing on the net, which could take over the actual urban communities.

There is an implicit dualism in this kind of expectations built around the computer: a new world (E-world, the electronic world, virtual world, cyberspace), which emerges from the computer, is confronted to a known world (K-world, the world of our knowledge), the world of our experience. The already commonplace distinction between the virtual and the real worlds would be one more manifestation of this dualism.

**Forms of relationship between the two worlds**

This dualism between new and known worlds being established, it is possible then to identify three forms of relation between the two worlds:

The new world (E-world) simulates the world of experience (K-world), with the expectation of replacing it. This is the case when it is claimed that a computer would perform better than the mind in the solution of certain problems. Intelligence - a concept of the K-world- is trans-located to the E-world. The computer simulates the brain, with the expectation of overcoming the limitations of human intelligence. New conceptions, born in the E-world, bring about a change in the K-world. This is the reverse relationship of the previous one. For instance, the concept of networking has become ubiquitous in our days. It has been evoked to explain mental processes, social models, business organisations and design strategies. Similarly, the generalised use of electronic mail makes it necessary nowadays to distinguish between "normal mail" (the mail as understood in the K-world) and the "electronic mail" (the mail in the E-world). The notion of mail had to be re-thought as a result of the advent of the electronic mail: "mail" cannot longer be restricted to the act of transporting a piece of paper between two distant places. What "normal" and "electronic" mail have in common is that, in both cases, there is a written communication between two sides. An intermingling between the E-world and the K-world exists, to the point that the distinction between the two becomes meaningless. The quick widespread of web sites in the Internet demonstrates that for many organisations to exist in the K-world of today, they need to have a presence in the E-world too. Both worlds become indistinguishable from each other. Conversely, many businesses in the new economy have begun from the presence in the Internet, moving from the E-world to the K-world.
It can be contended that these three kinds of relationship have undergone a historical progression. Thus, at the beginning of the computer era, simulation of the K-world has been the predominant paradigm. As the E-world created around the computer has grown, it has begun to transform the K-world itself. The next paradigm in this relationship is a mutual influence between the two worlds, to the point that the boundaries between the two become indistinguishable.

This intertwining of real and virtual worlds will characterise future developments at the cultural, social and technological levels. Computer environments will become intermingled with daily life, with our way of doing and thinking. As a result, the distinction real/virtual will become meaningless: it will remain as a sign of an earlier era.

**Roles of Internet in education**

This intertwining between two worlds will particularly affect education. The possibility to replace the actual classrooms with virtual spaces made up of teachers and students connected via networks were seen as the most obvious application of Internet in the field of education. This is a typical example of the E-world trying to replace the K-world.

However, the most challenging aspect of the integration of Internet into education is not the substitution of the classrooms by the networks. What we could have in Internet is a model of how knowledge is recorded transmitted and generated within a group of individuals. In this model, individuals would be represented through their conceptual views. The transmission of knowledge would follow some models or patterns, which would be equally embodied in the abstract model.

But, the abstract model of knowledge cannot be dissociated from its counterpart in the K-world. In order to achieve an efficient integration of Internet into education, it is necessary to overcome the paradigm of simulations that stems from the distinction between K-world and E-world. The issue at stake is not to the replacement of physical classrooms by networks. Rather, the intellectual challenge is to create a new conceptual framework that results from the interaction between the two worlds.

Furthermore, the relevance of Internet in education stems from its capacity to transform what we teach, rather than how to teach. Medium and content are so closely related that one might transform the other. The pedagogic content taught with Internet will be multidisciplinary, universal and participative, in correspondence with the characteristics of this medium. In this sense, Internet can be taken as a conceptual model that has the potential to transform the very content of education.
**Education of collaborative design**

Environments to support collaboration in design exemplify the potential of Internet to transform education. Representing a design in a computer (with a CAD program, for example) conveys an understanding of the inner structure of the object through a particular graphic language. By constructing the object using the methods provided by the CAD program, a procedure to create the object is at the same time established.

The main difficulty with traditional CAD programs has been to match the varying mental conceptions of the designer with the rather fixed structuring of the computer's representations. If we move to a collaborative scenario, the difficulties increase substantially. The inner structure of the design has to be made understandable to many designers, and the process of development of the object has to be transparent to all participants in the design (designers, clients, consultants, and users). A basic goal of a collaborative design environment, therefore, would be to represent the development of the design in two ways: as an object and as a process. To achieve that goal, it will be necessary to develop appropriate models of languages and processes of design and interaction.

The most significant contribution of computer-supported collaborative design lies in its potential to provide a unique understanding of the design process. This understanding, in turn, must have an effect on the design thinking of the individual designers and in the design processes. Through this reciprocal interaction between the two worlds -the E-world and the K-world- the education of design will be transformed."