APPENDIX A:
FORMAT OF THE CASE STUDIES REPORTS

APPENDIX A.1:
CASE 00_COUNTRY_UNIVERSITY

1. PROGRAMME REPORT

1.1 TECHNICAL INFORMATION
1.1.1 Source of information
1.1.2 Date of collecting the material

1.2 IDENTIFICATION OF THE PROGRAMME
1.2.1 Title of the programme
1.2.2 Institution
1.2.3 Faculty and Department
1.2.4 Year started
1.2.5 Address
1.2.6 Tel
1.2.7 Fax
1.2.8 e-mail
1.2.9 web

1.3 DESCRIPTION OF THE PROGRAMME
1.3.1 General information
1.3.1.1 Entry requirements
1.3.1.2 Period of study

1.3.2 Curriculum
1.3.2.1 Philosophy
1.3.2.2 Intention
1.3.2.3 Content
1.3.2.4 Sequence of study

1.3.3 Research
1.3.3.1 Areas of research
1.3.3.2 Groups / Units of research
1.3.3.3 Research phases[1]

1.3.4 People
1.3.4.1 Number of the faculty members
1.3.4.2 Number of the Ph.D. candidates
1.3.4.3 Number of Ph.D. graduates

1. By research phases, is intended for some doctoral programmes, the phases of the research process. In others, the sequence of all the programmes' phases from the beginning of the study until receiving the Ph.D. award is referred to.

APPENDIX A.2:
CASE 00_COUNTRY_UNIVERSITY

2. THESIS REPORT

2.1. TECHNICAL INFORMATION
2.1.1 Source of information
2.1.2 Date of collecting the material

2.2. IDENTIFICATION OF THE THESIS
2.2.1 Title
2.2.2 Author
2.2.3 Year of registration
2.2.4 Year of completion
2.2.5 Principal supervisor
2.2.6 Other supervisor/s
2.2.7 Nature of the thesis

2.3. DESCRIPTION OF THE THESIS
2.3.1 Abstract
2.3.2 Structure of the thesis
2.3.3 Motivation
2.3.4 Aims of the study
2.3.5 Methodology
2.3.6 Results
2.3.7 Contribution

APPENDIX A.3:
CASE 00_COUNTRY_UNIVERSITY

3. INTERVIEW REPORT

3.1. CIRCUMSTANCES
3.1.1 Kind of interview
3.1.2 Date
3.1.3 Time

3.2. ADVISOR'S PROFILE
3.2.1 Name and Surname
3.2.2 Title
3.2.3 Education
3.2.4 Research interests
3.2.5 Number of supervised PhD students

3.3. INTERVIEW
Unstructured open interviews.

APPENDIX B:
CASE STUDIES OF PH.D. PROGRAMMES IN DESIGN

APPENDIX B.1
CASE 01_CANADA_UNIVERSITY OF ALBERTA

1. PROGRAMME REPORT

1.1 TECHNICAL INFORMATION
1.1.1 Source of information
The web site http://www.ualberta.ca;
The interview with Prof. Jorge Frascara (22 October 2002);
Exchanged e-mails with Prof. Jorge Frascara (October 2002).
1.1.2 Date of collecting the material
July 2003.

1.2 IDENTIFICATION OF THE PROGRAMME
1.2.1 Title of the program
Interdisciplinary Ph.D.
1.2.2 Institution
University of Alberta.
1.2.3 Faculty and Department
Department of Art and Design.
1.2.4 Year started
1999.
1.2.5 Address
Department of Art and Design,
University of Alberta,
3-98 Fine Arts Building,
Edmonton Alberta T6G2C9, Canada.
1.2.6 Tel
+ 1 780 4923261.
1.2.7 Fax
+ 1 780 4927870.
1.2.8 e-mail
bmaywood@ualberta.ca
1.2.9 web
http://www.ualberta.ca/ARTDESIGN/

1.3 DESCRIPTION OF THE PROGRAMME
1.3.1 General information
1.3.1.1 Entry requirements
Bachelor's degree in design, fine arts, or its equivalent (Applicants with backgrounds other than design are considered on a case-by-case basis);
Master's degree;
English examination;
Submission of visual records or a portfolio of work and documentation of previous experience (The department's minimum admission requirements also include a grade point average of 6,5 over 9 in the last two years of undergraduate or graduate work).

1.3.1.2 Period of study
At least three years of study.

1.3.2 Curriculum
1.3.2.1 Philosophy
The Department of Art and Design does not offer a doctoral programme, however, an increasing number of doctoral candidates in a home department (departments of Anthropology, English, Psychology, and Sociology, and the Faculty of Education) offering a doctoral degree have Art and Design as a joint-department in their inter-disciplinary programme of studies.

"[…] the kinds of studies that I consider to be worthy of a Ph.D. always hitch on some other discipline, because I don't believe in having a Ph.D. in the practice of graphic design but I believe in having a Ph.D. in a combination of graphic design with some of the social sciences particularly or other disciplines with a set of tools for pure theoretical analysis." (Frascara, 2002).

1.3.2.2 Intention
The interdisciplinary Ph.D. programme offers the possibility to co-supervise Ph.D. students in interdisciplinary doctoral degrees on subjects that focus on theoretical studies in Design, History of Art, History of Design, and on Visual Culture.

1.3.2.3 Content
Graded single-term courses;
Ungraded proseminar in Teaching and Professional Skills (ungraded workshops);
Ungraded courses (designed to provide a bridge between graded courses and the completion of the dissertation);
Second language requirement (in few cases).

1.3.2.4 Sequence of study
The following list presents an overview of the typical passage through the Ph.D. programme for a full-time student.
First year: Coursework; Proseminar; Establish Specialization Exam and Plan; Establish Supervisory Committee; Annual Progress Report.
Second year: Specialization Examination; Two Ungraded Courses; Candidacy Examination; Annual Progress Report.
Third year: Thesis; Annual Progress Report.
Fourth year: Thesis; Public Presentation of Thesis; Final Doctoral Oral Examination.

1.3.3 Research
1.3.3.1 Areas of research
Theoretical studies in Design;
History of Art;
History of Design;
Visual Culture.

1.3.3.2 Groups / Units of research
No groups or units of research.

1.3.3.3 Research phases
Identification of a supervisor;
Establishment of a Supervisory Committee;
Annual progress report;
Specialization examination (about a specialization area that is distinct from the one proposed for dissertation project, takes place during the first semester in the second year of the programme);
Candidacy examination (oral examination of the thesis domain and the dissertation research proposal completed by the end of the second year of the programme; Students must demonstrate to the satisfaction of the examining committee that they possess an adequate knowledge of the discipline and of the subject matter relevant to the thesis, and the ability to pursue and complete

original research at an advanced level; Successful completion of the candidacy results in reclassification from a provisional candidate to a doctoral candidate);
Public presentation of thesis;
Final doctoral examination.

1.3.4 People
1.3.4.1 Number of the faculty members
22 faculty members.
1.3.4.2 Number of the Ph.D. candidates
2 Ph.D. candidates.
1.3.4.3 Number of Ph.D. graduates
1 Ph.D. graduate.

APPENDIX B.1
CASE 01_CANADA_UNIVERSITY OF ALBERTA

2. THESIS REPORT

2.1 TECHNICAL INFORMATION
2.1.1 Source of information
Burns, Ausra, 2002. *Social Issues in Design Practice: Learning from a Community-based Project in Sackville, New Brunswick.* Ph.D. thesis, University of Alberta.
2.1.2 Date of collecting the material
August 2002.

2.2 IDENTIFICATION OF THE THESIS
2.2.1 Title
Social Issues in Design Practice: Learning from a Community-based Project in Sackville, New Brunswick.
2.2.2 Author
Ausra Burns.
2.2.3 Year of registration
1997.
2.2.4 Year of completion
2002.
2.2.5 Principal supervisor
Professor Rosalind Sydie (Department of Sociology).
2.2.6 Other supervisor/s
Professor Jorge Frascara (Department of Art and Design).
2.2.7 Nature of the thesis
Research-based Ph.D. thesis (scientific approach to research).

2.3 DESCRIPTION OF THE THESIS
2.3.1 Abstract
"This dissertation is based on a two and a half year (1998-2001) case study that focused on social interactions in relation to a building project in the community of Sackville, New Brunswick, Canada. The study discusses the planning, design and construction of the Tantramar Regional Civic Centre - a public and recreational amenity for the town and surrounding region. The case study examines the ways in which accumulated knowledge informed practical action in the interplay of community life and the built environment. Qualitative research methods developed and commonly applied by anthropologists and sociologists were used in conducting fieldwork and collecting and analyzing data.

My primary goal in this dissertation was to contribute critical insights into what I consider reflective and responsible design practice, and in particular how this practice can be transformed and enriched by an interdisciplinary approach. The literature and theory review draws a contextual map for the case study and my discussion on design as a social practice while presenting ideas and works that form the basis for historical and contemporary discourse on urban theory, urban design and design practice. Integral to an expanded notion of design practice is recognition of the complexity of human existence. Design can transcend traditional disciplinary understandings related exclusively to form-giving to engage with popular culture, increase technological and environmental awareness, and acknowledge the gendered behaviours and power discourses of everyday living.

In this dissertation I have referred to the combined effort of individuals and groups involved in the Tantramar Regional Civic Centre project: the architect, myself, and other community members and professionals, as I attempt to identify and discuss the particular contribution of the designer in this context. Evaluation of the principles of design practice employed included an assessment of how the designer was able to adhere to historically established criteria for design practice such as professional rigour, technical knowledge, skills of communication and collaboration; and an assessment of how the designer was able to adapt these principles to the specific social and cultural setting." (Burns, 2002).

2.3.2 Structure of the thesis

The thesis is divided in an introduction, a conclusion and six chapters.
- Introduction:
Interpretation of the professional contribution and responsibilities of the author.
- Chapter 1. The Case Study:
Description of the dissertation topic; Formulation of the methodology and the research objectives;
- Chapter 2. Theoretical background:
Presentation of the ideas and works that form the basis for historical and contemporary discourses on urban theory, urban design and design practice;
- Chapter 3. Design and the Designer:
Presentation of the ideas and works that form the basis for historical and contemporary discourses on designer's role;
- Chapter 4. Methodological approach:
The overall methodological approach adopted in the study;
- Chapter 5. Exploring the relationship between social interaction and the built environment in Sackville: The Tantramar Regional Civic Centre Project:
A chronological narration of the case study; The practices and actions that took place;
- Chapter 6. Discussion:
Evaluation of the Civic Centre initiative; Further articulation of project contexts; and an examination of the role of various power groups involved in the project;
- Conclusion:
From the Sackville experience toward a more effective and socially responsive design practice.

2.3.3 Motivation

"My general research framework is formed to respond to the question of how design can be a socially responsible and reflective process. The approach in this thesis indicates that I perceive a need to reconsider the role of the designer in society. I concentrate on the links between design and the social sciences, especially as they relate to the experience, use and creation of public spaces. The transformation of the role of design can be achieved by shifting designers' modes of practice from authorship (dictatorship) to interpretation and participation. The orthodox notion of design as a disciplinary activity is product-oriented, largely concerned with formal features of objects. It rarely recognizes that social and political processes profoundly influence designed objects, environments and information. In reaction to such a disciplinary mode of theorizing and practicing, I submit that knowledge generated in other disciplines can lead to a new creative and

intellectual design activity and practice that reflects changing socio-economic conditions of society." (Burns, 2002).

2.3.4 Aims of the study

"My primary goal was to contribute critical insights into what I consider a reflective design practice, and in particular how this practice can be transformed and enriched by an interdisciplinary approach. Integral to an expanded notion of design practice is recognition of the complexity of human existence. This recognition involves transcending traditional disciplinary understandings related exclusively to form-giving and engaging with popular culture, increasing technological and environmental awareness, and acknowledging the gendered behaviours and power discourses of everyday living." (Burns, 2002).

"I have also striven to be useful to the community of Sackville while applying knowledge I have gained in my education as a designer and social researcher. Interdisciplinary skills help me in understanding issues that the people of the town are dealing with, and in communicating their concerns to architects, planners and bureaucrats." (ibid.).

"My intention was to achieve a more reflective understanding of the issues in question, to develop conceptual and practical insights based on that understanding, and to communicate my findings to academics and professionals across disciplinary boundaries (these disciplines include the social sciences, cultural theory, architecture, urban planning and design). I hoped to engage in socially responsible research and, through my direct involvement in the project, expected to contribute to raising people's awareness of varying forms of political and symbolic domination, as well as exposing the intricacies and processes of community planning." (ibid.).

2.3.5 Methodology

"the case study as a direction in knowledge generation

A recognition of the complex nature of social space and its meaning has affected my choice of methodology. I selected the case study as a form of inquiry because it best reflects my epistemological orientations as a social researcher and the working methods I have developed throughout my work as an urban designer. I contend that knowledge gained through work on design projects does not accumulate in an absolute sense; rather, it transforms us and leads us to more informed insights. What accumulates, of course, is not a catalogue of events defined by frequency or location of occurrence, but images, sensations, and perceptions of the critical links and causal relationships. This accumulation becomes a wide web of practical knowledge which cannot easily be labelled as 'true' or 'false.' In such an approach, whether the research and design transformations are concerned with peer relationships, work strategies, perceptions of images, or patterns of use in built environments, detached reflection based on a purely theoretical way of thinking is transformed into discussions and negotiations between researcher and the user-participant." (ibid.).

"My goal has been to use research techniques that are relevant and practically usable in my given project. I used qualitative research methods developed and commonly applied by anthropologists and sociologists in conducting my fieldwork and collecting and analyzing data (Ellen, 1984; Emerson, Fretz and Shaw, 1995; Larreau and Shultz, 1996). As part of the research I have made photographic images of town life and kept a journal recording my observations. I noted patterns of daily public behaviour and interaction in a variety of locations, such as video lottery terminal areas in convenience stores, public parks, the post office and the fitness club. I have recorded information and ideas gathered from solicited interviews, statements of opinion voiced at public meetings, and longer talks at dinner parties. I also analyzed the findings from sociological and other studies that have been conducted in the area by such groups as the Rural and Small Town Programme (Jordan, 1999). I contextualized my research findings by referring to historical sources and current media reports, especially those published in the local newspaper - The Sackville Tribune-Post." (ibid.).

“In my research work I moved back and forth between theoretical and empirical tracks of analysis, and in my writing, between explanation and description. In order to research and understand this particular environment, and take practical steps toward transforming it, I aimed to interlace the themes of public interaction in town, the progress of the Civic Centre project, my own perceptions of life in town throughout the year, and reflections on methodological and theoretical issues I pursue. In the dissertation, attention to details of everyday interaction enabled me to move toward theoretical discussions regarding significations and meanings of particular events and relationships in their socio-physical settings. The case study discusses the ways in which accumulated knowledge informed practical action in the interplay of community life and the built environment.” (ibid.).

2.3.6 Results

“Social context and history profoundly influence the actions and attitudes of groups and institutions involved in the implementation of complex design projects. In Sackville, the social composition, power relationships and political practices constitute broad cultural and social constraints which affected the project.” (ibid.).

“The discussion and findings of my dissertation support some of Habermas's (1984, 1987) key ideas about the necessity to nurture ‘communicative action' and ‘communicative rationality' as a vehicle and a procedural ethic in order to arrive at democratic and inclusive decisions in problem solving.” (ibid.).

“One of the lessons learned through reflection on the case was that public affairs are disproportionally dominated by formal bureaucratic and technocratic governmental mechanisms. This imbalance preclude people from perceiving design projects as arenas for deliberation, discussion and choice.” (ibid.).

“My analysis of the Civic Centre project from the position concerned with the quality of the design process and its catalytic impact on the community suggests that the initiative did not reach its goals. The unbalanced relations of power have produced an unbalanced project. The participatory undertaking, which was initially intended to provide a multi-purpose public facility, accessible to all community members, and integrated into the fabric of the town through careful site design, has ‘evolved' into a rink. However, the new rink in Sackville was needed and desired by its residents for many years. And the rink is being built. What has happened in between?” (ibid.).

“The politics of public funding

The easiest answer to the ‘what happened' question would be that a scarcity of public funding gradually forced the community to realize that this project was too expensive to bear. According to the popular opinion in town, the rink was a better alternative to nothing at all.” (ibid.).

“Shortcomings in the public input process

The political and design inexperience of the volunteer Board, the lack of professional planning and political support in navigating public participation, and power struggles within Town Council, had the most marked impact on the failure of the public input process. The participatory and inclusive nature of the Sackville Civic Centre project started fragmenting during the conceptual design phase. Despite the energy of local volunteers who started this project with considerable enthusiasm, public input and communication was not coordinated effectively.” (ibid.).

“Lack of professional support

Another reason behind the shortcomings in the Civic Centre planning was that the community of Sackville did not have timely and effective professional support. One of the key players in this design initiative, the architect, was introduced to the project when most of the conceptual

planning had ended, and at the point when tensions within the community regarding the project were surfacing." (ibid.).

2.3.7 Contribution

"As this study illustrates, in large scale design projects political forces condition the totality of the process. Such an idea is hardly new, but it gains a renewed potency when revealed within a design narrative which addresses the conditions and causes of design decisions and explains the designer's actions in the context of a multitude of power relations. One of the problems identified in this work is that the professional designer is normally called to engage in her or his professional activity when the most important design decisions have already been made. I argue that the catalytic role the designer as a creative, informed and skilful individual can be strengthened through getting involved from the time the problem is being identified, and through building a dynamic equilibrium between individual competency and the ability to generate collective design decisions among design participants. In order to create conditions for the maintenance of such a balance there is a need to further articulate the notion of design as a social practice and to enrich design's operational tools in order to link the traditional strengths of the designer's professional skills with an acute political and social knowledge and sensitivity." (ibid.).

"Unfortunately, town leaders and their supporters in the higher echelons of power did not see the full potential of the Civic Centre, and in particular its role in allowing the community to express and redefine itself through use of the new facility. Local and regional leaders did not cultivate the community's potential for change, and further, they did not recognize the various developmental opportunities the Centre represented including attracting fairs, conferences, cultural festivals and other regional events. Sackville residents, and especially those who usually remain outside of public debates and opinion polls, had lost the chance to fully benefit from the public development." (ibid.).

"Projects such as the Tantramar Regional Civic Centre are as likely to fail as to succeed, considering the many serious obstacles to their realization. Even with superior planning and community experts' help, the Sackville project was not likely to reach the 'ideal speech situation' (see Habermas, 1987) where individuals and groups would have been able to express themselves freely regardless of their social status and power base within the community. Greater transparency and accountability in design initiatives can, nevertheless, generate awareness of power structures at work and force all of the participants (including those who prefer to work behind closed doors) to reveal the nature of their contribution to the project and the character of their relations with other involved parties." (ibid.).

"In order to respond to the challenge of conceptualizing socially responsible and responsive design practice, it is necessary to re-examine the relationships between designer and designed objects, messages and environments. Among key directions adopted in my work were seeking a better understanding of the relationships between the social environment and the built environment, and addressing the relevance of these complex relationships to design practice." (ibid.).

APPENDIX B.1
CASE 01_CANADA_UNIVERSITY OF ALBERTA

3. INTERVIEW REPORT

3.1 CIRCUMSTANCES
3.1.1 Kind of interview
By telephone.
3.1.2 Date
22 October 2002.
3.1.3 Time
19:00 Italy time.

3.2. ADVISOR'S PROFILE
3.2.1 Name and Surname
Jorge Frascara.
3.2.2 Title
Professor.
3.2.3 Education
Graduate Studies in Sculpture, 1965;
Art Education Post Graduate Diploma, 1964.
3.2.4 Research interests
Visual communication design.
3.2.5 Number of supervised Ph.D. students
Three Ph.D. students.

3.3 INTERVIEW
3.3.1 Why you still don't have your own Ph.D. in design?
Partly because of an administrative reason. My department traditionally being a studio department does not offer a Ph.D. But partly, strategically I find that the kinds of studies that I consider to be worthy of a Ph.D. always hinge on some other discipline, because I don't believe in having a Ph.D. in the practice of graphic design, but I believe in having a Ph.D. in a combination of graphic design with some of the social sciences particularly, or other disciplines with a set of tools for pure theoretical analysis.

3.3.2 have you faced any problem while co-supervising with other departments the first three Ph.D. students?
No, let's say the first case involved Art and Design with Sociology and Anthropology. The student was working on the development of a community facility for the realization of a number of different activities. Everything hinges on people and the way in which people use design. My own self-education has a lot to do with understanding the public. Even if at the end the product that we were looking at was an architectural product, the notion of use is something that is very central to the notion of design in general. So I didn't feel methodologically handicapped when co-supervising. I stress co-supervising because I do believe that at that level, design is always an interdisciplinary activity. So, I was working with a sociologist and an anthropologist, and neither of them had a background in design methods and processes. So in that sense we complemented each other to assist the student.

The second case involved Art and Design with Psychology, the student is working on the psychology that contributes to the design of teaching aids, in the computer medium, for elementary school children. That enters developmental psychology, cognitive psychology, learning, and of course theories about communication design. So supervisions are always co-supervisions and the knowledge that we have within our discipline is always incomplete in that sense. The third case is dealing with English and Art and Design, on the design of an interface for a complex database on English literature.

3.3.3 How have these departments, which have their own methodologies and processes of research reacted?
What happened is that those departments recognized that the interdisciplinary Ph.D. is of a different nature from their disciplinary Ph.D. Therefore there are some requirements that are normal to those departments that are not applied in these cases. There is a comprehensive examination that takes place in every Ph.D. here, which is an exam on the literature in the field up to date. In the case of the interdisciplinary Ph.D., it is satisfied with less coverage, because it's not possible for the students to be conversant with all the literature, let's say in English literature, in computing science and in design at the same time. So, what is expected from the student is to have some strong point somewhere and a fairly sophisticated knowledge of the other fields, but not necessarily a comprehensive knowledge of every field that is involved.

3.3.4 Did the candidates added a visual part to the traditional written part of the Ph.D. thesis?
The visual elements are minimal, and it depends on the case in point. In the first case they were minimal. In the interface and the teaching aids they are far more important. These last two are not finished yet.

3.3.5 What are the advantages of this kind of interdisciplinary Ph.D.?
What I think is that because we understand now design as a discipline which goes beyond the technical and is always connected with some kind of content in terms of communication to transmit and some kind of contexts within which to operate, it touches always on something to do with a different discipline. Let's say if I'm providing a tool for English literature, I have to know something about English literature, otherwise I can't organize the database and I have to understand the user and their aims, so I could never supervise Ph.D. students on design problems just by myself, because at a certain point I'll be running into large areas of ignorance. Even in our Master's degrees, which are normally three years and the thesis is about 150 pages, I always work interdisciplinarily. I always have advice from other departments that is relevant to the topic of the thesis.

3.3.6 Is your interdisciplinary Ph.D. the only Ph.D. programme in Design in Canada?
I presume yes, I don't believe that other institutions in Canada offer this kind of Ph.D. programme.

3.3.7 These were my questions. Would you like to add something else?
That seems to me sufficient. Basically, I'm happy with this kind of Ph.D., because I believe in design as an interdisciplinary endeavour and I think this is an opportunity to further develop the idea institutionally. I prefer that our department does not offer a Ph.D. in design, and that we work with an interdisciplinary notion.

APPENDIX B.2
CASE 02_USA_MASSACHUSETTS INSTITUTE OF TECHNOLOGY

1. PROGRAMME REPORT

1.1 TECHNICAL INFORMATION
1.1.1 Source of information
The web site http://loohooloo.mit.edu/departments/descomp.html;
The interview with Prof. George Stiny (28 May 2003).
1.1.2 Date of collecting the material
August 2003.

1.2 IDENTIFICATION OF THE PROGRAMME
1.2.1 Title of the program
Design and Computation.
1.2.2 Institution
Massachusetts Institute of Technology.
1.2.3 Faculty and Department
School of Architecture and Planning,
Department of Architecture.
1.2.4 Year started
1996.
1.2.5 Address
Architecture Department Headquarters,
Room 7-337, MIT,
77 Massachusetts Avenue,
Cambridge,MA 02139-2307, USA.
1.2.6 Tel
+1 617 2537791.
1.2.7 Fax
+1 617 2538993.
1.2.8 e-mail
stiny@mit.edu
1.2.9 web
http://loohooloo.mit.edu/departments/descomp.html

1.3 DESCRIPTION OF THE PROGRAMME
1.3.1 General information
1.3.1.1 Entry requirements
A Bachelor's and a Master's degree or its equivalent from a college, university, or technical school of acceptable standing.
Applicants are evaluated by the department in which they propose to register on the basis of their prior performance and professional promise. These are evidenced by academic records, letters of evaluation from individuals familiar with the applicant's capabilities, and any other pertinent data furnished by the applicants.

1.3.1.2 Period of study
The average time for the degree is about four or five years.

1.3.2 Curriculum
1.3.2.1 Philosophy
The Design and Computation group examines computation and digital technologies, broadly conceived, as a means to explore architecture and the design process. The group encourages inquiries into methods and representations for design, the development of design tools,

applications of digital technologies to design practice and teaching, the impacts of these technologies on the built environment, and their social and cultural implications. These inquiries benefit from the perspective of professional practice in architecture as well as from a wide variety of disciplinary perspectives including mathematics, computer science, philosophy, history, art, and cognitive science.

1.3.2.2 Intention
The Ph.D. may be pursued in the area of Design and Computation. Research aims are broadly conceived around computational ideas as they pertain to the description, generation, and construction of architectural form. Issues range from the mathematical foundations of the discipline to the application and extension of advanced computer technology. The mission of Design and Computation is to enhance and enrich design from a computational perspective, with clear implications for practice and teaching.

Faculty, research staff, and students work in diverse but overlapping and mutually supportive areas. Work on shape representation and synthesis is directed at a new computational basis for design. Work on digital modelling and rendering seeks to extend the possibilities of visualizing design ideas and unbuilt work, as well as to improve architectural design practice where designers and technical collaborators are geographically separated. Work on rapid prototyping and CAD / CAM technologies aims to expand design possibilities through the physical modelling of design ideas, and to revolutionize the construction and building phase of architectural practice. In other work, researchers look at how designers design, both individually and together, and how this can be understood and enhanced through supporting technologies and working spaces.

Research in Design and Computation employs computational media for the representation and use of design knowledge. Faculty, research staff, and students associated with the group combine education in architecture and urban design with education in computer graphics, art, mathematics, and other fields.

1.3.2.3 Content
One required seminar.

1.3.2.4 Sequence of study
No set curriculum, it's a research programme.

1.3.3 Research
1.3.3.1 Areas of research
Shape representation and synthesis;
Digital modelling and rendering;
Rapid prototyping and CAD / CAM technologies;
How designers design, both individually and together, and how this can be understood and enhanced through supporting technologies and working spaces.

1.3.3.2 Groups / Units of research
Architecture fabrication laboratory;
Architecture representation + computation;
Shape grammars;
Design concepts group.

1.3.3.3 Research phases
There are no established and fixed research phases. Ph.D. candidates should pass two exams: the qualifying exam where the student demonstrates his qualification for the degree and the dissertation exam where the student proposes the subject of the research. These exams are individual.

1.3.4 People
1.3.4.1 Number of the faculty members
6 faculty members; 2 visiting faculty; 3 research staff.
1.3.4.2 Number of the Ph.D. candidates
12 Ph.D. candidates.
1.3.4.3 Number of Ph.D. graduates.
18 Ph.D. graduates.

APPENDIX B.2
CASE 02_USA_MASSACHUSETTS INSTITUTE OF TECHNOLOGY

2. THESIS REPORT

2.1 TECHNICAL INFORMATION
2.1.1 Source of information
Colakoglu, Birgul M., 2000. *Design by Grammar: Algorithmic Design in an Architectural Context*. Ph.D. thesis, Massachusetts Institute of Technology.
2.1.2 Date of collecting the material
May 2003.

2.2 IDENTIFICATION OF THE THESIS
2.2.1 Title
Design by Grammar: Algorithmic Design in an Architectural Context.
2.2.2 Author
M. Birgul Colakoglu.
2.2.3 Year of registration
1996.
2.2.4 Year of completion
2000.
2.2.5 Principal supervisor
Professor George Stiny.
2.2.6 Other supervisor/s
No.
2.2.7 Nature of the thesis
Research-based Ph.D. thesis (scientific approach to research).

2.3 DESCRIPTION OF THE THESIS

2.3.1 Abstract
"An experimental study was performed to explore the practical applicability of the rule based design method of shape grammars. The shape grammar method is used for the analysis and synthesis of the *hayat* house type in a particular context.

In the analysis part, the shape grammar method is used to extract basic compositional principles of the *hayat* house. In the synthesis part, first the evolution of a new *hayat* house prototype is illustrated. An algorithmic prototype transformation is considered. This transformation is achieved in two ways: by changing the values assigned to the variables that define the component objects of the form, and by replacing the vocabulary elements of the form with new ones. Then, the application of the rule based design method for housing pattern generation is explored. The design of a housing complex is illustrated using this method." (Colakoglu, 2000).

2.3.2 Structure of the thesis

The thesis is divided in six chapters:
- Chapter One: Introduction:
Objective of the thesis and definition of key terms;
- Chapter Two: Shape grammars:
Description of the shape grammar method; the shape grammar formalism; the shape grammar applications;
- Chapter Three: Methodology:
Description of the methodology used;
- Chapter Four: *Hayat* houses:
The case study;
- Chapter Five: Design by grammar:
The application of the method and the generation of prototypes;
- Chapter Six: Discussion and future work:
Discussion of the results and suggestion of future works.

2.3.3 Motivation

"Shape grammars have been used traditionally in two ways: for the analysis of historic buildings, and for the generation of form from scratch. Both applications are constructive in the form generation stage of the design process.
The first application has been widely used to understand and describe a diverse array of architectural designs and to analyse different design styles." (Colakoglu, 2000).
"The second application of shape grammars is for the creation of new designs. Here two- and three-dimensional shapes are used to generate designs within the given rule set." (ibid.).
"However, shape grammars have not been explored in detail for everyday practice. It is the goal of this thesis to explore their transition into everyday practice." (ibid.).

2.3.4 Aims of the study

"This thesis explores the applicability of algorithmic design in a real-world architectural context, through the use of the shape grammar formalism. This method is expressed as an algorithm that describes the computational mechanism for composing shapes, utilizing symbols, geometry, and algebraic operations. A shape grammar describes a vocabulary, the relationships between vocabulary elements, and the rules for generating designs in a particular style or design language.

Specifically, I use a parametric shape grammar. Rules in this grammar are defined by assigning values to variables. Parametrically defined variables allow different geometric properties of shapes, such as dimension, angle and position, to vary. By applying the parametric shape grammar method in an informal manner, I illustrate how grammar rules can be used to generalize the compositional design principles of a particular form within a certain style. Shape grammars are primarily used in design analysis. My objective in this thesis is to demonstrate their applicability to design synthesis in a real-world architectural setting." (ibid.).

2.3.5 Methodology

The methodology of the research is the case study. The author selected a case study, the "*hayat* house type" found in Sarajevo, Bosnia and Herzegovina, and applied the computational design method to the case.

The phases of the methodology are the following:
Fist, the study of the configuration of the *hayat* houses and the housing patterns, then the application of the computational method of design by grammar as following:
House prototype generation (primitive prototype; prototype instances; prototype development; prototype transformations; and prototype compounds.)
Housing pattern generation (housing patterns; and the application of the prototypes.)

"The goal of this thesis is to explore the applicability of the rule-based design method of shape grammars in a real design setting. I use shape grammars as an exploratory design tool for typological design analysis and synthesis. Specifically, I use a shape grammar to generate prototypes that capture specific qualities of the *hayat* house type in Sarajevo. I apply a simple parametric schema to generate three different *hayat* house prototypes and select one of these (a house with a central *hayat* on both floors) for further elaboration by the rule-based design method. Then I develop this prototype by applying shape rules and by introducing different constraints. This method is also used to generate patterns and row houses.
The shape rules that I use involve addition, subtraction, and union. Conceptually, shape rule addition introduces new vocabulary elements into the design, subtraction deletes existing vocabulary elements from the design and sum fuses shapes together in the design. Constraints introduce relations to define the context of a specific design problem, and limit the range of possible rule applications and design solutions. The constraints can (1) indicate relations between variables (geometric, spatial, material, etc.) that describe or define the object being designed and (2) express design knowledge in logical (if-then) rules, guiding shape rule applications.

Architectural design variables are complex. Some of them are fixed and others are dependent (values are determined by the values of other variables). Some are controlled by the designer and some are determined by factors outside the designer's control. The relationship between variables is subtle and highly non linear. Thus, they are complicated to deal with in formal models. In this thesis, I apply only constraints that are within the designer's control in order to produce architecturally acceptable forms.
Although I use a parametric shape grammar as a design tool, I do not elaborate its details in full. That is, I do not define rules with assigned variables. I describe rules and constraints with explicit drawings and give written descriptions of rules where needed." (ibid.).

2.3.6 Results
"In this thesis, I applied the rule-based design method of shape grammar as a design tool for typological analysis, as well as synthesis, of the *hayat* house type in a specific vernacular architectural context. There are certain limitations to what can be expressed using this rule-based method in architectural design. Therefore, this method is not a substitute for the actual design process, but is one of many design methods that can be used in preliminary stages of design. Therefore, the present work makes no claim to completeness.

The usefulness of this computational design method lies in the ability of architects to employ its mechanism and use it for their own purposes, whether for education or practice. Shape grammars have been used in three ways in education: as an apparatus for the formal analysis and synthesis of form, as has been illustrated in this thesis; as a constructive and pedagogical design tool for training students to create their own design language or style; and as an intermediate computational tool for teaching programming concepts to design students.

The shape grammar method as a design tool provides a constructive mechanism to teach the concept of a design language. In this method, any relation between the input and the output states of the design can be defined by rules. In an architectural context, this corresponds to the program and the designer's intentions (input state) and the actual design (output state). Between the two there are different computational procedures (rules) that will produce the design that satisfies both the program and the designer's intentions. In other words, any design can be constructed in many ways. However, each designer will have his/her own set of rules (design language) that distinguishes him/her from other designers. [...]. The shape grammar method provides an apparatus for teaching design languages in a structured and constructive way, and allows the student to enhance his/her repertoire of design rules." (ibid.).

2.3.7 Contribution
"The shape grammar method can be used as an intermediate computational design tool that builds a bridge between programming and design. In visualizing the rules of computation, it utilizes an understanding of algorithmic design procedures. Recent work on shape grammar computer applications has been based on creating stand-alone software capable of shape recognition and manipulation. The problem of compatibility between these programs with Computer Aided Design (CAD) currently prevents the use of shape grammars in more complex architectural software platforms. Thus, as a design tool, the future of the shape grammar lies in its integration with CAD. The inherent structure of CAD systems restricts the design exploration. Emergent sub-shapes that are recognized by designers in design computation are unrecognizable from computer's viewpoint. The shape grammar method has the potential to change the nature of CAD programs in two ways: by providing a technique for emergent shape recognition and manipulation, and by providing a mechanism for interaction between the user and the program through its visual programming techniques. The shape grammar method has developed a formal mechanism that can be implemented as a plug-in for CAD software and could ultimately change it from being static and closed to a dynamic, interactive, and parametric design tool. However, this also requires interdisciplinary study between CAD programmers and architects who have sufficient knowledge of CAD programming concepts.

In practice shape grammars utilize the generation of standardized designs, while respecting the existing stylistic characteristics in a given architectural context. They provide a formal mechanism for optimization and automated customization model. However, the integration of design models with mathematical models requires complex data and variable management and can be handled only through the use of computer technologies. Shape grammars provide a formal apparatus for communication between the two. The integration of these models creates a new research area, which requires interdisciplinary collaborative work between the disciplines of mathematics, computer aided design, and design." (ibid.).

APPENDIX B.2
CASE 02_USA_MASSACHUSETTS INSTITUTE OF TECHNOLOGY

3. INTERVIEW REPORT

3.1 CIRCUMSTANCES
3.1.1 Kind of interview
Face to face interview.
3.1.2 Date
28 May 2003.
3.1.3 Time
15:00 Boston time.

3.2. ADVISOR'S PROFILE
3.2.1 Name and Surname
George Stiny.
3.2.2 Title
Professor of Design and Computation.
3.2.3 Education
PhD UCLA 1975;
MS UCLA 1972;
SB MIT 1967.
3.2.4 Research interests
Shape grammars.
3.2.5 Number of supervised Ph.D. students
Two PhD students.

3.3 INTERVIEW

3.3.1 In which year was the programme launched, and could you describe it for me?

The programme here was started when I came here, which was about 1996, so it's been going about seven years. But I had been doing a Ph.D. programme as well at the UCLA for 15 years. So the programme that I brought here was not that new, it's been going on for 20/25 years. Here it's new because there was no one doing that kind of Ph.D. research in design. Here in the faculty there's a PhD in building technology, and there's also one in history. These are the standard and traditional ones.

The programme here is very diverse, in the sense that we have about 12 students, and each of them does their own project. Potentially, I like to run a Ph.D. programme, in terms of its organization, on the *Cambridge Model*, where the students do their own kinds of research, it's not a project research in the sense that you work on a big funded project and do one little bit of it and at the end of the day walk out of the door, so I tried to get away from that. Most of the research is pretty individual from the people who are involved in it.

The programme itself is organized around one seminar, so there's only one required course and that's the seminar. There are really two reasons for that. One is to try to give background of what I think is the appropriate kind of understanding to do a Ph.D. in design and computation, and the other is the socialization, so that the students get to meet each other and talk. My experience is that when Ph.D. students do talk to each other in a kind of official forum or official device, instead of disappear and do their own things, which I don't think is very healthy. I think students learn probably as much from each other as they do from instructors and supervisors. That's the education I got and I think it's a very healthy and robust kind of way of running a Ph.D. programme.

As for content of the programme it's pretty diverse, I mean people do a lot of different things and they have a lot of different ways of doing it and it depends on who they have for advisors. The only thing that I try to do is to get some sense of what both the limitations and strengths of calculating are in design, and that's more informed by my own personal research, which looks at different kinds of mathematical representation systems. So if you have a drawing and you're drawing something, lines and the different mathematical numbers and symbols and those kinds of things, and when you start to pay attention to that, it makes the kinds of things people do in most of their attempts to design stuff, especially when they're using computers very inadequate. Those are the sort of things that I want people to try to do, they're outside the normal round of what people do when they calculate.

3.3.2 Why do you try to escape the model of big financed projects for Ph.D. research?

I don't think it's a very healthy kind of research for Ph.D. students. It always seemed to me that the whole point of doing a Ph.D. is to show that you can work on your own and that you can investigate something in terms of your own interest and in terms of your own take on how it might go, and part of doing a Ph.D. is a kind of fall a couple of times and realizing if this works or that works or if it doesn't work, and in a big project that's harder to do. I suppose if we were a biology department and had huge experiments, so we have to run it that way, but we're not. Design is one of the few areas that kind of straddle both engineering science and mathematics on the one hand and the humanities on the other , so we can try on different things. That's the way I like it and what I think the Ph.D. is all about.

There are people on the faculty, not in design and computation, but in building technology, who run big projects, and where Ph.D. students do one piece or part of that project as a Ph.D. I think it has much to do with the personality of the people who are running the programme. We could do it that way, but I don't like this kind of organization. I don't think it has much to do with design. I'm just not very keen on big projects, I've run several, but I've never really run one that I thought students learned any more or did any more than they would had if they just worked on

their own. The most successful students are the one who worked on their own and did their own things and were motivated in terms of what they were interested in.

That's the way I did mine, but I didn't do mine in design. I did my Ph.D. in mathematics and I don't know, they just left me alone for three years. You know, I had to see my advisor occasionally, let him know what I was doing. But there was no classes to take or any pressure to do something that they wanted you to do. I thought that was successful. I guess one of the big differences between an American Ph.D. and a European Ph.D. is the course work that comes at the beginning of your Ph.D. In our design and computation Ph.D. it's up to the students to choose their courses, they choose whatever they want. I think that is an important aspect of doing an American Ph.D., you can get a certain breadth that you don't get in a European Ph.D., and doing the dissertation and the research itself is pretty open ended, people do what they want to do.

3.3.3 what about the research phases, i.e. passing from one phase of the research to the next one?
There are two exams. One is the qualifying exam which is meant to show that you know something, and that can be pretty big. Everybody knows something. And there's the dissertation exam, where you actually propose the subject that you want to look at. It looks at what you might want to do and whether you have the necessary background to do it. Those two exams are set by the MIT. The form of what's in these exams is up to us. We try to make the exams pretty individual so that each student does what he or she finds most appropriate given what they want to do. There is no set curriculum.

3.3.4 How many students do you graduate each year?
We graduate about two or three students per year, and the average time for the degree is about four or five years. So you know there's no hang ups, they all get out and get good jobs and turn out to be very successful, so that's it, it works.

3.3.5 Did you heard about the debates taking place in most of the European Ph.D. programmes in design, about whether it should be a traditional and conventional Ph.D. programme or a more practice-oriented one where the focus is on design practice and where the result of the research might end up in a product or a prototype?
My senses are that in our programme you can do it either way. I have a little more sympathy for the academic kind of programme, but I don't have much sympathy for set curriculum or the rigidity of standard Ph.D. programmes. I think we should search the general nature of a Ph.D. programme. I think it should be more than an individual design project. Even if the result is an innovative product or a computer programme. I think there should be something more than just an innovative product or a computer programme. You should be able to show how to design a hundred computer programmes like that. So there should be some generality to it. But having said that, there are a lot of ways to learn things, and there are a lot of ways to try.

We try to be as generous as possible. I know the kind of work I like, but there are a lot of other students that do work that I don't like. But they have advisors that like it. I think a part of research is trying a lot of different things and one of the difficulties in Ph.D. programmes that are too rigid and that are too structured, in the sense that there are expectations before you do a degree, it kind of pushes the research out, because it's not research if you know what it is going to be. If you have started a programme and you know what it's supposed to be and people do it and they get a degree, that's not my idea of Ph.D. research.

APPENDIX B.3
CASE 03_JAPAN_CHIBA UNIVERSITY

1. PROGRAMME REPORT

1.1 TECHNICAL INFORMATION
1.1.1 Source of information
The web site http//www.chiba-u.ac.jp;
The interview with Prof. Michio Miyazaki (05 June 2003).
1.1.2 Date of collecting the material
June/July 2003.

1.2 IDENTIFICATION OF THE PROGRAMME
1.2.1 Title of the programme
Human Environment and Design.
1.2.2 Institution
Chiba University.
1.2.3 Faculty and Department
Graduate School of Science and Technology.
1.2.4 Year started
1988.
1.2.5 Address
1-33 Yayoi-cho, Inage-ku, Chiba city,
Chiba Prefecture, 263-8522 Japan.
1.2.6 Tel
+81 43 2903885.
1.2.7 Fax
+81 43 2903885.
1.2.8 e-mail
T3885@office.chiba-u.Jp
1.2.9 web
http//www.chiba-u.ac.jp

1.3 DESCRIPTION OF THE PROGRAMME
1.3.1 General information
1.3.1.1 Entry requirements
Master's degree or the equivalent;
English language examination;
Research proposal and presentation;
Oral examination and interview.

1.3.1.2 Period of study
Four years.

1.3.2 Curriculum
1.3.2.1 Philosophy
Contribution to design study;
Contribution to the cultivation of design researchers.

1.3.2.2 Intention
To develop items stated at 1.3.2.1:
Pursuit the deepening of design knowledge;
Understand design from an interdisciplinary viewpoint.

1.3.2.3 Content
No required courses.

"I would like to comment one thing which may be very unique as a doctoral study in Japan. According to our system, Ph.D. degree can be obtained by means of research carried out outside university and of requesting assessment by the university. For instance, a person who studies by himself/herself without a supervisor is one possible way to obtain the degree. The professor who is requested to read the thesis will teach the candidate how to improve it. If the thesis is satisfactory for the degree, the professor will assign three or four judges to assess the research. I believe this system can be seen only in Japan." (Miyazaki, 2003).

1.3.2.4 Sequence of study
Research only programme.

1.3.3 Research
1.3.3.1 Areas of research
Design study for living such as environmental ergonomics, *Kansei* study, psychology related design, and design management;
Design culture study such as design related cultural study, design history of artefact, living culture formation, media design, and design system;
Total design study such as formative art, spatial design, and environmental art.

1.3.3.2 Groups / Units of research
No groups or units of research.

1.3.3.3 Research phases
Methodology and theory;
Discussion of bibliographical studies;
Discovery of research project;
Development of theory.

After the acceptance of research proposal, interim report of research progress is requested to be submitted to the research committee in the first year. Then, a standard process is as follows:
Submission of application of research assessment to the supervisor after around 3 years of study;
Set assessment committee (consists of more than 4 professors);
Preliminary assessment by the committee;
Questions of the audience and answers;
Final assessment by the committee;
QA and confirmation of thesis by all professors meeting;
Offer either the Ph.D. or the D.E. (Doctor of Engineering) degree.

1.3.4 People
1.3.4.1 Number of the faculty members
20 faculty members in Human Environment and Design.
1.3.4.2 Number of the Ph.D. candidates
32 Ph.D. candidates.
1.3.4.3 Number of Ph.D. graduates
87 Ph.D. graduates.

APPENDIX B.3
CASE 03_JAPAN_CHIBA UNIVERSITY

2. THESIS REPORT

2.1 TECHNICAL INFORMATION
2.1.1 Source of information
Ishikawa, Shigetou, 2003. *Formative process of the "Fat Face" types and the background for their emergences.* Ph.D. thesis, Chiba University;
Exchanged e-mail messages with Prof. Michio Miyazaki (August 2003).
2.1.2 Date of collecting the material
August 2003.

2.2 IDENTIFICATION OF THE THESIS
2.2.1 Title
Formative Process of the "Fat Face" Types and the Background for their Emergences.
2.2.2 Author
Shigetou Ishikawa.
2.2.3 Year of registration
2002.
"Japanese universities accept to judge theses submitted by independent researchers. This thesis was one of these cases. Therefore, the year of registration does not indicate the beginning of the research process that started few years before 2002." (Miyazaki, 2003).
2.2.4 Year of completion
2003.
2.2.5 Principal supervisor
Prof. Michio Miyazaki.
2.2.6 Other supervisor/s
No.
2.2.7 Nature of the thesis
Research-based Ph.D. thesis (humanities approach to research).

2.3 DESCRIPTION OF THE THESIS
2.3.1 Abstract
No available abstract.

2.3.2 Structure of the thesis
The thesis is structured in eight chapters:
- Chapter 1. Background of the research and objectives:
Introduction to the study;
- Chapter 2. Transition from Latin alphabet to Roman type and classification of typefaces:
Review of the historical process from the creation of the Roman letter of Latin alphabet until the development of the Fat Face;
- Chapter 3. Historical transition of typefaces in Britain:
Description of the history and the fundamentals of typefaces in Britain where the Fat Face was created;
- Chapter 4. Print bill headline typeface in Britain in the eighteenth century:
Research of the circumstances which brought forth the Fat Face through the examination of the history of posted bills which used noticeably many display types for the printed matters in Britain;
- Chapter 5. Typefaces used for jobbing and outdoor signboards in Britain in the eighteenth century:
Study of the typefaces for jobbing printing and for outdoor signboards used in Britain in the eighteenth century and the discussion of the relation of these typefaces to the Fat Face;
- Chapter 6. The formative process of Fat Face: how the shape was changed and established:

Discussion of the formative process and special features of the Fat face;
- Chapter 7. Emergence of Fat Face and its historical background:
Study of the creation and use of the Fat Face and the background for its emergence;
- Chapter 8. Conclusions:
The conclusion of the study.

2.3.3 Motivation
"After the Second World War, there was a radical influx of the western culture in Japan. In Japan, the western typefaces have been widely accepted not only for books but also for posters, advertisement, package design, etc. The author, a graphic designer, was interested in display type that used to a headline, because the display type, in particular among these western typefaces, has a unique shape that has not existed in Japanese typeface. Why, how, when, and where was the typeface born? To answer this question and curiosity, this research was started." (Shigetou, 2003).

2.3.4 Aims of the study
"This research aimed to clarify the historical background of the development process and the establishment of Fat Face and its influence on visual communication design." (ibid.).

2.3.5 Methodology
"The following methods were used:
Bibliographical review;
Research into Historical resources of Latin alphabet as a research basis, and understand the systematic transition of typeface by means of the study of historical materials of Roman typefaces which followed the former;
Trace the development change of Fat Face by means of printed media such as posters, signboards, and paintings, in which letters were depicted;
Study of the social circumstances where typefaces were used;
Discuss the background of the development process and the emergence of Fat Face." (ibid.).

2.3.6 Results
"As a result of this study, the author found that Fat Face inherited the size and the manufacturing technique from the ultra large size metal types that had been manufactured since the second half of the eighteenth century, and the shape from the modern Roman typeface which was the newest typeface for book printing at that time. Moreover, with the influence of the conspicuous display letters of outdoor signboards, Fat Face was developed as an ultra bold and ultra large size Roman typeface.

The Fat Face was designed by Robert Thorne between 1803 and 1808 as a display type for posted bills in London. The Fat Face was an unprecedented typeface with its characteristic, conspicuous shape; it was the first full, practical typeface for display purpose in the world.

The Fat Face was created in the beginning of the nineteenth century; in the background of the emergence of the Fat face there were attempts to realize new ideas at that time - the era of the industrial revolution -, and people were ready to accept these attempts. Furthermore, there was a trend to promote such attempts. At that time the literacy of people was increased, and printed media for commerce and entertainment flourished; posted bills were utilized for conveying information to the general public.

Display types of such posted bills had to appeal optically to people in an entirely different manner than the types for printing books. The British society at the time of the industrial revolution needed the Fat Face for conveying information to the public." (ibid.).

2.3.7 Contribution
"Britain was in the peak of industrial revolution in the beginning of the nineteenth century. The literacy of people was increased, consequently mass communication was getting popular through posted bills (posters). Under this situation, an ultra Fat Face was born. The Fat Face innovated the style of mass communication through the use of bills headline and drawing attentions on bills. The emergence and utilization of Fat face were an inevitable consequence of the history." (ibid.).

"This research is a valuable accomplishment by the evidence that typeface is a historical product. Moreover, since this study also clarified the development process and establishment of a typeface, it could conclude that the birth of various display types influenced today's visual communication design." (ibid.).

APPENDIX B.3
CASE 03_JAPAN_CHIBA UNIVERSITY

3. INTERVIEW REPORT

3.1 CIRCUMSTANCES
3.1.1 Kind of interview
Through e-mail.
3.1.2 Date
05 June 2003.
3.1.3 Time
03:41 Italy time.

3.2 ADVISOR'S PROFILE
3.2.1 Name and Surname
Michio Miyazaki.
3.2.2 Title
Professor.
3.2.3 Education
Doctor of Philosophy.
Graduated in 1964 from the Department of Industrial Design, Faculty of Engineering, Chiba University.
3.2.4 Research interests
Newspaper design;
Graphic design;
Media design.
3.2.5 Number of supervised Ph.D. students
Six Ph.D. students.

3.3 INTERVIEW
3.3.1 What's the approximate number of universities in Japan that offer a Ph.D. programme in design? For example less than 5, more than 5 or more than 10?
More than five, less than ten.

3.3.2 When most of Japan's Ph.D. programmes in design were launched?
During the 1990s.

3.3.3 What's your doctoral programme methodological approach?
Historical materials and documents, questionnaire about attitude and recognition, psychological experiments, *Kansei* assessment, etc.

3.3.4 Have you heard of practice-oriented Ph.D. programmes in design? What do you think of this approach for doctoral research?

No, I haven't heard of practice-oriented Ph.D. programmes in design. But if design practice, design works and processes can be highly analysed and theoretically developed, and then described in a thesis format, it is worth a Ph.D. degree. There are universities for this type of study.

I think that full practical work can be understood as a research work, but it is difficulty to judge (1) its value objectively, and (2) its value in terms of time span (three or four years). If the items (1) and (2) are persuasive, the practical work can be accepted as a Ph.D. study.

3.3.5 Do you develop such approach in your university?

Many professors may be negative to the above view, but few professors including me may accept this view.

APPENDIX B.4
CASE 04_ AUSTRALIA_UNIVERSITY OF SYDNEY

1. PROGRAMME REPORT

1.1 TECHNICAL INFORMATION
1.1.1 Source of information
The web site http://www.arch.usyd.edu.au/nwfa/research/area_descomp.html;
The interview with Prof. John S. Gero (24 July 2003).
1.1.2 Date of collecting the material
July 2003.

1.2 IDENTIFICATION OF THE PROGRAMME
1.2.1 Title of the programme
Design Computing and Cognition.
1.2.2 Institution
The University of Sydney.
1.2.3 Faculty and Department
Faculty of Architecture,
School of Architecture, Design Science and Planning,
Key Centre of Design Computing and Cognition.
1.2.4 Year started
1975.
1.2.5 Address
Key Centre of Design Computing and Cognition,
School of Architecture, design science and planning,
University of Sydney NSW 2006, Australia.
1.2.6 Tel
+61 2 93512328.
1.2.7 Fax
+61 2 93513031.
1.2.8 e-mail
kcdc@arch.usyd.edu.au
1.2.9 web
http://www.arch.usyd.edu.au/nwfa/research/area_descomp.html

1.3 DESCRIPTION OF THE PROGRAMME
1.3.1 General information
1.3.1.1 Entry requirements
A Master's degree or a Bachelor's degree with first or second class Honours or an equivalent qualification from an accredited university or institution;
A demonstration of adequate language skills if English is not the candidate's first language.
Admission to the degree is a two phases process. The first involves writing a statement of research interest which is submitted with the application. This admits the student as a probationary candidate for the first year during which a research proposal is developed. The research proposal is submitted to the candidate Ph.D. Committee after 12 months normally and the Committee determines the suitability of the proposal according to set criteria. Admission is based on the quality of previous work, quality of proposal and availability of resources.

1.3.1.2 Period of study
Four years for full-time study;
Longer period for part-time study;
International students may only study on a full-time basis.

1.3.2 Curriculum
1.3.2.1 Philosophy
"We take a scientific approach to our research as we study design. We have two research paradigms we utilise: computational and cognitive. The computational paradigm studies ideas using computational models, whilst the cognitive paradigm studies humans. These can be used separately or jointly." (Gero, 2003).

1.3.2.2 Intention
"We aim to train researchers who are capable of recognizing and formulating research problems as well as creating knowledge through their research. We aim to work at the cutting-edge of research topics. We introduce students to novel ideas and challenge them intellectually." (ibid.).

1.3.2.3 Content
Research only programme but the supervisor may recommend to take some subjects.

1.3.2.4 Sequence of study
One required course.

1.3.3 Research
1.3.3.1 Areas of research
Artificial Intelligence in Design;
Computer Support for Collaborative Design;
Design Cognition;
Virtual Architecture.

1.3.3.2 Groups / Units of research
Agent-based design systems;
Cognitive studies of designers;
Constructive memory models of designing;
Computer-supported collaborative design;
Creative design: computational and cognitive models;
Designing virtual worlds;
Digital worlds;
Emergence in design;
Evolutionary systems in design;
Formal models of design process;
Learning in design;
Multimedia in design;
Product modelling;
Qualitative representation and reasoning in design;
Role of drawings in design;
Situatedness in designing;
Virtual environments.

1.3.3.3 Research phases
Research area selection;
Literature analysis;
Topic derivation,
Pilot study;
Research proposal;
Executing research plan;
Reviewing results;
Writing thesis.

1.3.4 People
1.3.4.1 Number of the faculty members
9 academic staff.
1.3.4.2 Number of the Ph.D. candidates
22 Ph.D. candidates.
1.3.4.3 Number of Ph.D. graduates
45 Ph.D. graduates.

APPENDIX B.4
CASE 04_ AUSTRALIA_UNIVERSITY OF SYDNEY

2. THESIS REPORT

2.1 TECHNICAL INFORMATION
2.1.1 Source of information
Tang, Hsien-Hui, 2002. *Exploring the Roles of Sketches and Knowledge in the Interlinked and Multimode Design Process Using Protocol Analysis*. Ph.D. thesis, University of Sydney.
2.1.2 Date of collecting the material
July 2003.

2.2 IDENTIFICATION OF THE THESIS
2.2.1 Title
Exploring the Roles of Sketches and Knowledge in the Interlinked and Multimode Design Process Using Protocol Analysis.
2.2.2 Author
Hsien-Hui Tang.
2.2.3 Year of registration
1998.
2.2.4 Year of completion
2002.
2.2.5 Principal supervisor
Professor John S. Gero.
2.2.6 Other supervisor/s
Associated Professor Terry Purcell.
2.2.7 Nature of the thesis
Research-based Ph.D. thesis (scientific approach to research).

2.3 DESCRIPTION OF THE THESIS
2.3.1 Abstract
"The needs of computational tools provide the motivation to have a better understanding of the roles of knowledge and sketches in the design process. The inadequacies of current computer-aided conceptual design tools result from our vague comprehension of the nature of the design process. The hypothesis of this study is that the design process involves interlocked and multi-mode processes in which design knowledge and sketches interact with each other to advance the design process. These interactions make current computer-aided design systems unsatisfactory in the conceptual design process. The understanding of these interactions would provide the foundation of more useful computational tools and potentially play a role in developing better pedagogical methods.

This research utilized both process-oriented and content-oriented coding schemes to examine different aspects of the design processes. Concurrent and retrospective protocols were analyzed to determine their utility in revealing the design process. Retrospective protocols and the content-oriented coding scheme were selected for design cognition studies in this research, and the procedures of experiments and analyses were described in detail.

The results of encoded protocols were presented in terms of segments, levels and instances. They represented the design process in a way that enabled us to observe the interactions among sketches, knowledge, and different cognitive levels.
The examination of the conceptual design process demonstrated its features of interlinked levels and multiple modes; even one snippet of the process contained various modes and sub-processes. The shifting speed of intentions and the vagueness of sketches and functional references were also shown.

The study of the mediated roles of the sketches and knowledge in the design process shows the following. First, sketches are the affordances of perceptual and conceptual instances while designing. Most of the sketches made by designers are multi-functionally bounded. Second, design knowledge plays various roles in the conceptual design process. The ubiquitous designerly way of knowing demonstrates the differences between active developing and passive utilizing design knowledge. Finally, one of the roles of design sketches and knowledge is shown to be the connector among different cognitive levels in the design process.

The unpredictability of the design process is demonstrated in the results. Design knowledge provides previously generated solutions for the problem at hand, and design situatedness describes the phenomenon that a designer uses his/her experience to produce novelty and innovation. A method to measure the design innovation through an encoded protocol is proposed based on the concept of situated creativity.

The implications for future computer-aided design are presented based on the role of sketches, knowledge and situatedness in the interlinked and multi-mode design processes. The concept of cognition-oriented CAD is proposed to provide empirical clues to improve current CAD systems." (Tang, 2002).

2.3.2 Structure of the thesis

The thesis is divided in seven chapters.
- Chapter 1. Introduction:
Motivation; The hypothesis; Scope of the research; Aims and objectives; Method; Overview of thesis;
- Chapter 2. Cognitive protocol research:
A summary of work in the fields of design cognition research and protocol analysis;
- Chapter 3. Methodology:
The empirical methods that can be used in studying the roles of design sketches and knowledge; The methodology used for the research;
- Chapter 4. Features of the conceptual design process:
General overview of the results of the experiments;
- Chapter 5. Roles of sketches and knowledge in the design process:
The results of the experiments on the roles of design sketches and knowledge;
- Chapter 6. Discussion of S-creativity:
Discussion of the results;
- Chapter 7. Implication and conclusions:
The implications of the results.

2.3.3 Motivation

"Designing is one of the most complex human activities that demand high intelligence and skills. Numerous tools have been developed to facilitate the design process. For example, Computer-aided design (CAD) software is emerging as one of the important tools for designers. These tools, however, are often found to be inadequate and inconvenient to use in practice. This is due to our vague comprehension of the design process, and thus the needs of designers are not met by CAD. Further the interactive roles of sketches and knowledge in the design process are not known. For example, even the most powerful CAD software could not replace the pens and paper used by skilful designers especially during the conceptual design process. […] Therefore,

improving current computational tools should be based on the understanding of the design process that CAD initially intended to facilitate.

In design education, students are taught in two different modes (Roozenburg & Cross, 1991). The prescriptive mode is through the traditional science-like classes, while the descriptive mode is through the peculiar role of the studio at design schools. Both modes clearly have particular strengths and weakness, emphasizing different aspects of the design process. The clear distinctions between them, risks training students with impoverished understanding of the design process. Designers however still have to acquire both intuitive and reasoning resources to solve design problems through design knowledge and sketches. In order to improve understanding about the interaction between them, we could connect prescriptive and descriptive models to provide better pedagogical methods to train novices in using both, i.e. knowledge (reasoning) and sketches (intuition).

The needs of design education and computational tools provide the motivations to understand the roles of knowledge and sketches in the design process. This study pursues a better understanding of different aspects of the design process." (Tang, 2002).

2.3.4 Aims of the study

"Three interconnected aims are:
To improve understanding of the technique this research applied;
To explore the characteristics of interlinked and multimode design process;
To examine the interactive roles of sketches and knowledge in this process.

Corresponding to the aims, the following objectives are to be completed through the development of this research:
To determine the differences and similarities between concurrent and retrospective protocols obtained from the same design process;
To establish a coding scheme that can provide details of the roles of knowledge and sketches in the design process;
To examine the characteristics of different aspects of the design process being interlinked and interlocked modes;
To examine interactions among the sketches and other different aspects of the design process;
To examine interactions among the design knowledge and other different aspects of the design process;
To examine the unpredictability through the roles of the design process, design knowledge, and sketches." (ibid.).

2.3.5 Methodology

"The methodology this research utilises is protocol analysis that has been widely used in examining the cognitive activities of designers in the design research community. Two types of protocol analysis can be identified according to their experimental procedures and the research foci. These are compared firstly in this research to have a better understanding of their different abilities and disadvantages in terms of process-oriented and content-oriented design process. The main analytical resource is the verbal protocol reported by participating designers about their thinking processes in designing. Protocol, sketches, and videotapes recording the design process are utilised to reveal the details of the design process." (ibid.).

2.3.6 Results

The following results were achieved:
"The differences between concurrent and retrospective protocols
We conducted experiments to examine the differences between concurrent and retrospective protocols. […] The observed results showed that concurrent protocols provided more information in the problem formulation than retrospective protocols, in contrast retrospective protocols provided more information in the period when designers had intensive drawings

activities. […] The qualitative analyses utilized the structure of process-oriented, including design prototype, level of abstract, macro strategies, and micro strategies. These results showed that their distributions were significantly similar. Based on these results, the retrospective protocol and design content-oriented coding scheme were utilized in the subsequent experiments on design cognition." (ibid.).

"Interlinkage and multimode of the design process
The design processes of the two participating designers were examined from three different perspectives. Macroscopic viewpoint observed that there were two main modes in the design process. One was information-process mode which could be revealed by verbal thoughts in protocols. The other was reflection-in-action mode which could be observed by non verbal thoughts in protocols. The encoded data showed that different modes were related to each other in the design process. These interactions between modes played important roles in advancing the design process. This substantiated our first hypothesis of the design process." (ibid.).

"The roles of design sketches and knowledge as mediators
The roles of design sketches and knowledge were observed through the interactions of instances on different cognition levels in design content-oriented coding scheme. […] The results indicated the close connections amongst physical instances, perceptual instances, and functional instances. In these instances, the roles of sketches and knowledge acted as mediators on these cognitive levels; The second hypothesis was demonstrated. The design process, therefore , should be observed as a pattern of many modes in which design sketches and knowledge played important roles as mediators." (ibid.).

"S- Creativity
We found that there were two types of design process novelty; being design situation and situatedness. The empirical results demonstrated their existences in perceptual, functional, and conceptual levels. We argued that the distribution of design situation and situatedness revealed the degree of novelty involved in the design process. They were in concordance with geneplore cycle proposed by (Finke, et al., 1992). The utility of design situation and situatedness allowed us to observe the creativity from a process viewpoint. Therefore, a new model incorporating with this idea was generated." (ibid.).

2.3.7 Contribution
"Current commercial CAD systems focus on single representations and their manipulations. A small number of them were able to deal with information processing views of designing (Gero, 2000). The systems, however, seemed to be absent from the conceptual design process, and thus most designers still conduct their conceptual designing on paper, […]. CAD systems should have the capacity to support the conceptual design process to provide a holistic design process support. The first step in providing computer-aided support for conceptual design is to understand the conceptual design process.
Here we attempt to provide empirical bases for the next generation of CAD systems with the empirical results. It should be a cognition-based CAD system." (ibid.).

APPENDIX B.4
CASE 04_ AUSTRALIA_UNIVERSITY OF SYDNEY

3. INTERVIEW REPORT

3.1 CIRCUMSTANCES
3.1.1 Kind of interview
Through e-mail.
3.1.2 Date
24 July 2003.

3.1.3 Time
15:30 Italy time.

3.2 ADVISOR'S PROFILE
3.2.1 Name and Surname
John S. Gero.
3.2.2 Title
Professor of Design Science.
3.2.3 Education
Doctor of Philosophy.
3.2.4 Research interests
Situated design agents;
Computational models of creative design: evolutionary systems; analogy; emergence;
Visual reasoning: emergence in design; shape representation; qualitative representations;
Evolutionary systems in design: genetic engineering; style emergence, complex evolution;
Cognitive models of design: protocol studies of designing; role of drawings in designing.
3.2.5 Number of supervised Ph.D. students
Over 30 Ph.D. students.

3.3 INTERVIEW
3.3.1 What's your background education and how many Ph.D. candidates have you supervised?
I have a Ph.D. and I have supervised over 30 Ph.D. students.

3.3.2 In what year the Ph.D. programme in Design Computing and Cognition was launched?
In 1975.

3.3.3 What's the particularity of your programme?
We take a scientific approach to our research as we study design. We have two research paradigms we utilise: computational and cognitive. The computational paradigm studies ideas using computational models, whilst the cognitive paradigm studies humans. These can be used separately or jointly.

3.3.4 What are the intention(s) of the programme? What should it mostly stimulate in the Ph.D. candidate?
We aim to train researchers who are capable of recognizing and formulating research problems as well as creating knowledge through their research. We aim to work at the cutting-edge of research topics. We introduce students to novel ideas and challenge them intellectually.

3.3.5 Why is it stated explicitly that it is a Ph.D. "by research only"?
We have only one required course, the rest of the time of the candidature is spent on research, not doing more courses.

3.3.6 Are there fixed research phases to go through during the research project?
Research area selection; Literature analysis; Topic derivation; Pilot study; Research proposal; Executing research plan; Reviewing results; Writing thesis.

3.3.7 Did you hear about the debates surrounding the practice-oriented Ph.D. (mostly in the European context)? If yes what do you think of this approach?
If by practice-oriented Ph.D. is meant that the results of the practice are presented in lieu of a thesis then it is not research in the formal sense of creating knowledge that is available to others. If what is meant is that the results of practice become the vehicle for the explicit creation of knowledge that is articulated in a formal manner, then this presents no problems in treating the work as a Ph.D.

APPENDIX B.5
CASE 05_FRANCE_ECOLE NATIONALE SUPERIEURE DES ARTS ET METIERS PARIS

1. PROGRAMME REPORT

1.1 TECHNICAL INFORMATION
1.1.1 Source of information
The web site http://cpn-web.paris.ensam.fr/accueil.php;
The interview with Prof. Robert Duchamp (25 July 2003).
1.1.2 Date of collecting the material
August 2003.

1.2 IDENTIFICATION OF THE PROGRAMME
1.2.1 Title of the programme
Doctorat en Conception de Produits Nouveaux.
1.2.2 Institution
Ecole Nationale Supérieure des Arts et Metiers, ENSAM Paris.
1.2.3 Faculty and Department
Laboratoire Conception Produits Nouveaux et Innovation.
(The laboratory has three branches: one in *Paris*, one in *Angers* and one in *Marseille*.)
1.2.4 Year started
1982.
1.2.5 Address
Laboratoire de Conception de Produits Nouveaux et Innovation,
151 Boulevard de l'Hôpital,
75013 Paris, France.
1.2.6 Tel
+ 33 1 44246380
1.2.7 Fax
+ 33 1 44246359
1.2.8 e-mail
robert.duchamp@paris.ensam.fr
1.2.9 web
http://cpn-web.paris.ensam.fr/accueil.php

1.3 DESCRIPTION OF THE PROGRAMME
1.3.1 General information
1.3.1.1 Entry requirements
The candidate must hold a D.E.A, *Diplome d'Etudes Approfondies.*

1.3.1.2 Period of study
One year for the D.E.A., the *Diplome d'Etudes Approfondies* and three years for the doctorate.

1.3.2 Curriculum
1.3.2.1 Philosophy
"Je pense qu'aujourd'hui la caractéristique d'une recherche, une fois terminée, on doit pouvoir en sortir des cours de manière à faire progresser la connaissance. Donc, aujourd'hui on n'a pas la possibilité de faire pratiquement de thèses théoriques qui font des grandes découvertes susceptibles de déboucher sur des enseignements. Par contre, si on fait des thèses comme chez nous, avec des applications pratiques, on démontre que pour déboucher sur des produits il a été nécessaire de développer des synergies entre des métiers différents, une des caractéristiques du design, et que ces synérgies doivent etre utilisées de manière pour etre opérables, de manière à ce qu'on suive une méthodologie dans le temps qui soit si rigoureuse. Donc la méthodologie fait la partie théorique mais elle doit déboucher sur quelque chose de pratique. Ce quelque chose

de pratique doit porter un plus par rapport au niveau des connaissances précédants." (Duchamp, 2003).

1.3.2.2 Intention
La compétence que le programme développe auprès des doctorants est "tout ce qui est organisation de l'innovation, avec une faisabilité technique et commerciale en faisant sorte que l'innovation soit bien perçue par les utilisateurs potentiels et en respectant évidemment l'environnement." (ibid.).

"les doctorants doivent déboucher sur la réalisation de produits nouveaux ou de logiciels informatiques." (ibid.).

1.3.2.3 Content
50 course hours each year and for three years.

1.3.2.4 Sequence of study
There is no set curriculum, it's a research programme.

1.3.3 Research
1.3.3.1 Areas of research
Modélisation des attributs du produit;
Modélisation de l'intégration des métiers dans le processus de conception;
Modélisation de l'intégration des technologies dans le processus de conception.

1.3.3.2 Groups / Units of research
No groups or units of research.

1.3.3.3 Research phases
No established and fixed research phases.

1.3.4 People
1.3.4.1 Number of the faculty members
10 faculty members (2 of them are *Professeurs des Universités*; 3 of them are *Maitres de Conférence*; 5 teachers and researchers.).
1.3.4.2 Number of the Ph.D. candidates
21 Ph.D. candidates.
1.3.4.3 Number of Ph.D. graduates
60 Ph.D. graduates.

APPENDIX B.5
CASE 05_FRANCE_ECOLE NATIONALE SUPERIEURE DES ARTS ET METIERS PARIS

2. THESIS REPORT

2.1 TECHNICAL INFORMATION
2.1.1 Source of information
Jacqueson, Loic, 2002. *Integration de l'Environnement en Entreprise: Proposition d'un Outil de Pilotage du Processus de Création de Connaissances Environnementales.* Ph.D. thesis, ENSAM Paris.
2.1.2 Date of collecting the material
August 2003.

2.2 IDENTIFICATION OF THE THESIS

2.2.1 Title

Integration de l'Environnement en Entreprise: Proposition d'un Outil de Pilotage du Processus de Création de Connaissances Environnementales.

2.2.2 Author

Loic Jacqueson.

2.2.3 Year of registration

1999.

2.2.4 Year of completion

2002.

2.2.5 Principal supervisor

Professor Améziane Aoussat.

2.2.6 Other supervisor/s

Professor Dominique Millet.

2.2.7 Nature of the thesis

Practice-based Ph.D. thesis.

2.3 DESCRIPTION OF THE THESIS

2.3.1 Abstract

"Ces travaux portent sur les aspects environnement produits et plus particulièrement sur leur intégration dans l'entreprise. Le but visé par notre approche est de réduire l'important déficit de connaissances environnementales contextualisées existant au sein des entreprises, pour créer situations possibles d'intégration.

Malgré leur grande diversité, les approches existantes ne répondent que partiellement au besoin d'intégration de l'environnement. Notre vision de cette problématique, est que l'intégration de l'environnement est un processus à long terme conditionné par :
- la création par l'entreprise de nouvelles connaissances propres à ses activités,
- l'implication de l'ensemble des services de l'entreprise,
- le choix d'une approche managériale intermédiaire entre Top-down et Bottom-Up.

Dans ce sens, nous proposons un outil de pilotage du processus de création de connaissances environnementales composé d'un référentiel à trois dimensions permettant de caractériser les connaissances environnementales dans l'entreprise, d'une stratégie de progression et d'une typologie d'actions, et qui permet de piloter le processus (outil de suivi, d'analyse et de régulation).

La première partie du document s'attachera à détailler la construction de l'outil de pilotage qui sera évalué à l'aide d'expérimentations réalisée au sein de l'entreprise FAURECIA-Sièges d'automobile.

Les résultats de ces travaux portent d'une part sur la capacité de l'outil à piloter le processus de création de connaissances environnementales et d'autre part sur son rôle en tant que moyen de gestion des projets liés à l'environnement dans les entreprises." (Jacqueson, 2002).

2.3.2 Structure of the thesis

The thesis is divided in a general introduction and five chapters.

- General introduction:
Description of the contents of the five chapters;
- Chapter 1. *Contexte industriel et de recherche:*
The industrial context of the thesis, and the interactions between the environment and the automobile sector;
- Chapter 2. *Problématique:*
Articulation of the research problem;
- Chapter 3. *Hypothèses et protocole expérimental:*

The development of hypotheses, one principal hypothesis and two complementary ones; The experimental protocol and the different experimentations;
- Chapter 4. *Expérimentations:*
Development of two different experimentations to test the hypotheses;
- Chapter 5. *Conclusions et perspectives:*
The conclusions and the proposal of future perspectives to pursue the research.

2.3.3 Motivation

"Le secteur automobile, du fait de la mondialisation des activités des constructeurs est devenu ces dernières années de plus en plus concurrentiel (les regroupements, fusions et autres rachats dont la presse se fait l'écho témoignent de cette situation). Afin de mieux contrôler leurs coûts de production et de se focaliser sur leurs activités principales (la carrosserie, les motorisations et l'assemblage des véhicules), les constructeurs d'automobiles ont, petit à petit, externalisé la fabrication puis la conception des sous-ensembles fonctionnels des véhicules. C'est ainsi que le métier d'équipementier est apparu. Pour continuer à dégager des bénéfices suffisants et assurer la pérennité de leurs entreprises, les équipementiers ont dû, à leur tour, rationaliser leurs organisations et leurs méthodes de travail. Dans ce sens et pour se maintenir sur un marché extrêmement concurrentiel, l'innovation est devenue la principale force des entreprises. Dans la position de l'équipementier, innover correspond à identifier puis réaliser des changements qui devront satisfaire à la fois le constructeur (en terme de coûts, de fonctionnalités des produits, de fiabilité) mais également l'utilisateur final (en terme d'image, d'agrément, de service rendu). La forte valeur d'estime attribuée aux véhicules automobiles suscite de la part de la majorité des utilisateurs, un intérêt marqué pour les innovations technologiques intégrées aux produits (c'est le cas actuellement des systèmes de sécurité, la modularité de l'intérieur du véhicule, etc.).

Pour l'environnement, la situation est aujourd'hui quelque peu différente: en effet, si globalement les utilisateurs se disent concernés par la protection de l'environnement, ce sont rarement les critères environnementaux qui interviennent dans la décision d'achat d'un véhicule (la recyclabilité du véhicule ou le traitement qui lui sera appliqué lorsqu'il sera à l'état de déchet, environ quinze ans après sa date de mise en circulation, indiffèrent la grande majorité des acheteurs). Ainsi, face à la sévérisation du contexte réglementaire en matière d'environnement, l'équipementier se trouve dans une position où il doit prendre en compte, en plus de tous les critères mécaniques, de style et de confort, de nouveaux facteurs, qui d'un point de vue commercial n'ont quasiment pas de valeur (à ce jour). Par rapport à cette situation bien spécifique, ces travaux ont pour but d'intégrer la notion d'environnement non seulement dans la conception des produits, mais également dans toute l'entreprise afin de faire évoluer les pratiques pour qu'à terme les sièges aient un impact sur l'environnement mieux maîtrisé." (Jacqueson, 2002).

2.3.4 Aims of the study

"Nous avons vu à travers les différentes parties de ce chapitre, que la question de l'intégration de l'environnement en entreprise nécessitait de prendre en compte des aspects relevant des outils et méthodes de travail, de la création et de l'apprentissage de connaissances ainsi que du management des organisations. En effet, chacun de ces trois domaines essentiels apporte une vision spécifique de la question de l'intégration et nous pensons que seule une approche prenant en compte l'ensemble de ces domaines peut aujourd'hui fournir une réponse adaptée aux entreprises.

KAÏLA précise que la prise en compte de l'environnement dans la conception des produits comporte deux pôles essentiels nécessitant d'importants investissements de la part des entreprises (investissements financiers certes, mais également en temps et en hommes), d'une part pour modifier les pratiques managériales, et d'autre part pour créer des connaissances. Il donne en plus, et contrairement à la majorité des approches, une vision du problème novatrice en mettant en avant le rôle crucial des connaissances et donc le fait que les actions directes

auprès des acteurs de l'entreprise restent primordiales, comparées au développement des nouvelles ressources outillées (ces dernières restent nécessaires, mais ne doivent pas intervenir de façon hégémonique). Les liens existant entre le domaine des connaissances et celui du changement dans les organisations sont soulignés dans la littérature et notamment par CABIN, pour qui l'apprentissage de connaissances est une condition nécessaire du changement dans les entreprises.

Ces visions de l'intégration et des phénomènes de création et d'apprentissage de connaissances sont, de notre point de vue, particulièrement pertinentes par le fait que leur prise en compte simultanée permet de porter un regard nouveau et plus global sur ces questions. Dans le but d'intégrer l'environnement en entreprise, il nous apparaît donc nécessaire, aujourd'hui, de nous préoccuper de l'ensemble de ces aspects (outils et méthodes de travail, adaptation du management, création et apprentissage de connaissances environnementales). Si pour les domaines du management des organisations et de l'utilisation de ressources outillées, les expériences pratiques ne manquent pas (aussi bien pour l'environnement que pour d'autres disciplines telles que l'ergonomie), pour le domaine des connaissances et plus spécifiquement de l'activité de créations de connaissances, les modèles proposés ne sont pas directement opérationnels.

La question qui se pose alors pour un industriel, est de savoir comment, en l'absence de cadre de référence et d'outil spécifique, conduire concrètement l'intégration du domaine de l'environnement, en s'appuyant sur un processus de création de connaissances et en tenant compte de la pluralité des champs d'action concernés?" (ibid.).

2.3.5 Methodology

"Pour mettre à l'épreuve nos différentes hypothèses relatives aux propriétés d'un outil de pilotage ainsi qu'à son utilisation, nous avons mis en œuvre un programme d'actions et d'expérimentations précisé ci-dessous. Nous prenons comme point de départ, le référentiel à trois dimensions. Les numéros attribués à chaque action de notre programme permettent de les resituer sur le schéma de synthèse.

Première action: Recherche d'une segmentation des échelles pour chacune des trois dimensions du modèle n°1.
A l'image de la proposition de GAUCHERON (et par opposition à celles utilisées pour le modèle de MACK), nous pensons que des échelles graduées permettent d'augmenter la précision du référentiel pour évaluer l'évolution des connaissances au sein de l'entreprise. Afin de déterminer les échelles les plus pertinentes pour notre modèle, nous procéderons en deux étapes :
dans un premier temps, nous mettrons en œuvre une série d'actions spécifiques visant à favoriser l'évolution des connaissances suivant chacune des trois dimensions.
dans un deuxième temps, nous confronterons les résultats de ces actions avec les propositions de segmentations de la littérature et nous rechercherons de manière empirique les propositions les plus en adéquation avec nos impératifs: cest-à-dire les propositions ayant la double capacité de transcrire fidèlement les évolutions observées et d'être compréhensibles par les acteurs de l'entreprise.

Deuxième action: Définition d'une stratégie de progression de référence.
Pour compléter le modèle 2 et le faire évoluer du stade d'outil de suivi à celui d'outil d'analyse, nous proposerons et discuterons différentes stratégies possibles de progression au sein du référentiel. En nous appuyant sur des arguments bibliographiques ainsi que sur nos propres observations en milieu industriel, nous verrons comment déterminer une stratégie préférentielle par rapport au domaine de l'environnement.

Troisième action: Evaluation de la cohérence du modèle n°2 (évaluation simultanée des trois dimensions) et de la stratégie de progression de référence.

Afin de déterminer si l'utilisation couplée du référentiel et de la stratégie de progression permet d'analyser le déroulement d'un projet, nous l'utiliserons en tant qu'outil de simulation (utilisation a posteriori) pour transcrire l'enchaînement des actions de deux projets. Nous évaluerons dans un premier temps, l'activité recyclage de la cellule environnement R&D de FAURECIA, puis dans un deuxième temps, un projet prospectif sur les apports de la méthode d'Analyse de Cycle de Vie dans la conception des sièges. Cette double évaluation constituera notre première expérimentation.

Quatrième action: Proposition d'une typologie d'actions.
En nous inspirant de l'ensemble des actions menées au cours de nos travaux ainsi que d'exemples issus de la littérature, nous proposerons une première typologie d'actions, destinée à remplir la troisième fonctionnalité d'un outil de pilotage: capacité de régulation du processus décrit.

Cinquième action: Evaluation de l'outil de pilotage complet.
L'outil de pilotage ainsi constitué (comprenant le référentiel gradué, la stratégie d'action et la typologie d'actions) sera évalué en conditions réelles au cours d'un projet de mise en place d'un système de management des substances dangereuses dans les produits. Cette dernière évaluation correspondra à notre deuxième expérimentation, et nous permettra de juger d'une part, de la capacité de régulation de la typologie d'actions proposée et d'autre part, de la pertinence de notre hypothèse sur le rôle de l'outil de pilotage pour faciliter l'intégration de l'environnement." (ibid.).

2.3.6 Results

"Les expérimentations que nous avons réalisées ont permis dans un premier temps d'élaborer la structure d'un outil de pilotage et, dans un deuxième temps, lors de son utilisation au cours de projets spécifiques, de l'évaluer par rapport au processus de création de connaissances. Nous avons ainsi pu mettre nos hypothèses de départ à l'épreuve et porter un jugement critique sur la capacité de cet outil à influencer l'intégration de l'environnement dans l'entreprise." (ibid.).

"Dans un premier temps, nous avons utilisé le référentiel comme moyen de transcription du déroulement de deux projets, ce qui nous a permis d'aboutir à une validation de notre première hypothèse concernant les capacités de suivi et d'analyse de l'outil. Dans un deuxième temps, après avoir constitué une première typologie d'actions, nous avons testé l'outil dans son ensemble, au fur et à mesure de l'évolution d'un projet. Nous avons ainsi pu valider l'utilité de la fonction de régulation mais également la nécessité d'enrichir cette typologie afin de la rendre plus pertinente encore et d'élargir son champ d'application aux nombreuses disciplines du domaine de l'environnement." (ibid.).

"Une autre propriété particulièrement intéressante de cet outil est, qu'en plus de sa capacité à transcrire l'évolution des connaissances au niveau des projets (niveau micro pour l'entreprise), il permet de suivre l'évolution du domaine de l'environnement au sein de l'entreprise. L'évolution des connaissances pour chaque projet nous a amené à élargir systématiquement notre champ d'investigation, et à prendre en compte des domaines ayant un impact de plus en plus important sur les produits et sur l'entreprise. Ainsi, notre intervention initialement motivée par des interrogations sur la recyclabilité des produits en fin de vie, a évolué progressivement (et suite à nos premières investigations), pour s'orienter vers le cycle de vie complet des produits (études ACV). Nous avons par la suite commencé à concrétiser cette prise en compte du cycle de vie en initiant dans l'entreprise et au niveau de la filière des fournisseurs de FAURECIA, le suivi et le contrôle des substances dangereuses dans les produits. Les connaissances créées permettent ainsi d'appréhender le domaine de l'environnement avec un plus de précision à chaque nouveau projet." (ibid.).

"L'outil permet de mettre en évidence non seulement une évolution des connaissances au niveau micro mais également à un niveau plus global (niveau macro) correspondant à l'organisation même de l'entreprise. Les activités de création et d'apprentissage de connaissances permettent en définitive de favoriser l'intégration de la notion d'environnement de deux manières différentes : non seulement en faisant évoluer les connaissances et les pratiques des équipes projets, mais également en modifiant l'organisation de l'entreprise par une légitimation progressive des acteurs en environnement produit. On assiste dans cette évolution à la construction pas à pas du métier "environnement produit"." (ibid.).

2.3.7 Contribution

"Ainsi d'un point de vue industriel, ces travaux ont permis d'une part d'être à l'origine de la création de connaissances environnementales contextualisées par rapport à l'entreprise et à ses produits, et également de montrer que l'outil proposé permettait le pilotage réel du processus de création de connaissances par le suivi (assuré par le référentiel avec ses axes gradués) l'analyse (assurée par la stratégie de progression préconisées couplée au référentiel) et la régulation de ce processus (assurée par la typologie d'actions). D'autre part, il apparaît que l'utilisation de cet outil favorise l'intégration de l'environnement en indiquant la direction à suivre pour continuer l'intégration des autres sous-domaines de l'environnement pertinents par rapport aux activités de l'entreprise.

Du point de vue de la recherche, et dans l'optique d'une réutilisation de l'outil pour d'autres domaines (tels que l'ergonomie, la sécurité, la fiabilité, ...) il sera nécessaire de prendre quelques précautions. Notre situation privilégiée au sein des Etudes Avancées en Recherche et Développement (constituée d'un Bureau d'Etudes et d'une équipe d'ingénieurs produits) a indubitablement influencé notre point de vue et notre vision des problèmes tout au long de ces travaux. De ce fait, un certain nombre de résultats doivent être contextualisés afin de rester pertinents lors d'une réutilisation de l'outil." (ibid.).

APPENDIX B.5
CASE 05_FRANCE_ECOLE NATIONALE SUPERIEURE DES ARTS ET METIERS PARIS

3. INTERVIEW REPORT

3.1 CIRCUMSTANCES
3.1.1 Kind of interview
By telephone.
3.1.2 Date
25 July 2003.
3.1.3 Time
14:45 Italy time.

3.2 ADVISOR'S PROFILE
3.2.1 Name and Surname
Robert Duchamp.
3.2.2 Title
Professeur des universités.
3.2.3 Education
Doctor of philosophy.
3.2.4 Research interests
Methodologies of design.
3.2.5 Number of supervised Ph.D. students
50 Ph.D. students.

3.3 INTERVIEW

3.3.1 Ma première demande concerne votre éducation.
Je suis Professeur des universités.

3.3.2 Vous avez fait un doctorat?
Oui, j'ai fait un doctorat de mécanique.

3.3.3 En quelle année a-été lancé le doctorat en Conception de Produits Nouveaux de l'ENSAM Paris?
En 1982.

3.3.4 Quelle est la particularité de votre programme?
Notre programme aujourd'hui, c'est un programme constitué d'un D.E.A., un Diplome d'Etudes Approfondies qui se poursuit par la possibilité de faire une thèse de docteur.

3.3.5 Combien d'années faut-il pour avoir un doctorat?
Le Diplome d'Etudes Approfondies dure un an et la thèse de doctorat dure trois ans.

3.3.6 J'ai vu sur votre site web que vous avez des contacts et des rapports avec l'industrie, et qu'on peut faire le doctorat en collaboration avec l'industrie. Vous pouvez me donner une idée sur votre approche méthodologique?
Notre approche méthodologique est centrée sur l'analyse fonctionelle d'une part, l'analyse de la valeur et puis le dévelopment de produits en utilisant des outils méthodologiques intégrant les métiers come l'érgonomie, le design ou d'autres métiers comme l'environnement.

3.3.7 On peut dire que votre doctorat est un doctorat orienté vers la pratique?
Oui, puisque en fait les doctorants doivent déboucher sur la réalisation de produits nouveaux ou de logiciels informatiques.

3.3.8 Quelles compétences le programme tend à développer auprès des doctorants?
Tout ce qui est organisation de l'innovation, avec une faisabilité technique et commerciale en faisant sorte que l'innovation soit bien perçue par les utilisateurs potentiels et en respectant évidemment l'environnement.

3.3.9 Les doctorants doivent poursuivre des cours?
Les doctorants doivent avoir déjà fait un D.E.A., Diplome d'Etudes Approfondies pour pouvoir s'inscrire en thèse. Dans le cadre des trois ans de thèse, ils ont à peu près 50 heures de cours chaque année.

3.3.10 Vous avez entendu du débat entre les deux polarités du doctorat en design entre le doctorat orienté vers la théorie et le doctorat orienté vers la pratique?
Nous on est très pratiques. Nos candidats ne peuvent pas faire un doctorat s'il n'y a pas une application pratique. Je pense qu'aujourd'hui la caractéristique d'une recherche, une fois terminée, on doit pouvoir en sortir des cours de manière à faire progresser la connaissance. Donc, aujourd'hui on n'a pas la possibilité de faire pratiquement de thèses théoriques qui font des grandes découvertes susceptibles de déboucher sur des enseignements. Par contre, si on fait des thèses comme chez nous, avec des applications pratiques, on démontre que pour déboucher sur des produits il a été nécessaire de développer des synergies entre des métiers différents, une des caractéristiques du design, et que ces synérgies doivent etre utilisées de manière pour etre opérables, de manière à ce qu'on suive une méthodologie dans le temps qui soit si rigoureuse. Donc la méthodologie fait la partie théorique mais elle doit déboucher sur quelque chose de pratique. Ce quelque chose de pratique doit porter un plus par rapport au niveau des connaissances précédants.

3.3.11 Quelles sont vos intérets de recherche ?
De trouver l'amélioration des méthodologies que nous avons mis en place par des modèles mathématiques ou informatiques qui permettent de mieux préciser sur le plan théorique comment on augmente le rendement du design, le rendement de la méthode de recherche tout en essayant d'éxpliquer quelle est la gestion de l'espace et du temps qui permettent de mieux déboucher sur des produits nouveaux plus rapidement et des produits qui donnent satisfaction aux utilisateurs.

3.3.12 Quel est le nombre de doctorants que vous avez vous memes suivis ?
J'ai suivi sur 60 doctorants, 50 à peu près.

3.3.13 Quel est le nombre des professeurs au laboratoire qui peuvent suivre le dévelopement de la recherche des doctorants?
Aujourd'hui nous sommes deux Professeurs d'Université à Paris plus deux autres Professeurs d'Université à Marseille et deux Professeurs d'Université à Angers puisque notre laboratoire a trois sites, Paris, Angers et Marseille, et nous avons une dizaine de Maitres de Conférence et de rechercheurs.

APPENDIX B.6
CASE 06_ GERMANY_UNIVERSITY OF WUPPERTAL

1. PROGRAMME REPORT

1.1 TECHNICAL INFORMATION
1.1.1 Source of information
The Web site http://www.code.uni-wuppertal.de;
The interview with Prof. Mihai Nadin (24 July 2003).
1.1.2 Date of collecting the material
July 2003.

1.2 IDENTIFICATION OF THE PROGRAMME
1.2.1 Title of the programme
Computational Design.
1.2.2 Institution
University of Wuppertal.
1.2.3 Faculty and Department
FB5 - Design, arts, music pedagogies, printing engineering.
Industrial Design.
1.2.4 Year started
1994.
1.2.5 Address
Computational Design,
BUGH-Wuppertal,
35-39 Hofaue,
42103 Wuppertal, Germany.
1.2.6 Tel
+49 202 439 4704.
1.2.7 Fax
+49 202/439 4724.
1.2.8 e-mail
code@code.uni-wuppertal.de
1.2.9 web
www.code.uni-wuppertal.de

1.3 DESCRIPTION OF THE PROGRAMME
1.3.1 General information
1.3.1.1 Entry requirements
A Bachelor degree.

1.3.1.2 Period of study
Four years.

1.3.2 Curriculum
1.3.2.1 Philosophy
"Computation made possible and necessary a new paradigm for the field of design. It entails a new understanding for design work. The change leads to a new awareness in the designer in dealing with aesthetic, creative, and reflective aspects in industrial and educational environments. […] All areas and traditions-from foundational studies to methodology to the formulation of theories-must be rethought. Design in the digital environment affords a new definition of the discipline, and a new status. […]The research pursued within Computational Design revolves around aspects of theory and practice that reflect design's new condition. In order that successful design research come about, other branches of knowledge must come into the picture. […]." (Nadin, 2003).

“The specific thing is that we are working on research that should allow the building of a new culture that has the digital as an integrated component.” (ibid.).
“research methods play a role that is equivalent to the role of the applied part. It is a combination of both, the means of research are computational means that knowledge is expressed in computational forms.” (ibid.).

1.3.2.2 Intention
The programme intends to develop in the Ph.D. candidate “a competence in the meeting point between computer science and design, it has to unite both.” (ibid.).

1.3.2.3 Content
No required courses, it's a research only Ph.D. programme.

1.3.2.4 Sequence of study
It's a research only Ph.D. programme.

1.3.3 Research
1.3.3.1 Areas of research
Digital technology;
Ubiquitous computing;
Virtual reality.

1.3.3.2 Groups / Units of research
Four groups of research.

1.3.3.3 Research phases
No fixed research phases, “it's based exclusively on the progress in the research.”

1.3.4 People
3.4.1 Number of the faculty members
5 faculty members.
1.3.4.2 Number of the Ph.D. candidates
11 Ph.D. candidates.
1.3.4.3 Number of Ph.D. graduates
4 Ph.D. graduates.

APPENDIX B.6
CASE 06_ GERMANY_UNIVERSITY OF WUPPERTAL

2. THESIS REPORT

2.1 TECHNICAL INFORMATION
2.1.1 Source of information
Lango, Clemens, 2002. *Visuos. A visuospatial Operating Software for Knowledge Work.* Ph.D. thesis, University of Wuppertal.
2.1.2 Date of collecting the material
August 2003.

2.2 IDENTIFICATION OF THE THESIS
2.2.1 Title
Visuos. A visuospatial Operating Software for Knowledge Work.
2.2.2 Author
Clemens Lango.

2.2.3 Year of registration
1997.
2.2.4 Year of completion
2002.
2.2.5 Principal supervisor
Professor Mihai Nadin.
2.2.6 Other supervisor/s
No.
2.2.7 Nature of the thesis
Practice-centred Ph.D. thesis.

2.3 DESCRIPTION OF THE THESIS

2.3.1 Abstract

"Today's knowledge workers have access to practically endless amounts of information resources. However, this information alone is of no use if it cannot be reasonably retrieved and organized. Today's solutions are a collection of heterogeneous, inconsistent, separate environments that are not optimized for efficiency in the higher workflows typical in the knowledge work.

visuos is a concept for an operating software for knowledge work. It covers various forms of access to knowledge spaces, including knowledge management, information retrieval, research and refinement, monitoring of knowledge resources, and automation and scheduling of tasks. It is a system designed for a broad target group-from novice to expert. Its modular structure allows the users to adapt the system to their particular degree of experience and the individual form of access to knowledge space desired. The modules are integrated by a holistic conceptual model. This model was designed in order to allow effective workflows with minimum friction.

The benefits of the system include improved functionality, new workflows, a maximized target group, higher efficiency and productivity, and a higher degree of ser confidence." (Lango, 2002).

2.3.2 Structure of the thesis

The thesis is structured in five parts. Each part is then divided in different chapters.
- Part 1. Introduction:
The description of the project thematic background; the objective of the software that was developed; and the discipline involved;
- Part 2. Analysis:
The analysis of the characteristics of hypermedia and the numerous approaches to it; and the principles for the system architecture to be developed;
- Part 3. Synthesis:
The conception and detailed development of the software's user interface architecture; the concept, functional principles and interaction models of the software modules; description of the advantages of the software;
- Part 4. Concept, development and implementation:
The concept, development and implementation of the software; and the next steps towards further development of the concept *visous*;
- Part 5. digital presentations:
The practical, computer-based digital presentation of the project.

2.3.3 Motivation

"In today's environment of information overload, we are starved for knowledge – the truly relevant and actionable information we are seeking. The paradox is that knowledge workers now have more information than ever at their fingertips, yet they have neither all the right information nor the ability to access it and act upon it as quickly as they need. Collecting valuable information from diverse sources, quickly getting it to those who need it, wherever

they may be, and converting it to useful knowledge that can be wisely acted upon may be the most significant organizational challenge of the next five years. [Government Technology, 2000].

This statement properly describes the current situation of knowledge workers, the unsatisfying structures they have to work within, and what an ideal future will look like. It sets the stage for the objective of *visuos*." (Lango, 2002).

2.3.4 Aims of the study

"The project is intended to realize the concept, development, and implementation of an operating software for knowledge work." (ibid.).

"The proposed system needs to efficiently incorporate various forms of access to knowledge spaces, including, for example, knowledge management, information retrieval / research / refinement, monitoring knowledge resources and automation, and scheduling tasks. It must be a highly usable system for a broad target group – from novice to expert. A structure must be found that lets the user adopt the system to his specific degree of experience and his individual form of access to knowledge spaces. The complete system should have a highly visual and intuitive direct manipulative interface. These characteristics will result in a directly usable system that can be easily learned." (ibid.).

2.3.5 Methodology

The three phases of the methodology are the analysis phase, the synthesis phase and then the concept, development and implementation of the software phase.

Analysis: "Taking the advantages of today's solutions as a point of departure, principles for the system architecture to be developed are derived." (ibid.)

Synthesis: "[...] the conception and detailed development of the software complete user interface architecture [...]." (ibid).
"[...], each of the software module targets is defined. Their concept, functional principles and interaction models are developed." (ibid.).

Concept, development and implementation of the software: "The concept behind *visuos* – based on the objectives of the synthesis – is implemented." (ibid.).

The development of: "[...] a tabular summary of all system features. It describes their use and gives examples of how they can be applied. The features are classified according to the type of benefit they represent." (ibid.).

"[...] a detailed documentation of the overall system and all of the modules' functions and their operation." (ibid.).

2.3.6 Results

The concept, development and implementation of *Visuos*.
"*Visuos* is a concept for an operating software for knowledge work in open networks. It efficiently covers various forms of access to knowledge spaces, including knowledge management, information retrieval/ research/ refinement, monitoring of knowledge resources, and automation and scheduling of tasks. It is a highly usable system for a broad target group- from novice to expert. Its modular structure lets the user adopt the system to his specific degree of experience and his corresponding form of access to knowledge spaces. The modules are integrated by a holistic conceptual model allowing effective workflows across them." (ibid.).

2.3.7 Contribution
"The highly visual and direct manipulative quality of the system and the concept of information load reduction with details-on-demand minimize the cognitive complexity and learning effort and lead to highly productive environment. The system unifies classically divided systems, such as the personal computer "desktop environment", and network software, such as browsers, search engines, and ftp in one platform. Different conceptual models and interaction standards of classically isolated public or private information spaces, such as local information spaces (represented by the operating system's file management tools), public information spaces (represented by ftp tools), query results (represented by the query system's model), and sitemaps or link lists (represented by the publisher's model) are represented by the same conceptual model. This consistency minimizes learning efforts and allows "natural" interactions among these (technically and historically) different systems.

The system offers different forms of access to information. If an element is regarded as valuable, the user will assign it to a level in a hierarchic space for later retrieval. In addition to this user-driven object-oriented storing, the system records a linear time-based log containing all elements and system states. This is an automatically running background task. Any previous system state or element can be restored using this process oriented archive flow. Furthermore, the flow allows scheduling and automation of future tasks. Since it is treated like a space, it can be queried to retrieve elements or system states like any other (hierarchically structured) space.

The highly usable direct manipulative query interaction model is closely related to the system's representation of information spaces. Workflows across these modules can be accomplished naturally. The query module offers a visual, direct manipulative interface. No Boolean textual syntax has to be learned. Its tight coupling principle combines the definition of a query, representation of the results, and refinement in one interaction model.

The benefits of the system are a completely novel functionality, new workflows, a maximized target group, higher effectiveness and productivity, and a higher level of user confidence." (ibid.).

APPENDIX B.6
CASE 06_ GERMANY_UNIVERSITY OF WUPPERTAL

3. INTERVIEW REPORT

3.1 CIRCUMSTANCES
3.1.1 Kind of interview
By telephone.
3.1.2 Date
24 July 2003.
3.1.3 Time
14:00 Italy time.

3.2 ADVISOR'S PROFILE
3.2.1 Name and Surname
Mihai Nadin.
3.2.2 Title
Professor.
3.2.3 Education
Post-doctoral degree (Professor Dr. Phil. Habit.) in Philosophy, Logic, and Theory of Science;
Doctor of Philosophy in Aesthetics;
MA (with honours) in Philosophy;
MS (with honours) in Electronics and Computer Science.

3.2.4 Research interests
Anticipatory systems.
3.2.5 Number of supervised Ph.D. students
Four Ph.D. students.

3.3 INTERVIEW
3.3.1 In the first e-mail we exchanged on the 27 of February, you wrote that at the University of Wuppertal, they want to stop the Ph.D. programme in Computational design. What's the reason for this?
I'm not able to give you a good reason. Probably they didn't find qualified persons to continue what I started.

3.3.2 I understand, because you want to leave the university.
Yes.

3.3.3 What's the specificity of this kind of doctoral research?
The specific thing is that we are working on research that should allow the building of a new culture that has the digital as an integrated component.

3.3.4 What are the competencies or skills that the programme intends to develop in the Ph.D. candidates?
It is a competence in the meeting point between computer science and design, it has to unite both.

3.3.5 While doing my study, I noticed that most Ph.D. programmes in design in the USA, Canada, Japan and Australia are 'conventional' research programmes, I mean that the process of research is similar to the process of research in other academic disciplines. In Europe for example in Italy, France, Britain and in your case many programmes are practice-oriented, they focus on design practice more than on empirical research methods.
I would not say that it's correct in respect to my programme. No, research methods play a role that is equivalent to the role of the applied part. It is a combination of both, the means of research are computational means that knowledge is expressed in computational forms.

3.3.6 Do Ph.D. candidates have to take courses?
No, the requirement on a Ph.D. level is no longer a requirement of courses, it is rather a requirement of being involved in research as such.

3.3.7 Are there research phases to pass from one year to the next one?
No, it's based exclusively on the progress in the research.

3.3.8 Did you heard of the debates about the nature of research in design at the doctoral level, some members of the design research community prefer the model of 'conventional' academic research where Ph.D. candidates learn mostly research methods, while others prefer practice-oriented research where the focus is on design projects?
I know about the debate, it makes no sense. It is based on an old model of education. I don't care for this old model of education.

3.3.9 what's your point of view?
My point of view is that at this moment the most important means of research are computational means and that these computational means are no longer in the continuation of the traditional methods for any research.

3.3.10 What are your actual research interests?
At this moment there are two or three fields that I would call anticipatory systems.

APPENDIX B.7
CASE 07_GREAT BRITAIN_THE OPEN UNIVERSITY

1. PROGRAMME REPORT

1.1 TECHNICAL INFORMATION
1.1.1 Source of information
the web site of the department of Design and Innovation http://design.open.ac.uk;
the web site of the research school http://www.open.ac.uk/research-school;
1.1.2 Date of collecting the material
August 2003.

1.2 IDENTIFICATION OF THE PROGRAMME
1.2.1 Title of the programme
Design and Innovation.
1.2.2 Institution
The Open University.
1.2.3 Faculty and Department
Faculty of Technology,
Department of Design and Innovation.
1.2.4 Year started
1976.
1.2.5 Address
Department of Design and Innovation,
Faculty of Technology,
The Open University,
Walton Hall,
Milton Keynes MK7 6AA, United Kingdom.
1.2.6 Tel
+44 1908 652944.
1.2.7 Fax
+44 1908 654052.
1.2.8 e-mail
n.g.cross@open.ac.uk
1.2.9 web
http://design.open.ac.uk

1.3 DESCRIPTION OF THE PROGRAMME
1.3.1 General information
1.3.1.1 Entry requirements
To join the Open University's research degree programme the candidate needs at least an upper second-class honours degree from a British university or recognized higher education institution, or a recognized qualification from the former Council for National Academic Awards, or the equivalent. Non-graduates will not be admitted to postgraduate study unless they can show evidence of research ability - publications in refereed journals, or a significant academic contribution to university-level research, for example.

The application
The application may be considered if the candidate can show that his qualifications, professional experience or previous research is a suitable preparation for the proposed postgraduate research degree study.

The candidate should include two copies of a research proposal with his application. This is an important part of the application since it enables the academic staff who are responsible for selecting applicants to assess the competence of candidate in the proposed field of study, his

ability to conduct a research programme independently, and the nature of the supervision required. It may not always be possible to prepare a final research proposal; applicants' original outlines are often significantly amended in discussion at the interview stage and again in the early stages of the work itself.

The research proposal should include:
The topic or area to be investigated;
The problem or hypothesis that's to be tested (if it can be defined at this stage);
The methods and techniques to be used in the investigations;
The relationship of the proposed research to the published literature and current research in the candidate field, and an indication of the contribution that the thesis would make;
Details of work already done by the candidate in the proposed field;
If the candidate is applying for a project-based studentship where the research topic has been defined by the supervisor(s), instead of preparing a research project, the candidate should explain in writing why he's interested in the project and his suitability for the studentship. The candidate should include information about his knowledge of the relevant literature and research methods. The proposal should be about 400-600 words in length. The candidate may submit additional documents along with the research proposal in support of his application.

1.3.1.2 Period of study
Full-time: about three years.
Part-time: six to eight years.

1.3.2 Curriculum
1.3.2.1 Philosophy
The Department of Design and Innovation is a unique centre in integrating design and innovation studies across a broad range of topics, without being restricted to any single domain of design practice. The domains that are included in the research and teaching of the Department range widely, from the history of architecture and design to the processes and practice of industrial, product and engineering design, and the management of design and innovation, and beyond these to urban design and energy planning.

The academic and professional qualifications of the staff are correspondingly varied - the majority coming from product design, engineering or architecture , but some also from social science, computer science and mathematics. The diverse research activities of the Department are linked by a shared interest in the development of design knowledge and capability, through understanding and improving the products, processes and management of design and innovation.

The name of the department reflects the fact that innovation studies and design policy issues have always featured strongly in our teaching and research. Recent re-structuring has been mainly around our research area of sustainable technologies and design for the environment, with the formal inclusion now within the Department of the long-established Open University Energy and Environment Research Unit (EERU). This has resulted in a further strengthening in both the breadth and depth of our research.

1.3.2.2 Intention
To create a research culture in which the energy of individuals and of groups can be liberated; to support promising developments with targeted funding; and then to encourage dissemination via refereed journals, international conferences, workshops and other high quality outputs. The view in the Department is that the main key to research success lies in the recruitment and retention of staff who consider active research to be a personal necessity.

1.3.2.3 Content
Training: there are general training events, open to all full-time and part-time students, designed to complement the subject-specific and project-related training provided by academic units and disciplines. All students receive the research training resource pack *Doing Academic Research* at the beginning of their studies. This training pack is designed to provide basic skills in the organization and planning of the candidate project.

1.3.2.4 Sequence of study
Research only programme.

1.3.3 Research
1.3.3.1 Areas of research
Computational design;
Design and environment;
Design and innovation;
Design theory and methods;
Intelligent machines;
Robotics design;
Product design and development.

1.3.3.2 Groups / Units of research
Design Innovation Group (DIG);
Energy and Environment Research Unit (EERU);
Centre for Technology Strategy (CTS).

1.3.3.3 Research phases
Full-time research students are usually registered for the degree of Doctor of Philosophy. They're required to make satisfactory progress during their first probationary year. If they fail to do so their registration is changed to the degree of Master of Philosophy or terminated.

Part-time students are initially registered in the research degree programme but not for a particular degree. They have a probationary period of about two and a half years. Once this has been successfully completed, they're registered for the degree of Master of Philosophy or Doctor of Philosophy.

Annual progress reports are required for all research students, and continuing registration is subject to satisfactory progress.

1.3.4 People
1.3.4.1 Number of the faculty members
5 professors; 3 senior lecturers; 8 lecturers.
1.3.4.2 Number of the Ph.D. candidates
10 Ph.D. candidates: 5 full-time; 5 part-time.
1.3.4.3 Number of Ph.D. graduates
20 Ph.D. graduates.

APPENDIX B.7
CASE 07_GREAT BRITAIN_THE OPEN UNIVERSITY

2. THESIS REPORT

2.1 TECHNICAL INFORMATION
2.1.1 Source of information
Eckert, Claudia, 1997. *Intelligent Support for Knitwear Design*. Ph.D. thesis, Open University.

2.1.2 Date of collecting the material
August 2003.

2.2 IDENTIFICATION OF THE THESIS
2.2.1 Title
Intelligent support for knitwear design.
2.2.2 Author
Claudia Eckert.
2.2.3 Year of registration
1994.
2.2.4 Year of completion
1997.
2.2.5 Principal supervisors
Professor Nigel Cross.
Dr. Jeff Johnson.
2.2.6 Other supervisor/s
Dr. Helmut Bez.
2.2.7 Nature of the thesis
Research-based Ph.D. thesis (scientific approach to research).

2.3 DESCRIPTION OF THE THESIS
2.3.1 Abstract
"Communications between different members of a design team often poses difficulties. The knitwear design process is shared by the designers, who plan the visual and tactile appearance of the garments, and the technicians, who have to realise the garment on a knitting machine and assemble it. This thesis reports a detailed empirical study of over twenty companies in Britain and Germany, which shows that the communication problem constitutes a major bottleneck. Designers specify their designs inaccurately, incompletely and inconsistently; the technicians interpret these specifications according to their previous experience of similar designs, and produce garments very different from the designers' original intention. Knitwear is inherently difficult to describe, as no simple and complete notation exists for knitted structures; and the relationship between visual appearance and structure and technical properties of knitted fabric is subtle and complex. At the same time the interaction between designers and technicians is badly managed in many companies.

This thesis argues that this communication bottleneck can be overcome by enabling designers to produce accurate specifications of technically correct designs, through the help of an intelligent computer support system that corrects inconsistent inputs and proposes design suggestions that the user can edit. In this thesis this proposal is elaborated for one aspect of knitwear design: garment shape construction. Garment shapes are modelled using Bézier curves generated using design heuristics drawn from industrial practice, to create curves that look right to a designer and can be easily edited. The development of the garment shape models presented in this thesis involved the solution of unusual problems in numerical analysis. The thesis shows how the mathematical models can be integrated into an intelligent CAD system, and discusses the benefits of such a system could have for the design process." (Eckert, 1997).

2.3.2 Structure of the thesis
The thesis is divided in nine chapters.
- Chapter 1. Introduction:
"The introduction, presents the problem addressed by this thesis [...]The steps in which the research questions are posed are explained and the thesis is placed in the context of other academic and commercial work;"
- Chapter 2. Methodology:
"Discusses the methodology used to undertake the empirical work on the knitwear design process;"

- Chapter 3. The knitwear design process:
"presents the results of the ethnographic study by describing the entire knitwear design process, from the beginning of the research work on a new season to the point when a garment is sold to a retail chain buyer;"
- Chapter 4. The communication bottleneck:
"Looks at the communication between knitwear designers and knitwear technicians;"
- Chapter 5. Overcoming the bottleneck:
"Suggests ways to overcome the communication bottleneck through organisational changes and computer support;"
- Chapter 6. Mathematical models of garment shapes:
"Describes the mathematical construction of garment shapes;"
- Chapter 7. Automatic construction of garment shapes:
"Suggests a design support module for garment shape calculation;"
- Chapter 8. The benefits of the design support system:
"Discusses the effect of such a support module on the design process and the communication difficulties;"
- Chapter 9. Conclusions:
"Presents the conclusions of this thesis, looks at their validity in a wider research context and points to further work planned or in progress." (ibid.).

2.3.3 Motivation

"A knitted garment is among the most complex textile products. The design of a knitted garment involves subtle interactions between aesthetic and technical constraints under tight and complex financial pressures. Small technical modifications can change the appearance completely. A slightly different visual effect might require a total rethink about the way the fabric is created. The fabric and the shape are created at the same time from yarn. Industrial knitwear is produced on highly complex computerised machines. Industrial knitting machines can now, theoretically, produce nearly every structure possible for hand knitting, but they put unexpected restrictions on the use of certain structures for certain yarns. Knitwear is a fashion item. Fashion changes are led by tailored fashion. Knitwear follows trends from tailored fashion closely whilst incorporating new technical possibilities. The knitwear industry operates in a tight market. Like the whole textile industry European knitwear companies are under continuous threat from low labour cost countries. The European knitwear industry can only survive by pushing the capability and productivity of the machines to their limits while producing interesting well-timed designs." (ibid.).

2.3.4 Aims of the study

"[...] the problem addressed by this thesis: how can the communication between designers and technicians in the knitwear design and sampling process be improved through computer support?" (ibid.).

"In this thesis the pattern of communication between knitwear designers and technicians is analysed. Designers do not succeed in explaining their ideas. Technicians cannot make them understand why designs cannot be realised. The communication difficulties between designers and technicians constitute a major bottleneck in the design process. The principal argument of this thesis is that: A computer system that enables knitwear designers to create complete and consistent specifications of designs, which the technicians can understand, will help to overcome communication difficulties, thus releasing time for the design and sampling of each garment. This can be achieved by giving rapid technical feedback on tentative designs.

This argument is developed in detail for the design of garment shapes. From the designers' customary description of shapes, as a set of measurements and a short verbal description, a mathematical model can be employed to create the cutting patterns and two-dimensional outlines of the final shape of the garments. Domain heuristics are used in the mathematical model to create curves which include domain constraints and can be easily edited. The

mathematical models lie at the heart of a design for an intelligent system which completes the designers' specifications and turns them into solution suggestions which can be edited." (ibid.).

2.3.5 Methodology

"The author employed an approach drawn on the practices of ethnography, together with a combination of an ethnographic approach and interviews in 20 knitwear companies in Britain and Germany, talking to and observing designers and technicians.
The study of the knitwear design and sampling process was initially undertaken as knowledge acquisition for an intelligent support system to support placing pattern elements onto the shape of a garment. The analysis of the design process and the interaction between the designers and technicians became the focus of later observations. An approach based on ethnography was chosen as a method of knowledge acquisition since it is applicable when easy and repeated access to the same domain experts is impractical." (ibid.).

2.3.6 Results

"The knitwear design process follows a similar pattern of research, design and sampling in all the observed companies.
The knitwear design process is inefficient. This can be attributed to a failure in the communication between designers and technicians. The participants recognise the process as inefficient.
The communication bottleneck cannot be attributed to one single cause, but is caused by difficulties inherent in the structure of knitwear and by factors deriving from the traditional work culture of the knitwear industry.
An intelligent CAD system, which uses knowledge involved in the technical realisation of garments, would enable designers to create complete and exact descriptions of their designs and thus ease the communication difficulties.
Relevant aspects of garment shapes can be represented through mathematical models using Bézier curves and incorporating domain heuristics.
Garment shape construction can be used in combination with automatic reasoning from partial information, to increase the scope of existing textile CAD systems." (ibid.).

2.3.7 Contribution

"This thesis is concerned with the knitwear design and sampling process and its possible improvement. Not all of the 20 companies visited face all the problems mentioned, because the tasks and abilities of individuals are different; for example in some companies designers and technicians have worked out their own language for stitch structures. However, the same pattern of problems applies to all the observed companies. One company has overcome some of the problems associated with the working culture by taking a concurrent engineering approach.

Some results of the empirical work apply to other areas of textile and fashion design, because knitwear includes the tasks of these domains. It subsumes the creating of fabric in textile design, the design of the shape of the garment in fashion design and the granularity problems associated with carpet design:

The initial design research process is the same throughout the textile industry with different emphases on individual products;

The mathematical models can also be applied to fashion design. The cutting patterns in fashion design have fewer constraints than in knitwear design, because there is no need to worry about the fabric unravelling. The mathematical models can be applied to fashion design after changing the end tangent vector constraints. The shape construction module described in chapter 6 could be applied in exactly the same way to fashion design. The significance of the shape construction module would be even greater in fashion than in knitwear design, because the shapes are more complex and more important.

The mathematical modelling approach, using Bézier curves with interpolation points that can be edited by a user, would also apply to other craft domains, such as furniture design. In these domains solid modellers or surface modellers can be used to create three-dimensional objects. Creating mathematically correct outlines could serve as a halfway step between sketching and using the three-dimensional modeller functionality. Designs could be annotated, communicated and initially checked using this much simpler representation. Two-dimensional outline designs suggested by a CAD system could provide the input measurements for solid modellers." (ibid.).

APPENDIX B.7
CASE 07_GREAT BRITAIN_THE OPEN UNIVERSITY

3. INTERVIEW REPORT

3.1 CIRCUMSTANCES
3.1.1 Kind of interview
Face to face interview.
3.1.2 Date
6 June 2002.
3.1.3 Time
09:11 London time.

3.2 ADVISOR'S PROFILE
3.2.1 Name and Surname
Nigel Cross.
3.2.2 Title
Professor of Design Studies.
3.2.3 Education
Ph.D. Computer Aided Design, University of Manchester Institute of Science and Technology
M.Sc. Industrial Design Technology, UMIST.
B.Sc. Architecture, University of Bath.
3.2.4 Research interests
Analysis of the designers cognitive activities.
3.2.5 Number of supervised Ph.D. students
Four Ph.D. students.

3.3 INTERVIEW
3.3.1 Christopher Frayling proposed distinguishing three types of design research, "research in design; research through design; and research for design." Alain Findeli interpreting Frayling's terminology stated that "research in design" covers the academically recognised design research, "Research for design" describes what is known as "R&D," and "Research through design" is in his view the future of design research, it is research carried out through the design project. I would like to know what you think about this classification and its interpretation?

It's obviously a very good classification because people keep referring to it, so people find something useful in it and I think before Christopher Frayling gave these three categories, we just talked about design research, and I think that categorization tends somehow to clarify what we mean about design research, so I think it's a very good and helpful thing, and I don't have a different classification. I haven't myself seen that there was a problem before in design research. I have a fairly traditional view of research and I went through research training myself when I did my Master's degree and my own Ph.D. I had a kind of very conventional research training and a traditional understanding of what research is. So I didn't myself think there was a real problem, but obviously in the art and design world there's a problem, rather than the design and technology world which is more where I come from.

So I think I haven't really thought of that at all, about the idea of research through design. Design is something and research is something else. I could understand the problem about the other two categories. Research for design, which is part of what the confusion has been I think in the past, because if you had to design something you need to do some research, you need to find out something, you need to gather information. And I think one idea of design research in practice was that this was what research was, it was research for design, research to be used in design. I think I had only really been aware of research in design, research into design, trying to understand designing through research into the design process. That's where I come from and that's what my interest is and that's what I think my Ph.D. students have been doing, research into the design process, research into design activity, improving the design process, for example through the use of computers, and I'm quite happy with that. I think research for design is something which does not necessarily mean that it has to be research for a Ph.D. for example, but that's a kind of design research and I think I said many years ago well, I would like to see some examples of this research through design, and I still haven't seen them yet, maybe it's my fault because I haven't found them or maybe they haven't been produced yet.

This is a great idea, I'm very much sympathetic to designers and the world of design, and the world of art and design, that's where my own personal sympathies are, and I would like to believe that there is some kind of special research activity which is a designerly kind of researching. I've written about designerly ways of thinking, I strongly support the ideas that design has certain ways of thinking and certain ways of working and acting which belong to the world of design. From design epistemology and design philosophy, there is a way of thinking and working which is a designerly way of thinking and working. And I can see that it is different from the conventional scientific ideas about research, so I don't want to promote the idea of science, I want to promote the idea of design. I've written about design as a discipline, that there's something special about design, that we in the design world have to try to articulate, try to explain be fair about.

So the idea that you could do research through design is a challenging idea, and I'm not opposed to it. I just think that it can be a sort of easy option to say, just by doing design we're doing research, and that's the big danger of that view, just to say, "well my design is my research." I think the worst example of that are when designers who also teach in universities claim that their practice is their research, because I don't think that practice is research. I don't think that normal practice can be regarded as research. So if you were an architect and you're teaching in a school of architecture and you design some beautiful buildings, that's fine, that's good and I'd like that, but I don't think you should say this is my research, because it is not, it is your practice. I think it may be possible, and for these kind of academic practitioners, these kind of people who work both in practice and in academia, they could do some kind of challenging projects that maybe would be some kind of research through design. But as I said, I would like to see them, I haven't seen them yet.

Every five years in this country we have the assessment of the research activity in the universities, and I know that in the schools of architecture some of them say that our practice, our architecture is our research and part of the argument from people like Christopher Frayling in the world of art and design is to support that idea, to support the idea that the people doing works of art and works of design should be regarded as being doing works of research, and I don't really accept that idea. I think it was an argument in this country, at that time when Christopher Frayling put that argument forward it was because the art schools were doing very badly in the Research Assessment Exercise assessing every five years all the research in the universities. People teaching in schools of art, in schools of architecture and schools of design weren't really doing any conventional research, weren't publishing papers, they weren't writing books. They were maybe putting on exhibitions occasionally, and they were maybe doing their own works of art and works of design, and they wanted that their work would be regarded as a kind of research. I think that's a dubious argument, which has been successful in this country, at least the idea is now accepted that if you have an exhibition, that you put on some kind of

exhibition and there's some kind of record, some kind of permanent record of it, there's a book, there's something which came out of it, the catalogue of the exhibition, some kind of attempt to record it and reflect on it, then that is now counted as a form of research for these academic purposes in this country. But I think it came for the wrong reasons, I think it was a way for making sure that the art schools also will have their funding, it was all about money, government money for research. So I think research through design is a lovely idea, and I would like to see it, but I haven't seen it yet.

3.3.2 What about the paradigms of research, which paradigm for the Ph.D. in design and why?

I think that for Ph.D. research my paradigm has been a scientific one and I think I had that perhaps naively just because I hadn't thought of other kinds of research, research through design for example. So I think I'm prepared to admit that my own view was perhaps naive, that the scientific paradigm, the scientific model is the model for doing research. And as I said, I'll be quite happy to try to find ways, other ways than that. And I would like to think that the world of design, the academic world of design can develop its own paradigm for design research. What I don't want to do is just to say practice is research, and that's what we've said before, so I think it's an easy option to say that we just do our design works and we call it research and the other option is to say we do scientific research, science based paradigm. I would like to think that we can find something which brings in the designerly paradigm, but also means you have to think just as hard as you do in the scientific research.

One thing which I have noticed about Ph.D. students is that, even to do the kind of research into design which is basically my model, it's better if they have a design background. We have some students for example who come from computer science or psychology or social sciences or something else or even from art, and they don't have an understanding of design because they haven't done design. So there's something beneficial, and I prefer to work with Ph.D. students who have a design background because then they don't say naïve things about design activity, they have some understanding of design activity, of design process and what design thinking entails. So there is something that comes from having a design background which is beneficial in doing this kind of research. Usually the difficulty they have is in the kind of writing for the thesis. They haven't had this kind of training as design students, about writing long essays or theses and dissertations. They haven't had that kind of experience, and I think it should be a part of their education, their undergraduate education, but it isn't. So what they struggle with is my demand or my colleagues' demands here, about how you express yourself verbally. You know they've been broken up, they've been trained, educated in a number of ways of communicating, and unfortunately I still think that you have to be able to communicate verbally, in a written way, which they find very difficult.

So I'm still looking for a paradigm which is a designerly paradigm for research, and I think this is a thing that it is time to do. I don't think we just want to copy science, I don't want to copy science, science has the way of doing it and science has a lot of imperfections, and it's not a designerly way of thinking. So I hope that we can find collectively, we can make a paradigm for design research, which is not an easy option but is something which I think is very hard to do actually. I've said and written many times before that I don't mind about designers, professional practicing designers who say, "well, I don't want to write theses, I don't want to write dissertations, that isn't my life and in fact that would not make me a worst designer if I didn't develop those skills."

Even if they are doing research?

Well. Yes, even if they are, I think that's the kind of research which is just the kind of gathering information that is not quite the same as creating knowledge, doing original research in that sense. I don't think gathering information and getting them into catalogues, books about some new project, is not the same as creating knowledge and doing new research. Well I don't mind if they say, "No I don't want to do that, that is not my life, that isn't my world," but I think the

academics in the design world do have a responsibility to develop that paradigm. I think that is the danger, that's what I would call an easy option, to say: "well we just do this because we can call it research." There's one old saying that there's nothing so practical as a good theory, that's true if you have some good theory, then you can do some good practice. Theory informs practice and practice can also inform theory, so yes, there can be a very strong relationship between theory and practice. It doesn't mean for me that just doing some practice is just doing research.

Well I think there are changes going on, I mean I always regarded the Ph.D., classic Ph.D., as a research training, that's what it is to be for in this country and in most of the western world. That's what the Ph.D. is about, demonstrating that you can do some independent research, it's not about demonstration that you can do some advanced design work. It's a demonstration that you can do an original research, I mean on your own, you have a license to practice research, a license to do research. That's what I usually say to my students, that's what you have to demonstrate, that you can do some independent research, and it's not that you can demonstrate you're a good designer. But you know in other places they have different ideas about that, and I wouldn't say that they are all wrong. I just would like to see something different, something new and exciting coming out of those ideas about practice and research, about theory and practice, and not just conventional kinds of advanced practice. And also I think that the traditional model, about licence, is based very much on the academic model of life, then they can come to universities, they are trained researchers, and their life really is in the universities. And it may well be that design practice needs different kinds of trained researchers, that it doesn't have the traditional scientific model for research and training. I'm quite open to those developments, but I just don't want it to be an easy way of doing that. I would like to think there is a real debate, we have to have a real dialogue, an intellectual struggle to work out what this new world of design research might be. So I'm not opposed to the idea, but I haven't seen much evidence of something good coming out of it so far.

3.3.3 Do you think that research through design could be a direction that leads to the development of new tools for design research?

Yes, in some cases we do need to do that, but I think we also need to do some very classical kinds of research. There's still lots of research to be done, and yes, I think it would be interesting, it's an interesting challenge to develop new ideas about what research in the world of design might be like. And so yes, I would like to think that we should take up that challenge, that idea of tools, of ways of thinking and ways of working which belong to the world of design and not to the world of science. There is plenty of research that is still to be done from the classical kind. I think what we have to articulate, what we have to be able to say is if this is some kind of advanced education which these Ph.D. students are having is not an advanced kind of practice, maybe there is something which is an advanced kind of practice, and maybe it's at the doctoral level, it's a doctor of design. You know there's a doctor of music, doctor of education, maybe there can be a doctor of design, and people who want to do that can articulate what it is.

What I don't see coming out from anywhere particularly is the articulation of what are the educational goals for this new kind of design research. All of the traditional ones which are based on the Ph.D. come from the scientific model. A Ph.D. is a Ph.D., and it's not a Doctor of design, it's a doctor of philosophy and so it has its particular rules and standards and we know what we're trying to do. The whole world knows what the doctor of philosophy is supposed to mean. The doctor of design means something different, and here we have to think very hard, and we have to argue and develop what are the skills and what's the special knowledge and what's the highest level education that we are working for in that area. Yes, it may be different kinds of tools, different kinds of thinking, different kinds of research from the classical scientific kind and there's a big challenge for the people who want to do that. I think we have to face that challenge and we have to say what it is what they are doing.

APPENDIX B.8
CASE 08_GREAT BRITAIN _THE ROYAL COLLEGE OF ART

1. PROGRAMME REPORT

1.1 TECHNICAL INFORMATION
1.1.1 Source of information
The Royal College of Art web site http://www.rca.ac.uk;
The interaction design department web site http://www.interaction.rca.ac.uk;
The interview with Prof. Irene McAra-McWilliam (14 May 2003).
1.1.2 Date of collecting the material
August 2003.

1.2 IDENTIFICATION OF THE PROGRAMME
1.2.1 Title of the programme
Interaction design.
Doctor of Philosophy: Ph.D. by Project.
Doctor of Philosophy: Ph.D. by Thesis.
1.2.2 Institution
The Royal College of Art.
1.2.3 Faculty and Department
Interaction design department.
1.2.4 Year started
1990.
1.2.5 Address
Interaction Design Department,
Royal College of Art,
Kensington Gore, SW7 2EU,
London, United Kingdom.
1.2.6 Tel
+44 (0)20 75904293
1.2.7 Fax
+44 (0)20 75904290
1.2.8 e-mail
interaction@rca.ac.uk
1.2.9 web
http://www.interaction.rca.ac.uk

1.3 DESCRIPTION OF THE PROGRAMME
1.3.1 General information
1.3.1.1 Entry requirements
Applicants must have a Master's degree or an equivalent qualification. Applicants with other qualifications may be required to register for an M.Phil. degree in the first instance.

Application procedure and research proposal:
If the candidate have identified an area of study which he would like to explore further by undertaking a research degree and would like to apply to the College, the first step is to approach the Head of Department responsible for the department in which he wants to study.

The candidate might find it helpful to consider the following issues when completing his research proposal:
What is his particular research question, argument or hypothesis?
How does he propose to address these questions and find out the answer (what is his methodology?)

How does he see his work in the wider context of the discipline? Who else's work might be relevant to his project?

If the candidate is proposing to undertake a research degree by project, how will the studio and written work relate to each other? If he is proposing to undertake a Ph.D., what is the original contribution to knowledge and understanding? How does he propose to reflect upon or analyse critically his approach to the project.

All successful M.Phil. and Ph.D. applicants to the College will have been interviewed in their Department.

1.3.1.2 Period of study
M.Phil.-Ph.D.:
Full-time: Four academic years;
Part-time: Six academic years.
Ph.D. direct:
Full-time: Three academic years;
Part-time: Six academic years.

1.3.2 Curriculum
1.3.2.1 Philosophy
The product of design is things: products, systems, information, experiences and so on. The product of research, on the other hand, is knowledge and understanding. The two are equally important, but different. The Interaction Design Research Studio is trying to develop new ways of doing research which are rigorous and challenging but do not follow the traditional models of the sciences or the arts.

Research should operate at three levels, each feeding the others:
At the philosophical level, we must understand what it is to design for these new technologies and media: how are they different, what is their potential in society, and what is the role of the designer to bring about that potential?
At the experimental level, we must take that understanding and envisage scenarios about what it might mean in practice, both now and in the future. Making models and prototypes allows people to imagine and assess possible alternative futures.
At the practical level people work as consultants, testing and disseminating their ideas through projects in the real world.

1.3.2.2 Intention
"To give focus for the designer possibility, I think that in very general terms, if we tried to describe design, and especially design showing innovation or design research, it's really trying to encode possibilities, possible lines of development, possible cultural artefacts of the future." (McAra-McWilliam, 2003).

"[…] if we look at the practice of sociology or psychology or the humanities they tend to describe and interpret the world as it is today, and technology has more potential to try to look a little bit at the future, but design can make sense of those two sides and give a cultural context to technology, and that's the idea that we're developing in terms of interaction design. So we like to challenge assumptions, you could say about the world we will live in, in the future and offer other possibilities in a wider academic discourse." (ibid.).

"We also encourage that our research students publish and show their works in conferences, those could be design conferences, social studies conferences, technology conferences, things like that." (ibid.).

1.3.2.3 Content
New research degree students are normally required to attend the college's Research Methods Course (RMC), which runs annually. The RMC is provided exclusively for M.Phil. and Ph.D. students and aims to prepare them in the principles of research at a higher level and to address specifically central concerns of research in art and design.

The aims and objectives of the Research Methods Course (RMC) are: to address research methodologies in art and design with particular respect to research by practice; to equip research students with necessary study and professional skills for carrying out research.

The RMC provides training in: preparation of a research abstract and a research proposal;communication skills: writing, dissemination and media skills; bibliographic and computing skills; principles of research design and data collection and analysis; legal issues: copyright, IPR, patents; research management; self-assessment and institutional feedback mechanisms.

1.3.2.4 Sequence of study
Research only programme.

1.3.3 Research
1.3.3.1 Areas of research
Tangible computing: electronic products, intelligent objects and other digital-physical hybrids;
Intelligent environments: spaces and installations mediated by information and communications technology;
Information architecture: software, online applications and information design.

1.3.3.2 Groups / Units of research
No groups or units of research.

1.3.3.3 Research phases
Each PhD student will be supervised or co-supervised by a member of staff from within the subject area who will be expected to conduct tutorials, editorial sessions and progress meetings. In some circumstances it may be necessary for there to be an external co-supervisor who is an expert in the field and who has experience at this level of study. It shall be the responsibility of the student to maintain regular contact with his or her supervisor(s) to discuss progress and to seek approval for any variation in the approved programme of research. The nature and amount of supervision will be agreed between the student, the Head of Department, and the Research Degrees Committee.

1.3.4 People
1.3.4.1 Number of the faculty members
18 permanent staff members.
1.3.4.2 Number of the Ph.D. candidates
3 Ph.D. candidates.
1.3.4.3 Number of Ph.D. graduates
3 Ph.D. graduates

APPENDIX B.8
CASE 08_GREAT BRITAIN _THE ROYAL COLLEGE OF ART

2. THESIS REPORT

2.1 TECHNICAL INFORMATION
2.1.1 Source of information
Dunne, Anthony, 1999. *Hertzian Tales. Electronic Products, Aesthetic Experience and Critical Design.* Ph.D. thesis, Royal College of Art.
Seago, A., and Dunne, A., 1999. New methodologies in art and design research: the object as discourse. *Design Issues*. Volume 15, number 2.
2.1.2 Date of collecting the material
August 2003.

2.2 IDENTIFICATION OF THE THESIS
2.2.1 Title
Hertzian Tales. Electronic Products, Aesthetic Experience and Critical Design.
2.2.2 Author
Anthony Dunne.
2.2.3 Year of registration
1992.
2.2.4 Year of completion
1999.
2.2.5 Principal supervisor
Gillian Crampton Smith.
2.2.6 Other supervisor/s
No.
2.2.7 Nature of the thesis
Practice-based Ph.D. thesis.

2.3 DESCRIPTION OF THE THESIS
2.3.1 Abstract
"Whereas architecture and furniture design have successfully operated in the realm of cultural speculation for some time, product design's strong ties to the marketplace have left little room for speculation on the cultural function of electronic products. As more of our everyday social and cultural experiences are mediated by electronic products, designers need to develop ways of exploring how this electronic mediation might enrich peoples' everyday lives.

HERTZIAN TALES sets the scene for relocating the electronic product beyond a culture of relentless innovation for its on sake, based simply on what is technologically possible and semiologically consumable, to a broader context of critical thinking on its aesthetic role in everyday life." (Dunne, 1999).

2.3.2 Structure of the thesis
"HERTZIAN TALES consists of two main parts: six essays exploring design approaches for developing the aesthetic and critical possibilities of electronic products outside a commercial context, and five conceptual design proposals expressed as objects, videos and images – by-products of an investigation into a synthesis between practice and theory, where neither practice nor theory leads." (ibid.).

The book is structured in a preface, seven chapters and a conclusion.
- Preface:
The introduction and a synthetic overview of each chapter;
- Chapter 1. The electronic as post-optimal object:

"The first chapter, THE ELECTRONIC AS POST-OPTIMAL OBJECT, discusses existing design approaches to the development of aesthetic possibilities for electronic objects;"
- Chapter 2. (In)human factors:
"(IN)HUMAN FACTORS discusses a role for different degrees of user-unfriendliness such as estrangement and alienation in the design of electronic objects;"
- Chapter 3. Para-functionality: the aesthetics of use:
"PARA-FUNCTIONALITY investigates the design of function (rather than form) to provide new types of aesthetic experience;"
- Chapter 4. Psychosocial narratives:
"PSYCHOLOGICAL NARRATIVES discusses behaviour as a narrative experience determined by objects, and how the embodiment of unusual psychological needs and desires in electronic objects can encourage the user to experience new narrative situations as a protagonist;"
- Chapter 5. Real-fiction:
"REAL-FICTION discusses systems of presentation and consumption for ideas which, unlikely to be mass-produced or even prototyped, exploit the conceptual status of objects as ideas;"
- Chapter 6. Hertzian space:
"HERTZIAN SPACE explores how artists and designers have made links between the invisible environment of electromagnetic radiation and the material culture of objects, and draws attention to the neglected aesthetic dimensions of electromagnetic fields;"
- Chapter 7. Hertzian Tales and sublime gadgets:
"HERTZIAN TALES AND SUBLIME GADGETS is a commentary on the design work for this project. It consists of five conceptual design proposals for the electronic as a post-optimal object[...];"
- Conclusion:
The main conclusions of the research. (ibid.).

2.3.3 Motivation

"Whereas architecture and furniture design have successfully operated in the realm of cultural speculation for some time, product design's strong ties to the marketplace have left little room for speculation on the cultural function of electronic products. As more of our everyday social and cultural experiences are mediated by electronic products, designers need to develop ways of exploring how this electronic mediation might enrich peoples' everyday lives." (ibid.).

"The origins of HERTZIAN TALES as a project lie in two areas: firstly a frustration with the limited role currently played by industrial designers (compared to those of engineers and marketers) in the development of new electronic products; and secondly a belief that design, too, has much to contribute as a form of social commentary, stimulating discussion and debate amongst designers, industry and the public about the quality of our electronically mediated life." (ibid.).

2.3.4 Aims of the study

"HERTZIAN TALES explores the way critical responses to the ideological nature of design can inform the development of aesthetic possibilities for electronic products. It focuses on the role they play in shaping our experience of inhabiting the 'electrosphere', looking beyond the quality of our relationship with objects themselves to the aesthetics of the social, psychological and cultural experiences they mediate.

The primary purpose of this book is to set the scene for relocating the electronic product beyond a culture of relentless innovation for its own sake, based simply on what is technologically possible and semiologically consumable, to a broader context of critical thinking about its aesthetic role in everyday life.

The project proposes an approach that uses the design of conceptual electronic products as a way of provoking complex and meaningful reflection on the ubiquitous, dematerialising and intelligent artificial environment we inhabit." (ibid.).

"The book aims to map out the curent technologcally-informed environment of ideas about electronic objects and to understand industrial design's potential within it – developing a position that is both critical and optimistic." (ibid.).

2.3.5 Methodology

The methodology used is action research. "Action research is research in which the process of making or designing an artefact constitutes the methodology." (Seago and Dunne, 1999).

"Design is seen as a form of socio-aesthetic research towards the integration of aesthetic experience and everyday life through the development of conceptual products rather than working prototypes or models which attempt to simulate a final product designed for mass production." (ibid.).

"Dunne's methodology comprises a sophisticated synthesis of a detailed review of developments at the fringes of contemporary electronic product design, mediated through the insights of twentieth–century critical theory. Rather than aiming for transparency, as a conventional applied researcher / product designer would do, Dunne's attempt to enhance the critical distance between the electronic object and the human subject through the introduction of "poetic" techniques of aesthetic "estrangement" is reminiscent of the writing of Walter Benjamin, or the methods of avant-garde theorist / performers such as John Cage, rather than those associated with university-based academic Ph.D.'s in applied electronic engineering." (ibid.).

"The key methodological factor which separates Dunne's approach from that of a conventional applied researcher, who typically would be involved in the fabrication of working prototypes, is his idea of using the process of invention as a mode of 'discourse'." (ibid.).

2.3.6 Results

Since the research is articulated in six essays exploring electronic products outside a commercial context, and five conceptual design proposals, the results of each essay and of the five conceptual proposals are as following:

Essay 1. The electronic as post-optimal object

"Most designers of electronic objects have responded to this challenge by accepting a role as a semiotician, a companion of packaging designers and marketers, creating semiotic skins for incomprehensible technologies.

From Banham writing about portable radios in the 1970s, through the plethora of essays on 'product semantics' in the 1980s, to Norman Bolz's 1994 essay THE MEANING OF SURFACE, the treatment of electronic object as a package for technology, designed to communicate use, cultural meaning, and corporate identity through its surface, has been thoroughly explored. The electronic object accordingly occupies a strange place in the world of material culture, closer to washing powder and cough mixture than furniture and architecture, and is subject to the same linguistic discipline as all package design, that of the sign. It is lost somewhere between image and object and its cultural identity is defined in relation to technological functionalism and semiotics. This chapters considers three perspectives on the electronic object: THE ELECTRONIC AS LOST OBJECT briefly discusses theoretical perspectives, THE ELECTRONIC AS OBJECT focuses on design approaches and THE ELECTRONIC AS POST-OPTIMAL OBJECT introduces the idea of the 'post-optimal' object." (Dunne, 1999).

Essay 2. (In)human factors
"By poeticising the distance between people and electronic objects, sensitive scepticism might be encouraged, rather than unthinking assimilation of the values and conceptual models embedded in electronic objects. I am not arguing for a way of designing that is free from ideological content but, rather, one that draws attention to the fact that design is *always* ideological. User-friendliness helps conceal this fact. The values and ideas about life embodied in design objects are not natural, objective or fixed, but man-made, artificial and mutable.

This chapter looks at 'poeticising' the distance between people and electronic objects through 'estrangement' and 'alienation', locating interactivity between transparency and opaqueness, the pet and the alien, prose and poetry. The first section looks at the origins of user-friendliness in Human Factors and how it manifests itself in design approaches; the second TRANSPARENCY, discusses the implications of closing the distance between people and machines; and the third, (IN)HUMAN FACTORS, looks at alternatives based on estrangement." (ibid.).

Essay 3. Para-functionality: the aesthetics of use
"This chapter reviews projects from art, architecture, and design which exemplify the functional estrangement I call 'para-functionality'. The term means here a form of design where function is used to encourage reflection on how electronic products condition our behaviour. The prefix 'para-' suggests that such design is within the realms of utility but attempts to go beyond conventional definitions of functionalism to include the poetic." (ibid.).

Essay 4. Psychosocial narratives
"This chapter looks at the following ideas: the user as a protagonist and co-producer of narrative experience rather than a passive consumer of a product's meaning; how the psychological dimensions of experiences offered through electronic products can be expanded to include darker conceptual models of need – usually limited to cinema and literature – by referring to the world of product misuse and abuse; the lack of work by authors and film-makers exploring this area, despite its prevalence in everyday life; the idea that the designer, in their role as a provider of new behavioural opportunities, becomes an 'author' working in a medium that can present experiences rather than represent them; and how the electronic product becomes a 'role model' bringing about transformations of perception (and conception) in the user as a protagonist by embodying unusual psychological needs and desires in 'pathological' electronic objects." (ibid.).

Essay 5. Real-fiction
"REAL-FICTION focuses on the problem of 'crossing over', and discusses how conceptual design intentions and formats of work, differ from those of commercial design, and require different contexts in which the design thinking can be encountered by the public. It is concerned with representation and contexts of representation for ideas about everyday life in the form of conceptual design objects." (ibid.).

Essay 6. Hertzian space
"It might seem strange to write about radio, a long-established medium, when discussing today centres on cyberspace, virtual reality, networks, smart materials and other electronic technologies. But radio, meaning part of the electromagnetic spectrum, (fig. 6.1) is fundamental to electronics. Objects 'dematerialise' not only into software in response to miniaturisation and replacement by services, but literally dematerialise into radiation. All electronic products are hybrids of radiation and matter. This chapter does not discuss making the invisible visible, or visualising radio, but explores the links between the material and immaterial that lead to new aesthetic possibilities for life in an electromagnetic environment." (ibid.).
"In design, immateriality is often referred to through visual motifs (fig. 6.2), usually in relation to product semantics and representation, but is rarely dealt with directly as a physical phenomenon." (ibid.).

Hertzian tales and sublime gadgets
"This section is a commentary on five conceptual design proposals for post-optimal electronic objects: ELECTROCLIMATES, WHEN OBJECTS DREAM..., THIEF OF AFFECTIONS, TUNEABLE CITIES, and FARADAY CHAIR.
Each proposal is a material tale, a process of investigation. They are 'value-fictions': they try to maintain a degree of technological realism while exploring values different from those current. Their subject is the role of electronic objects in the aesthetic inhabitation of a rapidly dematerialising, ubiquitous and intelligent environment. They explore ways of presenting conceptual designs as investigations and processes rather than as finite things in themselves. Each proposal is a radio, an interface between the electromagnetic environment of hertzian space and people. Each Explores different forms of realism: technical, functional, social and psychological.

The proposals are not intended for mass-production or even prototyping, but for mass-consumption through publication and exhibition. They ask questions rather than provide answers and should stimulate discussion in the way a film or novel might. Each focuses on different design issues. THIEF OF AFFECTIONS explores designing role models and psychological narratives. From ELECTROCLIMATES emerges ideas for genotypes, pseudo-interviews, and poetic products. WHEN OBJECTS DREAM... offers alternative conceptions of the smart object as dreamy object, and new tools like the gaussmeter for mapping hertzian space. TUNEABLE CITIES explores overlapping electromagnetic and urban spaces using a car and scanner to experience a city. Architectural models emphasise radio as environment rather than medium, and video stresses the design of experience rather than that of objects. FARADAY CHAIR investigates a conceptual approach to the aesthetics of hertzian space and the object." (ibid.).

2.3.7 Contribution

"This project set out to develop a design approach for producing conceptual electronic products that encourage complex and meaningful reflection on inhabitation of a ubiquitous, dematerialising and intelligent environment: a form of social research to integrate critical aesthetic experience with everyday life.
Whereas architecture and fine art often refer to popular culture, industrial design *is* popular culture. Its language is accessible and appeals to the senses and imagination rather than the intellect. I hope in my approach I have retained the popular appeal of industrial design while using it to seduce the viewer into the world of ideas rather than objects. Industrial design locates its objects in a mental space concerned with identity, desire and fantasy, and shaped by media such as advertising and television. Again, I hope this remains intact, but is subverted to challenge the aesthetic values of both consumers and designers.

One result of this research is a toolbox of concepts and ideas for developing and communicating design proposals that explore fundamental issues about how we live amongst electronic objects. The most important elements of this approach are: going beyond optimisation to explore critical and aesthetic roles for electronic products; using estrangement to open the space between people and electronic products to discussion and criticism; designing alternative functions to draw attention to legal, cultural and social rules; exploiting the unique narrative possibilities offered by electronic products; raising awareness of the electromagnetic qualities of our environment; and developing forms of engagement that avoid being didactic and utopian. The emphasis on behaviour as narrative experience stimulated by the design of new functions links these proposals more to the complicated pleasure of literature and film than sculpture – the traditional reference for industrial design.

But perhaps the most important conclusion is that design is existential and cannot ignore its complicated relationship to people and their mental lives. This project offers one possible approach to allow some of the more complicated and difficult aspects of our relationship to electronic objects to be reflected in future designs." (ibid.).

APPENDIX B.8
CASE 08_GREAT BRITAIN _THE ROYAL COLLEGE OF ART

3. INTERVIEW REPORT

3.1 CIRCUMSTANCES
3.1.1 Kind of interview
By telephone.
3.1.2 Date
14 May 2003.
3.1.3 Time
15.00 Italy time.

3.2 ADVISOR'S PROFILE
3.2.1 Name and Surname
Irene McAra-McWilliam.
3.2.2 Title
Professor.
3.2.3 Education
Master of Art degree from the University of Aberdeen.
3.2.4 Research interests
Strategic design;
Ubiquitous computing.
3.2.5 Number of supervised Ph.D. students
One Ph.D. student.
Two M.Phil. students.

3.3 INTERVIEW
3.3.1 I divided the interview into three parts. The first one is a series of questions about your academic activity and background education, the second one is about people involved in the programme, and the third one is about the curriculum, so my first question is, about your background education?
I have a Master of Art degree from the University of Aberdeen in Scotland in Psychology.

3.3.2 What are your research interests?
Basically, I have covered a number of different areas, but one is what I call strategic design, just design for innovation, design for technology research, advanced technologies, especially in the area of ubiquitous computing and any forms of envisioning the future through design. And all of it, as you can understand about my background, from a psychological people-centred point of view. So at the moment for example I'm looking at cultural interfaces, so how we design for different cultures, and not only use advanced technologies for the western point of view.

3.3.3 Did you supervise Ph.D. candidates?
I supervised one Ph.D. and two M.Phil. but I'm in the process of interviewing more, so I expect to take on another two Ph.D.s and one more M.Phil. for the new academic year.

3.3.4 Now I pass to the second part of the interview, it's about people involved in the programme. For example, what's the number of faculty members who can supervise Ph.D. candidates?
Perhaps I should explain something about the Royal College of Art's approach, because we had set up a research methodologies programme which is university wide. We're a small university but though we have a college, we have a director of research which covers all of the research activities in the Royal College of Art, and for the first year for M.Phil.s and for Ph.D.s, they follow a research methods course. So, once a week they meet and follow this course and they

also meet the research students from other parts of the university so they can exchange best practice and so on.

So we have found out a very useful tool in giving input on methodologies from many experts, but also allowing the students to collaborate and work together and form a community within the university. So they don't just have a relationship with myself as a supervisor, but they would have relationships with notably other supervisors in my department and other people in other departments. So I have personally the numbers I gave you but Dr. Bill Gaver, who's also in my department, he also has research students. So when you ask for numbers, the numbers I'm giving you are my personal students and not department numbers. So we would have to e-mail you, if you want kinds of faculty members and so on, that would be just easy if I just e-mail you that.

3.3.5 OK, then we can move to the third part of the interview. When was the Ph.D. programme in interaction design first launched?
I have only been in the department for a year, and given that some people have already graduated, I think it started about five or six years ago at least.

3.3.6 There are two different ways to do a Ph.D. in interaction design, the Ph.D. by thesis and the Ph.D. by project. When was the Ph.D. by project first started?
Well I don't know whether you've been sent any materials. Have you been able to get a Royal College of Art prospectus, because these things are described within it. We could send you this. We also have a research handbook where you can get the whole philosophy and programme about how we do our Ph.D.s and how we structure the whole programme. We have two kinds of Ph.D.s, that's correct. One is by thesis, which is the typical written report, you could say, at the end. And the other is by project, which means as an art and design university we accept that an embodiment of research can be manifested as an installation or a piece of design or a piece of painting. So we consider output in those forms as research output in themselves. So that's why we accept and support Ph.D. by project. There is some writing involved as well, but it's less of course than a larger thesis.

3.3.7 Yes, in fact I read Anthony Dunne's thesis, he did a Ph.D. by project in interaction design.
Yes, it's still a very rigorous process of course, but it's very necessary that within an art and design university that these are valid outputs along the research process, and we have set methodologies for evaluating that. So I don't know in your research if you have found other universities that do the same things.

Yes, for example at the *Politecnico di Milano* similar research processes were started a few years ago at the Ph.D. programme in Industrial Design and Multimedia Communication, and there's an internal debate about the nature of this kind of doctoral research.
I think it's a typical problem that has come out between a more traditional academic approach and an art and design based approach, and in general even in any field of research. I come from business, and in business a designer will embody their work and it is considered design research. So we're also reflecting best practice in business, because to make ideas tangible is also a form of output, of research output. So we look at an embodiment of ideas as a way of expressing abstract notions and especially the area that I described where I work, which we could describe as the designer socio-technical systems, then we can look at the sociology and cultural part, and we can could look at the technologies as they are developing, but the output is a fusion in a sense between the two that we call design, and we recognise that as a valid research output.

3.3.8 In your opinion, what should the Ph.D. programme stimulate in the Ph.D. candidate?
To give focus for the designer possibility, I think that in very general terms, if we tried to describe design, and especially design showing innovation or design research, it's really trying

to encode possibilities, possible lines of development, possible cultural artefacts of the future. It can even embody questions to some outputs, you could describe the questions rather than solutions, but they are embodied so they describe possibilities. And design in its very broadest term, all design for me is the embodiment of possibilities, some of them very real and immediate and some of them more future based. But the fact of embodying, which is the synthetic, the synthesis of data from sociology and technology and design practice in terms of embodying those possibilities, it allows a broader discourse, I feel, which is a strength. Because we all know as soon as we make any design and you make it tangible, you can get feedback, not just academic feedback but we can get feedback, from users or even potentially businesses that may be interested in supporting directions to create such artefacts.

So the very real strength advantage of design is being able to make things communicable, intelligible and comprehensible to a broader group of people. Now within design research perhaps the scales are smaller because the research community is smaller, but still there's a very great interest in design research being linked to academic discourse on the one hand and to business and innovation on the other. So I think in the future that's a very strong bridge to embody future potential directions and to be asking questions, cultural questions about technology. So I have sometimes described it, that if we look at the practice of sociology or psychology or the humanities they tend to describe and interpret the world as it is today, and technology has more potential to try to look a little bit at the future, but design can make sense of those two sides and give a cultural context to technology, and that's the idea that we're developing in terms of interaction design. So we like to challenge assumptions, you could say about the world we will live in, in the future and offer other possibilities in a wider academic discourse.

We also encourage that our research students publish and show their works in conferences, those could be design conferences, social studies conferences, technology conferences, things like that. So I think it's a new and very fast developing area of academic study, the embodiment of ideas.

3.3.9 There is one extreme way for doing Ph.D. research in design, it's when the Ph.D. is very practice-centred, do you think it's a good way for doing a Ph.D. in design?

I think that because we are developing design research by thesis and practice that the methodologies in a sense are part of the research. So I don't think that we can only take existing methodologies to make new kinds of artefacts. I think that we have to design and consider our methodologies as part of the process. An example of that, if you look at the Royal College of Art interaction design web site you will see something described called "cultural probes," which is a methodology that was created in order to get the type of input that we needed for design, that was different from input that we could receive from ethnography for example, or standard practices within the social sciences. So as designers we also create methodologies to express cultural inputs, so yes, they can be practice-based, but I think that we have to challenge our way of working. I think it's very much a part of the research process to consider the methodologies as being part of the experiment, and perhaps even a focus for the research, to develop new methodologies, to integrate new kinds of inputs, because we cannot divorce artefacts from the cultural context in my view.

3.3.10 Do the Ph.D. candidates take other courses, other than the research methods course?

Yes, they have access like all students in the Royal College of Art, to the humanities lectures, which cover a very broad spectrum, and the fact that we are a small university, they can talk to tutors in other courses because especially in my area, the interaction design, some people are building new kinds of intelligent products for the future, some might be working in the area of , for example, wearable computing, in which case it's very useful to them to also have access to knowledge in fashion and textiles. So I see design especially in some areas like interaction design or strategic design, which you also have in Milan, really needing a broad base of

expertise within a university which can't be covered by one or two supervisors. So I tend to point my students to people that can give them a broader foundation in areas which are their focus. And this is what I think universities in the future need to facilitate inside their own university and with other cultural partners.

3.3.11 Are there research phases?
It's a research project with specific timings and exams, and the way that we normally do it at the Royal College of Art is: students apply for a Ph.D., but normally we ask them to first do an M.Phil., and having done the M.Phil. and passed their interim exams, they can then transfer to Ph.D. Only if the applicant has had a very wide experience and clearly has in a sense already exceeded expectation of M.Phil. would he be accepted directly for a Ph.D.

3.3.12 what's the most particular aspect of your Ph.D. programme?
In terms of a Ph.D. programme, the thing that is very interesting to me is that I have three levels of graduates who are in my department. One group is doing the Masters course, which is a full time course of two years, one level up from that is M.Phil. and one level up from that is Ph.D., and then of course we have a research studio with projects running, and which are funded by the British government or the European Commission or whatever. And what I think the benefit of the Ph.D. and the M.Phil. is a line of development into a longer, deeper level of thinking about this discipline which is emerging with all its complexity that we've talked about, to really set an example of world class design research in the terms we've talked about, by thesis or by project, because then we can fit it into our own research strategy of high examples of what we mean when we're doing research, and of course all the people involved in research have access to the Masters course, all the visiting lectures and projects.

We have a good crossover between our Masters course and also people who are doing research in various ways, and all of it is furthering the development of the discipline. So interaction design as created at the Royal College of Art is perceived to be leading in terms of the definition of the discipline, and the Ph.D.s must be at the front end of that. They are doing the in-depth research along certain lines. We are quite small and we only accept a few, but they have to be very relevant to our research strategy and our own particular cultural focus. So we have a quiet rigorous process of interviews for Ph.D. as a result. We do get a lot of inquiry, but we only select very few to fit in with our research aims.

APPENDIX B.9
CASE 09_GREAT BRITAIN_SHEFFIELD HALLAM UNIVERSITY

1. PROGRAMME REPORT

1.1 TECHNICAL INFORMATION
1.1.1 Source of information
The web site of the Cultural Research Institute:
http://www.shu.ac.uk/schools/cs/cri;
The web site of the Art and Design Research Centre (ADRC):
http://www.shu.ac.uk/schools/cs/cri/adrc/research2/index.html;
The online prospectus on the web site:
http://www2.shu.ac.uk/prospectus/op_pglookup1.cfm?id_num=CUL039;
1.1.2 Date of collecting the material
August 2003.

1.2 IDENTIFICATION OF THE PROGRAMME
1.2.1 Title of the programme
Art and design.
1.2.2 Institution
Sheffield Hallam University.
1.2.3 Faculty and Department
School of Cultural Studies,
Cultural Research Institute,
Art and Design Research Centre (ADRC).
1.2.4 Year started
1993.
1.2.5 Address
Art and Design Research Centre,
Psalter Lane Campus,
Sheffield Hallam University,
Sheffield, S11 8UZ, England.
1.2.6 Tel
+44 (0)114 2252669/2738
1.2.7 Fax
+44 (0)114 2252607
1.2.8 e-mail
m.h.handscombe@shu.ac.uk
2.9 web
http://www.shu.ac.uk/schools/cs/cri/adrc/research2/index.html

1.3 DESCRIPTION OF THE PROGRAMME
1.3.1 General information
1.3.1.1 Entry requirements
The normal minimum entry requirement for an M.Phil. or Ph.D. subject to Confirmation is a British honours degree (first or upper second class or a relevant Master's degree); for a Ph.D. direct, the normal entry requirement is an M.Phil. or Masters in research.

Candidates with other qualifications are considered individually on their merits. In such cases the University will look at relevant academic and work experience, previous experience or training in research methods and any other evidence that the applicant is likely to be successful. The University gives special consideration to applicants with relevant research experience that may compensate for lack of formal qualifications.

1.3.1.2 Period of study
M.Phil.: two years full-time and three years part-time.
Ph.D.: four years full-time and seven years part-time.
Ph.D. direct route: three years full-time and five years part-time (for a candidate already holding an MPhil or Masters qualification in research).

1.3.2 Curriculum
1.3.2.1 Philosophy
The primacy of practice: Design practice is itself a fundamental tool of research and a foundation for much of the applied and academic research that we pursue. The essential skills and implicit knowledge of design – observational drawing, model making, understanding materials and processes – is vital, not only to the courses we provide, but to our research culture.

Redefining practice: The nature of professional practice in design and the role of the practice as a research tool are both being redefined rapidly. Our responsibility is to reflect on the nature and direction of change, to inform our own educational and research practice with this reflection, and to contribute to national and international debates over the future role of the designer.

Driving regional regeneration: Sheffield School of Design dates back 160 years, originally providing the design skills and expertise needed by the city's metal trades. Our commitment to our region remains as strong today, seeking to use design as a driving force for regional regeneration and industrial competitiveness. This has led us to establish the Advanced Product Development Centre and the Packaging Partnership, meeting the needs of business in South Yorkshire.

1.3.2.2 Intention
Candidates are required to critically investigate and evaluate an approved topic, to demonstrate an understanding of research methods appropriate to their chosen field, to make an independent and original contribution to knowledge and to present and defend a thesis by oral examination.

1.3.2.3 Content
Research training: all students are required to complete research training modules unless already studied as part of a masters degree. [...]. Training is followed by theoretical and textual research, analysis and writing, working closely with the supervisors. Students are expected to present seminar papers on their work and to submit written papers for comment. Students will also be expected to attend relevant seminars from the research seminar series.

1.3.2.4 Sequence of study
Research only programme.

1.3.3 Research
1.3.3.1 Areas of research
Creative practice: fine art, metalwork and jewellery;
New product development: domestic, medical, packaging, transport, and materials;
Design management research: computer–aided design (CAD), design and marketing;
Educational research: CAD, design education, and craft education;
Critical theory and practice – public art, cultural policy and management.

1.3.3.2 Groups / Units of research
Disciplinary groupings:
Design research;
Visual culture research;
Fine art research;
Research in design and technology education;

1.3.3.3 Research phases
Research programme approval
All candidates wishing to undertake a programme of research leading to the award of Master of Philosophy (M.Phil.) or Doctor of Philosophy (Ph.D.) must have their programme of research approved. The University's Research Degrees Sub-Committee is responsible for this approval. Candidates must submit a proposal.

This proposal must include:
candidate details - background, qualifications and experience;
programme of research - degree, title, aims and objectives;
support for the programme - supervision, collaboration with other organisations, resources (including funding), related studies. (written confirmation of any essential support from any other organisations must also be provided).

Confirmation of PhD
To gain Confirmation of Ph.D. status, an application from the candidate and supervisory team must be made to the Research Degrees Sub-Committee. The application comprises a Confirmation of Ph.D. registration form (RF2A), together with a Confirmation of Ph.D. Report by the candidate of not more than 6000 words; the report should review progress made, detail the intended further work and the original contribution to knowledge which is likely to emerge.

The examination
The examination process involves the formal assessment of the completed programme of research and related studies, to the required standard for the award of the appropriate degree. The assessment includes the submission of a thesis and its defence by oral examination.

Conferment
Conferment is the formal award of the degree on successful completion of the examination process. The University's Academic Board, on the recommendation of the research degree examiners, certifies that the candidate has fulfilled all the necessary requirements for the award and the candidate receives the certificate, signed by the Vice Chancellor on behalf of Academic Board.

1.3.4 People
1.3.4.1 Number of the faculty members
Design research: 14 research active staff.
Fine art research: 7 research active staff.
1.3.4.2 Number of the Ph.D. candidates
15 Ph.D. candidates.
1.3.4.3 Number of Ph.D. graduates
3 Ph.D. graduates.

APPENDIX B.9
CASE 09_GREAT BRITAIN_SHEFFIELD HALLAM UNIVERSITY

2. THESIS REPORT

2.1 TECHNICAL INFORMATION
2.1.1 Source of information
Whiteley, Graham Paul, 2000. *An Articulated Skeletal Analogy of the Human Upper-Limb*. Ph.D. thesis, Sheffield Hallam University.

2.1.2 Date of collecting the material
August 2003.

2.2 IDENTIFICATION OF THE THESIS

2.2.1 Title

An Articulated Skeletal Analogy of the Human Upper-Limb.

2.2.2 Author

Graham Paul Whiteley.

2.2.3 Year of registration

1996.

2.2.4 Year of completion

2000.

2.2.5 Principal supervisor

Professor Chris Rust.

2.2.6 Other supervisor/s

Professor A.J. Wilson.

2.2.7 Nature of the thesis

Practice-centred Ph.D. thesis.

2.2.3 DESCRIPTION OF THE THESIS

2.3.1 Abstract

"Currently available upper-limb prostheses do not meet the needs or aspirations of the amputee.

Many technical challenges have been given as the limiting factors on the further development of these prostheses. Generally developments have occurred as incremental developments on three existing moderately successful archetypes; the cosmetic, body-powered and myoelectric prostheses.

Continued development on these archetypes appears to be further separating prostheses into those primarily considered cosmetic and those primarily considered functional. However, amputees have a need both for function and cosmesis from their prostheses.
Technology currently being developed for actuation and control in other laboratories indicates that the previous limitations placed on prosthesis design may be challenged. Therefore, it is appropriate to look for new design archetypes.

This thesis describes the development, implementation and evaluation of mechanical analogies of the skeletal components of the human hand and arm which have the potential to inform the design of a new generation of upper-limb prostheses integrating cosmesis and function in a single device.

The research has been undertaken using a form of practice led design research methodology. This iterative methodology uses physical models for both evaluation and also as a means of encouraging end-user involvement in the design process. These evaluations are then used in subsequent cycles of research activity.

The research has concentrated on developing mechanical analogies of the joints of the hand, wrist, forearm and elbow. The joints of the hand are shown to have a simple and similar structure. Therefore, a modular mechanical archetype has been elucidated that results in a hand configuration made from multiple similar modules positioned at different points throughout the hand. However, the wrist and forearm contain more complex joints which have been found to be unique to their anatomical position. The selection of appropriate prototyping techniques has been an integral part of the research.

Problems have arisen in assessing the degree of analogy achieved because the intact joints of the human skeleton are covered by soft tissue that has not been part of the skeletal analogy implemented. Additionally, it is postulated that there are subtleties to human movement which are not reflected in standard anthropometric measures. Therefore, a two stage evaluation has been undertaken that assesses the quality of the analogy realised in the models. This consists of

goniometric measures to quantify basic angular rotations whilst qualitative evaluations by professionals with a good anatomical knowledge have been used to assess the more subtle movements within the joints.
The skeletal mechanical analogy developed through this research has been shown through evaluation to simulate the articulations of the human upper-limb. The model embodies design principles that appear to have short and long term significance to the field of prosthetics. The production of a tangible model has not only aided evaluation but has also stimulated research in other centres into ways of actuating and controlling a future upper-limb prosthesis. Additionally, the mechanical analogy may have applications in the field of tele-presence robotics, aerospace and the entertainment industry." (Whiteley, 2000).

2.3.2 Structure of the thesis
The thesis is divided in eight chapters.
- Chapter 1. Introduction:
Context of the thesis and the state of the art;
- Chapter 2. Methods:
The description, justification and evaluation of the different methods used in the development of the prototypes;

Development of an anatomically analogous skeletal model hand (chapters 3, and 4):
- Chapter 3. Development of anatomically analogous interphalangeal joints;
- Chapter 4. Development of anatomically analogous metacarpophalangeal joints and the assembly of a skeletal model hand; The development of a prototype skeletal model hand and wrist and its evaluation;

Development of an anatomically analogous skeletal model arm (chapters 5,6, and 7)
- Chapter 5. Development of a anatomically analogous forearm joints;
- Chapter 6. Development of an anatomically analogous elbow joint;
- Chapter 7. Development of an anatomically analogous wrist joint and the evaluation of the model arm; The development of the articulated model skeletal arm;

- Chapter 8. Conclusion and suggested future work:
The main conclusions and suggestions for future work.

"Plan of thesis
This research was carried out largely through practical design work and the form of the thesis reflects this. Drawings and artefacts are an integral part of the material presented, and in some cases these provide the clearest means of communicating aspects of the research.

The process used in the preparation of this thesis began with the creation of a systematic archive of models and drawings created during the project. Once assembled this archive was catalogued. The work is described by a series of images extracted from this archive accompanied by narrative text.

The work described in this thesis falls naturally into two parts: the development of a model hand and its evaluation; and the development of a model arm and its evaluation. For convenience and to aid understanding the work in each section has been divided into chapters, each of which addresses a particular joint or joint area.

The chapters are arranged as far as possible in the order in which the work was carried out. However, the research was essentially iterative and where developments were carried out in parallel this is indicated in the text." (Whiteley, 2000).

2.3.3 Motivation

"The stimulus for this work has come from the needs of amputees who currently must chose between prostheses that either appear outwardly like the original limb and posses limited or no function and devices mechanistic in appearance that provide some useful functionality. The prostheses provided to amputees have not significantly changed since the clinical introduction of the myoelectric prosthesis in the 1970's (Kostuik 1980).

Research efforts have largely focussed on refining these historical prosthetic designs (Banerjee 1982, Parker and Scott 1988). Additionally, incremental developments from these archetypes appears to have resulted in further division of function and cosmesis.

Amputees require both functionality and cosmesis from their prostheses (Fraser 1998). It is only the limitations of currently available prosthetic technology that necessitate amputees to prioritise between cosmesis and function (Tura 1998, Herder 1998, Fraser 1998)." (ibid.).

2.3.4 Aims of the study

"There is need in both the fields of prosthetics and robotics for a hand which combines both form and function. This thesis examines the development of a skeletal analogy of the human upper limb which must form the basis of any device possessing both the form and functionality of the limb." (ibid.).

"The starting point for the work in this thesis was the proposition that design principles appropriate to a future generation of prostheses combining both cosmesis and functionality in a single device would only result from the close analogy to the human upper-limb. A crucial first step in this process is the development of a close analogy of the articulations of the skeletal limb, which not only could form the basis of a prosthesis, but might also be used to test appropriate actuation and control strategies. Therefore, the aim of this research was to elucidate design principles to construct such an analogy." (ibid.).

2.3.5 Methodology

"Need for a another research approach.
In seeking an appropriate form for such a mechanical platform, conventional engineering design methods, used in previous prosthetic research, may be inappropriate. These methods are used as many of the tasks given to engineering designers are subdivisions of a larger whole (Pitt 1973). Therefore, using 3D structural analysis and other analytical techniques a component can be designed to meet a given specification (Papalambros and Wilde 1991). [...]. Thus, methods focussing on optimisation have failed to combine cosmesis and function and a methodology is required that can elicit appropriate new design principles." (ibid.).

"Creative reasoning.
The research method chosen is a form of practice led design research as described by Archer (1995). This places emphasis on creative activity during analysis stages in order to *'shed light on the problem'* (Archer 1995). Within this research project the term 'creative reasoning' has been adopted to describe the stage within the research process when new analogous ideas are generated. The techniques used focus on the close scrutiny of the anatomical hand through 'observational drawing' and 'sketchbook idea development'.

This process has been referred to as 'observational drawing' within this research project. A stage of observational drawing from three-dimensional skeletal anatomical models has been included as a primary research activity to inform subsequent detailed design work. The drawing techniques used in the main body of the work record shape through delineation, form by hatching techniques and dimensional annotations are added to record scale information. However, observational drawing is not exclusively used in the creative reasoning process. It is combined with reviews of anatomical literature to inform the process of functions of the limb which are not apparent from the study of static three-dimensional limbs.

Observational drawing and sketchbook idea development are combined with literature review to form the inputs to the process of creative reasoning used to develop skeletal joints analogous to those of the human limb." (ibid.).

"Analogy.
In language, analogies are used to express likenesses or parallels to clarify or simplify thoughts or concepts. In design and engineering analogy is used as a primary tool to find solutions to problems that may have been previously addressed in other fields or in the natural world (Papanak 1972). Analogy as a means of stimulating new ideas has been described as the most powerful concept (Pugh 1990), and the 'staple diet for the would be inventor' (Thring and Laithwaite 1977).

However, design principles based on a skeletal analogy of the human limb appear extremely appropriate, as the resulting design ideas will be embodied at a similar scale to those observed. This is important as the inherent mechanical properties of the observed forms will be appropriate to those of an upper-limb prosthesis using the appropriate choice of materials." (ibid.).

"Need for Physical Models and their role in Evaluation.
Therefore, the production of physical models permits the design concepts to be tested against reality. In the case of a model developed to be a close skeletal analogy of the human arm; this can be demonstrated in the use of conventional goniometric techniques used to assess the range of movement of the proposed joint designs (Norkin and Joyce-White 1995).

The complexity of the human limb suggested that an iterative method based on the production of physical models and prototypes and their subsequent evaluation would lead to an increasingly refined analogy." (ibid.).

"In the original implementation of the research method, the first stage, the analytical stage, combined observational drawing with sketchbook idea development and literature review. During the development of the distal and proximal radio-ulna joints it was found that the observational drawing and sketchbook idea development in the analytical stage was insufficient. It was found too difficult to visualise the potential effects of different mechanical configurations which mimicked the complex coupled movements of the linked distal and proximal joints. Therefore, during the development of the forearm joints it was necessary to add mathematical analysis to the analytical stage to aid the investigation of potential mechanical configurations." (ibid.).

2.3.6 Results
First, the development of an anatomically analogous skeletal model hand: the development of anatomically analogous interphalangeal joints, the development of anatomically analogous metacarpophalangeal joints and the assembly of a skeletal model hand.
Then, the development of an anatomically analogous skeletal model arm: the development of a anatomically analogous forearm joints, the development of an anatomically analogous elbow joint, the development of an anatomically analogous wrist joint and the evaluation of the model arm.

"Both the qualitative and quantitative evaluations performed on the models indicate that the model joints have achieved a close level of analogy with the articulations of the human limb. Additionally, review of the model by end-users, indicates both short and long term applications for the design principles embodied in the model." (ibid.).

2.3.7 Contribution
"Creating Enthusiasm for a New Generation of Prostheses
Previously, the majority of prosthetic research has focussed on developing iterations on established archetypes (Banerjee 1989). However, the development of the skeletal model, embodying features that may support a practical prosthetic implementation appears to have reawakened interest in this research field. In particular, interest has been shown from researchers working on novel actuators. Currently, a model arm has been delivered to a laboratory in Pisa. These researchers are initiating experiments that apply novel actuation methods to actuate pronation / supination movements of the model forearm (Chiarelli 2000). […]. Additionally, a replica model arm has been requested to provide a 'demonstrator' for this new actuation technology being developed in Pasadena (Bar-Cohen 2000).

Potential Short Term Implementation of Design Principles
The review of the model by both a key figure in prosthetics research and a prosthetics manufacturer have highlighted the significance of the modularity of the joints of the hand to aid the short term implementation of design ideas into prostheses. Delivery of replicas of the finger joints have been promised to one key prosthetics researcher to support his work on combining both static and dynamic cosmesis in prosthetic terminal devices (Gow 2000).

Summary
Evaluations indicate that the model limb represents a close analogy of the articulations of the human upper-limb and it embodies design principles that appear to have both short term and long term significance to the field of prosthetics.
The production of tangible models has aided the evaluation of the model and is also supporting further research into other aspects of the limb in other laboratories.
Dissemination of the model to robotics laboratories may indicate wider uses of a close skeletal analogy of the human upper-limb." (ibid.).

APPENDIX B.9
CASE 09_GREAT BRITAIN_SHEFFIELD HALLAM UNIVERSITY

3. INTERVIEW REPORT

3.1 CIRCUMSTANCES
3.1.1 Kind of interview
By telephone.
3.1.2 Date
22 October 2002.
3.1.3 Time
11:00 Italy time.

3.2 ADVISOR'S PROFILE
3.2.1 Name and Surname
Chris Rust.
3.2.2 Title
Professor.
3.2.3 Education
Industrial design (transport).
3.2.4 Research interests
Design for disability and healthcare.
Tacit knowledge.
3.2.5 Number of supervised Ph.D. students
Two Ph.D. students.

3.3 INTERVIEW

3.3.1 I'm very interested on knowing more about the practice-based Ph.D. that you supervised. I would like to know what are the problems that you faced while supervising this kind of Ph.D.?

Perhaps the first problem is we had never done it before. So we actually did not know how to do it. We had to invent quite a lot of the procedures ourselves. Have you seen the paper that I did on the thesis, the one from the European Academy of Design conference.

Yes, I did.

It gives you an idea of the fact that the supervisors felt that they were having a kind of invent how the Ph.D. was to be done as well as the student. The reason we were able to do it was because we had an exceptional student, a very talented student. He had some very great strengths particularly in both his spirit of inquiry and his practical creative inventive skills were of very high order and he also worked astonishingly hard. He was so committed, he worked for four years and he never stop working for all that time which is obviously quite exceptional. So that was the first thing that made it possible to do it.

The other thing that made it possible to do it is that we were trying to gather an understanding of Ph.D. from science, which my colleague was coming with, and see how to translate that into a different environment. The important thing there was that the science supervisor had a very opened mind and he was very interested in the idea of using creative processes, the idea of research to practice. So I suppose from that point of view it was important that we had those advantages at the start, because there were times when we really did not know what we were doing. If there been any mistrust or lack of effort than we would to be out to make progress.

So that's the general problem. What is so great because the student defined his research, he came with an interesting problem in the first place about people's needs, people who had prosthesis and the needs they had. It didn't take very long first to recognise that the realism of the motion of the prosthesis was the interesting problem that nobody has answered, so that what seems now that was quiet straight forward to determine. The method by which he addressed that, the main method, the two things he did was a very energetic literature review and talking to people, doing contacts with specialists and using his normal investigative inventive process of design. So again we had the tools we needed to the main work.

The difficult part I think was when we came to evaluation of the, some things were easy to evaluate, they were measurable effectively and it was possible to create very normal scientific measuring methods to work out. But some of the positive aspects were more difficult to understand how we would do a good evaluation and maybe we didn't do as well as we should have done. What was interesting was that it opened up some new ideas for us which we're still working with. Particularly the question of how you can employ the tacit knowledge of experts. So that is all I can say about the problems.

3.3.2 Do you see any disadvantage of doing this kind of Ph.D.?

I don't see any disadvantage because it does two things, it enables someone with a design background to exploit their strengths so they're able to do something that is intellectually demanding which makes the contribution to knowledge and helps them to become experts without having to change their discipline. I think quite a lot of people in design end up becoming social scientists or pedagogists in order to get a Ph.D. So we can find a way that obviously you do after engage with other fields of knowledge, after you engage with the methods of science, of social science and so on, but it's not necessary for you to become a different person if you take the practice-based approach.

There's a lot of concern about the term of practice-based, it's partly linguistic argument in English which is kind of boring but these days I tend to think not so much about calling it practice-based but I call it investigative practice. That means you investigate through design

practice and some people in their Ph.D. might do a lot of that and some people might do a small amount of that. It doesn't really matter. But the fact that it's possible to carry out investigation to creative work and I think it's very interesting and progressive idea. The other reason why I think it's a very positive thing to do is that it enables us to take a different look, a different kind of look at the existing problems. It enables the designer to go into a problem area outside design and make a distinctive contribution. So people working, let's say, from the science perspective or a medical perspective, they get a benefit from somebody with a different way of looking at the problem coming in. So, I don't feel any negatives, it creates a different kind of knowledge, it makes a different contribution to multidisciplinary work and it allowed the designers to develop as designers and not to become somebody different.

3.3.3 I read about the problems faced while structuring and writing the thesis.
Yes, in the end the thesis was not unconventional. It was constructed in a different way but the end result it was a book with text and pictures and it had chapters and you could read it and it read very much as any thesis might, although there were more pictures and the pictures were perhaps very helpful. So what happened was that the job of writing the thesis was done differently but the thesis was not so different in the end. We had one change in the regulations which was we had to have single line spacing.

So I think that the difficulty is not in fact in the form or the format but the difficulty is in whether the student is able to write, to communicate clearly and whether he's able to understand what the reader is expecting to find in the thesis.
I think at the moment this is a quite difficult task for someone from the visual creative background to take on, compared to somebody who maybe comes from the humanities, who is used to writing a lot more. So that that was obviously something we had to work very hard on making sure that our student didn't have a disadvantage there. I don't feel it was a serious problem, not a problem that made it exceptionally difficult. Every Ph.D. student has a problem in some aspect of their work.

3.3.4 In this particular Ph.D. research, the candidate did many social science research but he didn't report the investigations in the thesis.
I will make two points about that. The first one is that in this particular case, I don't think that the social science work done was particularly strong. It was difficult for him and for us, because we were scientists and designers not social scientists, to follow a clear strategy for that early enough, it was not the centre part of the work. We're working on that, we're doing much more work with our design students on ethnographic methods. But the other issue is that nobody has ever criticised this particular Ph.D. project and I think that's the most important thing. People criticise ideas about research, they can criticise theory that we might do something. What's interesting is what happens when they looked at the actual example, and when you get the actual example then clearly if there is rigour there, if it's an appropriate investigation people say well in this case that would be fine. You may be familiar for instance with Ken Friedman from Norway. He's one of the people that has been very critical of some of the practices in practice-based research but he's always been one hundred percent happy with this particular project. So it's quite clear that often the problem lies in the theory rather than the practice, the theory of a Ph.D. rather than the practice of a Ph.D. When you actually have a chance to see what people were really doing, in most cases it's very sensible. So, I will say we do not have enough examples yet and we have too many people who have not seen good examples because they aren't there and perhaps people in different locations who are not close to people doing this work they have fears and worries but those fears are only because they are not seeing the work, they're only seeing a worrying theory if you like.

So what you're saying is that people should see the project from a closer point to understand the kind of work done.
The other point about it, you mentioned the social science aspects, although we did a lot of work with the audiences, it wasn't very rigorous in the way it was done. What was more important is

that we worked with the clinical scientists and they over sighted their view on the scientific and technical rigour from a physics point of view. So in every project you have to decide what are the important issues. We're doing a different project now also in medicine but is much more concerned with psychology. It has to do in the way we still make mistakes using certain equipments and often very serious accidents, for instance for somebody who's been giving the wrong anaesthetic. So our investigation is into the equipment that is used in anaesthetics and the psychological factors which we can use to ensure that people work correctly. The interesting thing there is although it's again a medical environment we're not interested in the physical sciences, we're interested in psychology, so we have to start to work in a way that is rigorous from the perspective of the psychologists. What designers always do is to encounter new areas of knowledge, new specialism and they try to align themselves with the ideas of the area they're working in, and then actually sometimes almost forget those ideas because they're going in a different area.

APPENDIX B.10
CASE 10_ITALY_POLITECNICO DI MILANO

1. PROGRAMME REPORT

1.1 TECHNICAL INFORMATION
1.1.1 Source of information
The web site http://pcsiwa12.rett.polimi.it/~phddi
1.1.2 Date of collecting the material
August 2003.

1.2 IDENTIFICATION OF THE PROGRAMME
1.2.1 Title of the programme
Industrial Design and Multimedia Communication.
1.2.2 Institution
Politecnico di Milano.
1.2.3 Faculty and Department
III Faculty of Architecture,
INDACO (Industrial Design, Art, Communication and Fashion) Department.
1.2.4 Year started
1990.
1.2.5 Address
Ph.D. programme in Industrial Design and Multimedia Communication,
INDACO Department,
via Durando 38/A,
20158 Milano (Campus Bovisa), Italy.
1.2.6 Tel
+39 02 23995984.
1.2.7 Fax
+39 02 23995984.
1.2.8 e-mail
phddi@mail.polimi.it
1.2.9 web
http://pcsiwa12.rett.polimi.it/~phddi

1.3 DESCRIPTION OF THE PROGRAMME
1.3.1 General information
1.3.1.1 Entry requirements
The candidate should hold a Bachelor's degree and should pass the admission test.
The admission test to the programme is both written and oral. Aim of the written test is an explicit demonstration of the candidate potentials in research planning and managing within the wider disciplinary domains of industrial design and multimedia communication. The oral test focuses on the written examination contents as well as on the candidate curriculum.

1.3.1.2 Period of study
The average time for the degree is three years.

1.3.2 Curriculum
1.3.2.1 Philosophy
In the continuity with the activity assumed in the last decade, the complex of the issues investing the theme of innovation will represent the conceptual trajectory of the whole programme.

The attention to innovation-related phenomena are due to various factors, partly internal to the dynamics of the discipline of industrial design, partly motivated by the perception of the growing complexity of the innovative process, thus fostering in-depth analysis and new approaches which can legitimately be faced within the doctoral programme. Whatever the motivations for the analysis of technological change and innovation, this trajectory of enquiry highlights the factors and fundamental ingredients of the process of development, transition and transformation of industrial products, services and systems.

As a starting point a broad view of innovation is assumed, being a dynamic process involving the development or improvement of new products, services, technologies, processes, institutions, systems, strategies. Such an extended view of innovation includes the range of economic and social activities - in areas such as communications, corporate strategies, market dynamics, education, public institutions - so relevant for design action as product design in its strict sense.

1.3.2.2 Intention

The doctorate programme final objective is the training of a high profile researcher, whose aim is to develop research either in academic or industrial contexts. Relevant steps connected with such a training are the refinement of analysis techniques, the development of critical abilities, the organisation of an original contribution to knowledge in technological and industrial culture, the proposal of innovative approaches and visions for the theory and practice of industrial design and multimedia communication, the building of increasing skills in research planning, research strategy building and research management.

1.3.2.3 Content

The Politecnico di Milano doctorates are a three-year programme of study, articulated in 180 credits including visiting periods in foreign countries and stages within public or private institutions.

The programme and the credits are articulated in the following trajectories:
Introductory courses:
Courses supplying introductory knowledge about the scientific themes and theories to be faced during the doctorate;
Main courses:
Courses that develops the basic themes (problems, theories and methods) of research within the disciplinary scientific sectors of reference of the doctorate program. At least 40 credits are assigned to this training areas;
Elective courses:
Training activities and in-depth analysis of a limited number of specific themes. Development of the doctoral thesis.

1.3.2.4 Sequence of study

First year: three introductory courses; two main courses; one elective course; presentation of the dissertation theme and thesis proposal;
Second year: one introductory course; Four main courses; Three elective courses; first and second advancement of the state of research;
Third year: one main course; three elective courses; third advancement of the state of the research and conclusion of the dissertation.

1.3.3 Research

1.3.3.1 Areas of research

Industrial design;
Multimedia communication.

1.3.3.2 Groups / Units of research:
Design dei beni culturali;
Designing design processes;
Design per la comunicazione;
Design e innovazione per la sostenibilità;
Ergonomia & Design;
Interni;
Mobility design;
Moda e Tessile;
Percezione visiva e rappresentazione;
Pianificazione e progettazione sostenibile;
Progetto & Prodotto;
Storia e semiotica per il design;
Teorie e culture della ricerca.

1.3.3.3 Research phases:
Research group: at the beginning of the doctorate each candidate is asked to join one or more groups of research in the purpose to get closer to the ongoing or new departmental research.

advisor: each candidate is also asked at the beginning of the first year to choose a advisor, expected to share similar research interests. As further supervisors, a co-advisor and a reader are nominated.

Area of research: the selection of the area of research anticipates the selection of the dissertation topic, so to reach progressively the core of the research. This selection is done during the first semester of the first year.

Dissertation Proposal: at the end of the first semester of the research activity, the dissertation topic is presented to the board of professors. Developed under the advisor supervision, the proposal will outline the foundations of the research as well as a preliminary introduction to the research basic hypothesis. The original proposal may undergo some changes due to the discovery of new opportunities of development or new significant trajectories.

Research Plan: at the end of the second semester of the first year, a research plan should be presented by the candidates. The plan will point out not only to the nature of the research to be developed, its originality and validity but also to the objectives, method(s) and expected results.

Oral Presentations of Intermediate Advancements: the advancements of the different phases of the dissertation are scheduled every semester by the board of Professors.

Dissertation: the objective of the doctoral thesis, obtained through the research activity, is an original contribution to the knowledge of industrial design or multimedia communication. A written dissertation may be integrated or partially substituted by other forms of elaboration of research results, if coherent: if an artefact is part of the research outcome, it will have to be presented with suitable documentation.

1.3.4 People
1.3.4.1 Number of the faculty members
21 faculty members.
1.3.4.2 Number of the Ph.D. candidates:
29 Ph.D. candidates.
1.3.4.3 Number of Ph.D. graduates:
43 Ph.D. graduates.

APPENDIX B.10
CASE 10_ITALY_POLITECNICO DI MILANO

2. THESIS REPORT

2.1 TECHNICAL INFORMATION
2.1.1 Source of information
Meroni, Anna, 2000. *Il Cibo Disegnato. Un Nuovo Ambito Disciplinare per il Disegno Industriale.* Ph.D. thesis, Politecnico di Milano.
2.1.2 Date of collecting the material
August 2003.

2.2 IDENTIFICATION OF THE THESIS
2.2.1 Title
Il Cibo Disegnato. Un Nuovo Ambito Disciplinare per il Disegno Industriale.
2.2.2 Author
Anna Meroni.
2.2.3 Year of registration
November 1997.
2.2.4 Year of completion
October 2000.
2.2.5 Principal supervisor/s
Prof. Giorgio Longoni.
2.2.6 Other supervisor/s
Prof. Giovanni Anceschi.
2.2.7 Nature of the thesis
Practice-based Ph.D. thesis.

2.3 DESCRIPTION OF THE THESIS
2.3.1 Abstract
No available abstract.

2.3.2 Structure of the thesis
The thesis is divided in an introduction and three parts.
- Introduction. *Ricerca attraverso il progetto:*
Why alimentary products; hypothesis and objectives; method of research; and basic assumptions;
- First part. *Un modello di lettura per i prodotti alimentari industriali:*
The review of literature;
- Second part. *Strumenti concettuali ed operativi per la progettazione dei prodotti alimentari industriali:*
Analysis, synthesis and development of two projects, the "Menumobile" and the "Fast Mela;"
- Third part. *Il design per I prodotti alimentari: contribuire alla definizione d'identità:*
Results and conclusions.

2.3.3 Motivation
"Il dibattito sull'opportunità di una progettazione degli alimenti ad opera del designer, si riaccende periodicamente attraverso pubblicazioni ed eventi[9]: una recente mostra a Glasgow[10] ha fatto il punto su una serie di ricerche ed attività proprio in questa direzione. Alla base l'ipotesi che il cibo, come tutti gli altri beni progettati, sia più di uno strumento che risponde a semplici bisogni fisici, e precisamente un valore che deve soddisfare pienamente tutti i nostri sensi." (Meroni, 2000).
"Queste affermazioni danno fondamento ad un'ipotesi di ricerca, che però rimane interamente da verificare. Infatti, l'ipotesi di riuscire a delineare un territorio di progettazione e competenza del disegno industriale nell'ambito dei prodotti alimentari, non può tacere un

confronto ed un ricordo di precedenti, e ben note, sperimentazioni progettuali del tutto fallimentari." (ibid.).

2.3.4 Aims of the study

"Se un intervento di design è possibile, è qualcosa di diverso da quello appena descritto, probabilmente più sistemico, più vicino all'esplorazione di possibilità comunicative ed interattive che alla composizione formale. L'obiettivo della ricerca si è, quindi, supposto principalmente come un contributo di carattere disciplinare al disegno industriale, che proponesse strumenti e metodi originali, per agire all'interno del sistema dei beni alimentari di largo consumo." (ibid.).

"Questa ricerca è scaturita dalla volontà di capire se il disegno industriale potesse in parte intervenire a colmare una lacuna di progettualità e dalla volontà di scoprire nuove connessioni di senso tra prodotti e comportamenti, e sviluppare interferenze che introducono sistemi di analisi e generazione di idee, propri e caratteristici della disciplina del disegno industriale." (ibid.).

2.3.5 Methodology

"Un approccio di tipo interpretativo è sembrato subito il più indicato ad affrontare una situazione di grossa incertezza, in cui è apparso più utile individuare delle possibilità di intervento attraverso l'osservazione critica della complessa rete di interazioni, piuttosto che definire a priori una precisa linea di azione." (ibid.).

"L'avvio della ricerca si è, infatti, caratterizzato per una situazione di chiarezza riguardo lo scopo del lavoro, ma di elevata incertezza riguardo il percorso conoscitivo da intraprendere per raggiungerlo. Si è scelto dunque di adottare una tecnica euristica per guidare il percorso conoscitivo e deciderne la strategia. Un percorso che ha preso la direzione dell'action research in quanto tecnica per "capire del fare", per pianificare con chiarezza le mosse vicine e via via definire quelle più lontane. Questo ha permesso di determinare la successione ed il contenuto delle azioni, nonché i procedimenti e gli strumenti da applicare." (ibid.).

"La ricerca progettuale è apparsa il percorso euristico più indicato per stabilire nature e modalità di quello che può definirsi un trasferimento metodologico da un dominio di conoscenza consolidato ad uno nuovo ed inesplorato. Il processo progettuale in quanto tale, con le sue fasi analitiche e sintetiche, è stato assunto come luogo teorico della riflessione sul progetto dei beni alimentari, in un continuo rimando fra pratica e teoria: [...]."(ibid.).

"Il modello concettuale più efficace per descrivere il percorso svolto è, dunque, quello che va sotto la definizione di action research: questo modello non solo ha suggerito durante la ricerca alcune mosse da fare, ma ha aiutato a posteriori nella rilettura del percorso compiuto. Alla base vi è un principio di ciclicità fra azione (ossia intervento, cambiamento operato su un contesto) e conoscenza (che deriva della riflessione critica esercitata sopra l'azione)[18]: in questo senso la ricerca ha gradualmente trovato delle risposte attraverso successivi consolidamenti e sviluppi concettuali, ciascuno come riflessione sull'azione appena svolta e pianificazione della successiva. Il carattere del tutto esplorativo del lavoro ha reso necessario innanzitutto identificare qualitativamente le caratteristiche del sistema pertinenti con gli obiettivi stabili: è stato necessario, cioè, capire quali fossero le "domande giuste" da porsi in relazione alla progettualità del designer. La strada dell'azione è parsa, dunque, immediatamente percorribile in quanto possibile e diretta sperimentazione di una potenzialità operativa. L'approccio empirico, in risposta all'evidenza di un problema progettuale, ha prodotto riflessioni sull'esperienza operativa, innescando una spirale di conoscenza ad ogni passo più raffinata e proficua per raffrontare il passo successivo." (ibid.).

2.3.6 Results
"E importante rilevare che, a prescindere dalla possibilità e opportunità di intervenire esteticamente sull'artefatto materiale, siano emerse numerose altre opzioni progettuali esercitabili attraverso il disegno industriale, dal condizionamento del prodotto (la porzionatura, le dosi, etc), alle intelligenze del packaging, dalla strategia produttiva ai servizi." (ibid.).

"Le attività svolte hanno così contribuito alla costruzione dell'identità d'insieme dei prodotti, in stretta collaborazione con le scelte tecnologiche, comunicative e funzionali. Proprio il carattere spiccatamente partecipativo di tutto l'iter progettuale, ha permesso a tutte le competenze coinvolte di procedere per successivi aggiustamenti degli obiettivi, tenendo conto degli sviluppi in corso negli altri contesti della ricerca, e rivedendo più volte ogni decisione. Questo ha innescato un andamento ciclico di progettazione e riflessione che ha permesso, ad ogni passo, un piccolo incremento conoscitivo ed operativo. Dal design il contributo più significativo alla coerenza generale sensoriale e funzionale del prodotto, e quindi alla sua identità, è venuto sotto due forme:
- l'attività di "accompagnamento" del progetto nelle successive e diverse fasi dello sviluppo, secondo un approccio strategico.
- l'attività di product design focalizzata sugli aspetti di visibilità ed interazione della soluzione alimentare.

Le potenzialità strategiche del design: le competenze e le potenzialità strategiche del disegno industriale trovano nel settore dei prodotti alimentari industriali due grandi possibili ambiti di applicazione, che stanno a cavallo fra il sistema ed il prodotto:
1) l'attitudine multidisciplinare e coordinativa
2) la capacità di produzione e visualizzazione di scenari di prodotto e servizio." (ibid.).

2.3.7 Contribution
Tre sono i principali contributi in questo senso ravvisabili a partire dall'attività svolta:
- la possibilità di utilizzare il settore dei beni alimentari come palestra per la progettazione di sistema;
- l'interesse a sperimentare ed approfondire in campo alimentare un approccio al product design originalmente sinestetico, per poi tradurlo in una pratica applicabile anche a contesti diversi, svincolati da così forti valenze sensoriali;
- l'interesse a sperimentare e definire il concetto di "design per l'esperienza", in quanto foriero di un nuovo punto di vista e nuove metodologie.
Sono contributi che presuppongono di avviare altri percorsi di ricerca, appena abbozzati da quella presente. Ad essi si affiancano una serie di ulteriori istanze sollevate nel corso della ricerca, che hanno attinenza ed urgenza rispetto al contesto alimentare, ma che possono ugualmente tradursi in sollecitazioni di validità generale. Tra queste si possono evidenziare le tecniche di identificazione dei bisogni alimentari, i concetti di personalizzazione e soggettività di giudizio, i valori di convenienza ed usabilità in contesti non convenzionali, la rilevanza delle componenti sensoriali dell'interazione." (ibid.).

APPENDIX B.10
CASE 10_ITALY_POLITECNICO DI MILANO

3. INTERVIEW REPORT

3.1 CIRCUMSTANCES
3.1.1 Kind of interview
Face to face interview.
3.1.2 Date
19 June 2003.

3.1.3 Time
14:00 Itlay time.

3.2 ADVISOR'S PROFILE
3.2.1 Name and Surname
Ezio Manzini.
3.2.2 Title
Professor.
3.2.3 Education
Bachelor degree in architecture;
Bachelor degree in engineering.
3.2.4 Research interests
Strategic design;
Service design;
Design for sustainability.
3.2.5 Number of supervised Ph.D. students
Nine Ph.D. students.

3.3 INTERVIEW
3.3.1 Le ho sempre sentito parlare di ricerca che chiama "off-line research" come ricerca a livello di dottorato. Vorrei sapere cosa intende?
Dunque adesso la faccio breve poi se per caso c'è qualcosa che ti sembra che bisogna approfondire, la facciamo più lunga. Partiamo da una constatazione come dire fenomenologica quasi. Tutte le pratiche del progetto richiedono la ricerca, un vecchio modo di parlare del progetto è che il progetto di per se è una ricerca. Ogni volta che tu inizi qualche cosa in fondo è nuovo, quindi implicita nella progettazione di non essere ripetitivo. Quindi nel momento in qui è nuovo devi ricercare ciò che ti serve per poter affrontare questa novità e arrivare a un risultato. E quindi è una visione tradizionale del progetto e, c'è una fase di ricerca che porta ad avere delle idee, a fare delle ipotesi di progetto e poi si sviluppa il progetto. Questa in sostanza resta vero, c'è tutta la progettualità che le singole persone, le comunità, la società possono avere, richiede con un momento di ricerca in cui si accumula della conoscenza, delle informazioni, che poi diventano ipotesi e poi azioni e poi il progetto. In realtà non è così lineare ma in somma adesso lo semplifichiamo.

Personalmente penso che i designers fra i tanti diversi progettisti avevano la loro pratica di progetto e quindi alcuni la loro pratica di ricerca. Poi possono esserci dei progettisti per cui c'è più una ricerca formale sui materiali, sulle texture, poi ci sono dei progettisti come le Corbusier nel versante product, fino a Sottsass che ha fatto degli oggetti che non avevano senso ma che erano un po' la messa a punto di un linguaggio formale. Quindi ci possono essere delle ricerche formali, ci possono essere delle ricerche invece delle potenzialità tecnologiche, delle potenzialità di nuovi materiali, e molti progettisti, non lo so, Alberto Meda, o chi per altro adesso per fare un esempio fanno la loro ricerca che poi darà luogo a un progetto. Questa ricerca in generale è una ricerca molto personalizzata, la fai tu, accumuli l'esperienza per te, però è difficile che poi la trasmetti perché l' hai ricercata nei modi e nelle forme con la codificazione che serve a te per alcuni una ricerca di un sapere implicito detto con le terminologie attuali.

Tutto questo non è che non possa più esistere, io mi auguro che esisterà ancora in parte, però certamente diventa sempre più difficile farlo, comunque sempre più difficile immaginare che questa sia la normale pratica del progetto e questo per la concomitanza di due fattori. Uno, che i problemi da affrontare sono sempre più grossi, più complessi e quindi in teoria per affrontarli ci vorrebbe ancora più ricerca. Sai per dire una delle cose che tu sai di quale mi occupo io, ad esempio semplicemente tu introduci davvero una questione ambientale e con la questione ambientale introduci davvero la visione euristica e del Life Cycle Analysis e quindi tutti i cicli, tutte quante, poi le implicazioni etc. Quindi da un lato dovresti fare ricerca sempre di più e

dall'altro, la variabilità del mercato e tutte queste cose che il management, e che il marketing ci ha insegnato, fa si che ci sia un time to market sempre più breve. Quindi tu dovresti fare un progetto rapidissimamente fino ad arrivare a tutta questa che adesso è una retorica e anche una realtà in qualche modo. Il discorso di una specie di progettazione continua in relazione con il mercato per cui arrivano dei feedback, in tempo reale, si cambiano le cose quindi. Se questo lo portiamo, anche se non è che sia proprio così, è un po' una visione, però sinteticamente è un continuo ascoltare delle cose che arrivano e reagire sulle cose che arrivano quindi in un certo senso anche la figura classica del progettista che si prende i suoi tempi per fare il suo progetto per quello che ha pensato,è come se non ci fosse più perché diventa un processo ricorsivo complesso. Non è che sia tutto così però è come una tendenza.

Per cui da un lato ci sarebbe un progettista che in un certo senso, questo cui è il limite, non ha tempo di pensare o forse non gli viene neanche più richiesto di pensare perché gli arrivano dal mercato delle indicazioni di ricambio e dell'altro in realtà invece i problemi che ci devono affrontare richiederebbero di fermarsi e dire ragazzi qui non muoviamo più uno spillo fino a quando non abbiamo capito come da vero si può fare, a fare muovere le persone, a sviluppare nuovi criteri di mobilità per fare un' esempio.

Tu mi dicevi, evidentemente una situazione paradossale, che occorrerebbe fermarsi per un secolo a pensare e ricercare che fare e contemporaneamente tutti i modelli del sistema di produzione-consumo portano al tempo reale, a non pensare, etc. Da cui, come mia intuizione, ma adesso forse le parole sono mie ma la realtà penso che sia condivisa da molti. È quindi dire va bene, allora ci sono delle attività di progettazione quindi dei progettisti che chiamiamoli "on-line" la cui capacità è proprio quella di essere sensibili di sentire qualcosa che cambia, di modificarlo un po', di andare a vedere, di tornare indietro e quindi di avere questa sensibilità a tutte quelle che possono essere atteggiamenti del mercato, comunque sono del contesto nel quale si trovano, però questi non affronteranno mai un po' di petto alcuni questioni di fondo e questi lavorano su quello che trovano in giro mettendolo insieme e ricomponendoli, al che, quella che a me sembra l'esigenza di avere qualcuno che stacca la spina, si stacca un po' da questo. Certamente ha avuto, come dire, dei brief generali su quelli che sono i problemi e si prende il tempo per approfondire finalmente.

Uno dice, ma che cosa approfondisce visto che nel frattempo la produzione va avanti per i fatti suoi. Per approfondire nel mio linguaggio dei "semi-lavorati", ci possono essere dei semi-lavorati di ricerca, che poi danno luogo a dei semi-lavorati prototipali, per cui i progettisti che lavorano "on-line" quando devono andare a cercare le informazioni con cui chiudere il progetto hanno dei pezzi di sapere organizzato, costituito, che può effettivamente essere integrato. E questi pezzi di sapere a differenza appunto del sapere del progettista classico che faceva per lui, e quindi non doveva essere sostanzialmente compreso da altri perché è una ricerca che è stata fatta con i suoi criteri, con il suo linguaggio, invece adesso, non lo so, per un pochino più formalizzato, perché io faccio la ricerca e poi tu la usi eventualmente, quindi devi essere capace di utilizzare il risultato della mia ricerca. Non solo se come poi i problemi sono anche veramente molto grandi, probabilmente non basta neanche una persona sola che faccia la ricerca, ma ce ne vogliono più di uno e quindi come tutta la ricerca scientifica, anche se io faccio fatica ad usare il termine proprio scientifica per questo tipo di ricerca, però deve essere cumulativa, uno studia delle cose, poi un' altro può andare e studiarne delle altre e complessivamente poi il problema diventa via via più chiaro.

Ricapitolando, tutte le attività progettuali richiedono una ricerca, sempre nel passato e nel presente. Nel presente però la condizione classica che voleva dire, c'è un'attività di ricerca che sta a monte di ogni singolo progetto che è molto personale in qualche maniera si è spinta e ci sono degli grandi e complessi progetti di attività di co-progettazione, delle reti chiamiamoli di progettazione nelle quali si lavora con i tempi e modi che la realtà quotidiana in qualche modo chiede, però con la disposizione dei risultati di ricerca che qualche nodo della rete che sono come dire un po' staccato ha preso la briga di approfondire, e quindi se come questa è una

ricerca che deve essere sui problemi vasti e trasmettibile deve essere anche con alcune caratteristiche della ricerca scientifica, c'è cumulabile e appunto esplicita e quindi in qualche modo trasmettibile dall'uno all'altro.

3.3.2 Quali sono secondo Lei le competenze di un designer-ricercatore?
Certamente c'è un'attitudine anche forse una pratica che uno assume la ricerca che non è ovvia e che in questo fosse simile a quella che potrebbero essere l'attitudine di ricerca di qualcuno che progettista non è, e questa attitudine ha come caratteristiche, adesso non sto a numerare tutte ma in somma è, la capacità di guardare la realtà ed estrarre della complessità della realtà alcuni elementi che sono quelli su cui costruire delle ipotesi. Quindi questa capacità di guardare in qualche modo, modellizzare delle ipotesi, su queste ipotesi lavorare, e lavorare appunto producendo un sapere che sia in qualche maniera esplicito.

Ci possono essere degli altri progettisti che hanno delle intuizioni straordinarie della realtà, però l'intuizione straordinaria dalla realtà non è un'attitudine di ricerca, è un qualcosa che ti potrebbe servire, però questi progettisti non ti danno mai il percorso per arrivarci, quindi la puoi amare o odiare, non puoi discuterla o accumulare in un certo senso. Forse adesso esagero un po', ma in somma è un po' per intendersi sul modo di essere. Quindi non è la tipica attitudine di ricerca perché non è raccontabile questo può soltanto affascinare le persone, non puoi costruire un pezzo di discorso. Mentre la capacità di costruire un pezzo di discorso è quando tu riesci ad articolare la materia e modellizarla. Quindi questo certamente è una dote che devono avere i designers quando vogliono fare ricerca perché devono produrre qualche cosa che deve servire ad altri. Una sorta di chiamiamola verbalizzazzione di quello che sono le motivazioni di quello che sono i risultati, maggiore di uno che fa un bellissimo prodotto, e tu lo devi godere come un bellissimo prodotto indipendentemente dal perché è arrivato a farlo.

Contemporaneamente quello più difficile è in che cosa però lui è un designer ricercatore e non un ricercatore in scienze sociali, in tecnologie etc. Qui andiamo veramente sulle sabbie mobili perché da un lato la cosa più semplice che si potrebbe dire lo è perché l'oggetto della sua ricerca è attinente alle tematiche del design. Per cui non lo so uno che faccia una ricerca di ergonomia ed è qui nel nostro dipartimento di design deve avere quello che abbiamo detto prima e dopo di che fare una ricerca di design possiamo dire che un ricercatore nell'ambito della disciplina del disegno industriale perché l'oggetto della sua ricerca è attinente alle cose che sono molto importanti per il disegno industriale. E quindi in questo sta fondamentalmente la sua pertinenza come un dottorato che si può fare cui anzi bene che lo faccia qui perché se invece di farlo qui lo facessi in altri posti dove si fa ergonomia per dire la medicina, farebbe altre cose ma avrebbe altri stimoli etc. e quindi si vede gli ergonomi che hanno fatto ergonomia in medicina sono diversi degli ergonomi che hanno fatto ergonomia qui. Però nel momento in cui che fai ergonomia nel senso che prendi delle misure, che fai delle statistiche, che fai delle verifiche, etc. etc. non è specificatamente designer in quello che stai facendo. Allora secondo me comincia ad essere designer quando usa gli strumenti che sono gli strumenti progettuali nella sua ricerca. E gli strumenti progettuali possono investire la ricerca al cento per cento e allora è una ricerca progettuale e questo come tu sai bene è più confuso e difficile terreno ma secondo me quello su cui un dottorato come questo vorrei di venirne fuori, a dire e cercare di chiarire che cos'è.

Quindi la ricerca progettuale vediamo che cos'è, in somma potrebbe essere qui da noi come alcune cose che fa Trabucco oppure ci possono essere delle attività di ricerca che non sono così immediatamente, dice va bene questo ha fatto un progetto quindi è ricerca progettuale, ma che sono al mio avviso progettuali anche se la progettazione non porta al fatto che sia alla fine c'è anche il disegno di alcuni prodotti, allora che cosa vuol dire. Adesso faccio degli esempi che mi vengono in mente. Se tu prendi certi lavori di Pino Castelli che ha fatto tutta una seria di persone, di organizzazione, di texture, di colori, etc. la classificazione, la nominazione, c'è dividere il mondo in un certo modo cominciando ad individuare delle categorie, dei criteri, dando dei nomi, mettendo insieme etc., questa non è una questione scientifica nel senso formale

del termine perché quelle categorie hanno molto soggettività, e quindi è un progetto. Prendiamo una cosa semplice io devo fare una sorta di categorizzazione di texture finale di un materiale plastico, il modo in cui decido l'organizzazione di questi può essere o da ergonomo e quindi vado a vedere con qualche parametro che mi permette di dirlo, la rugosità oppure la brillanza, etc. Ma se ti muovi verso le qualità che sono quelle che puoi chiamare del design primario esci da cose che sono misurabili ed entri in categorie che qualcuno a un certo punto definisce. Questa è una definizione di un atto progettuale che costruisce alla fine una sorta di catalogo che può servire anche per altri. E un elemento di costruzione.

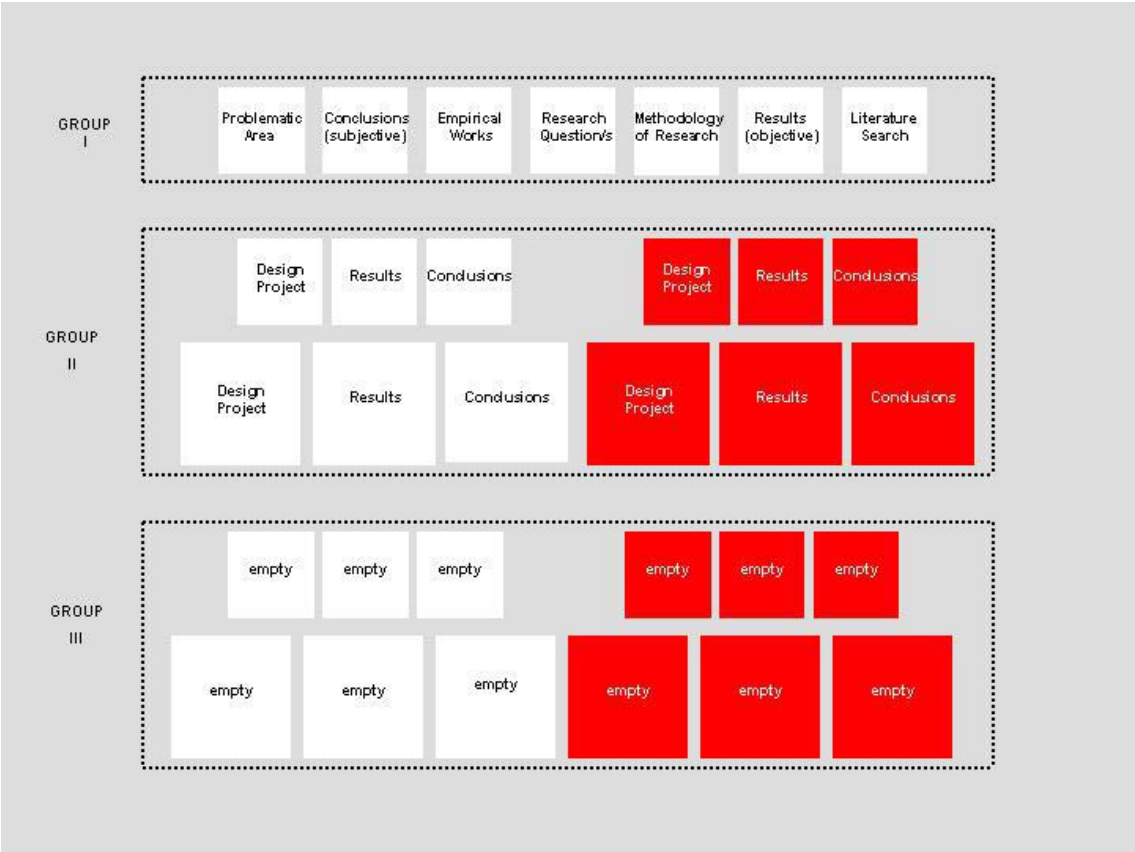
Faccio un altro esempio. Faccio degli esempi combinatori, con la serie variata puoi fare delle cose diverse. Tu puoi fare una ricerca per dire come faccio per ottenere il massimo delle varietà con il minimum delle variabili. Questa è una ricerca che ha dentro del progetto, non è una cosa che deriva da delle formule matematiche perché devi fare delle combinazioni e vedere cosa viene fuori, per questi effettivamente ci sono delle differenze che poi sono percettibili. Quindi una ricerca che si proponesse di vedere, data la potenzialità tecnologica, quali sono le varietà che possono emergere, cercare di impostare una categorizzazione di queste varietà per me è una ricerca progettuale anche questa. Perché è una ricerca non soltanto un progetto perché una volta che l' ha fatto, il progettista successivo può anche basarsi su questo per andare effettivamente avanti. Una volta che la vede, è stato un po' spiegata la sua motivazionie e se aderisce può anche effettivamente andare avanti e così via.

Quindi allora abbiamo detto ci può essere una ricerca progettuale perché uno ha un progetto con certe caratteristiche, e secondo me questa è la più problematica, e nello sviluppare questo progetto possiamo dire che c'è un'attività di ricerca che in qualche manierata fa accumulare degli informazioni per i momenti successivi. Ci sono delle forme di ricerca progettuale che sono più da metà-progetto diciamo, che organizzano certe variabili che poi qualcuno successivamente dovrà finire. Ci sono delle capacità progettuali, come dire, ecco un settore del quale mi occupo abbastanza io, di carattere scenaristico per cui tu metti insieme delle visioni di quello che potrebbero essere, e questa visione è un progetto anche se non puoi dire che è un progetto e punto, perché è un progetto fatto per poterci lavorare sopra e fare venire fuori eventualmente gli altri progetti. Però questo pezzo di lavoro che hai fatto è un'attività progettuale di ricerca non scientifica perché non puoi dedurre quello scenario facendo degli ipotesi che poi un' algoritmo le porta a sviluppare, ci devi mettere le tue capacità progettuali.

Poi adesso la metto per ultimo perché è una via di mezzo tra vera ricerca progettuale e una ricerca non necessariamente progettuale ma che utilizza delle sensibilità di un progettista per cui comunque sia tu puoi trattare delle tematiche complesse con degli strumenti di comunicazione che le rendono in qualche maniera più chiare, più trasparenti e più comprensibili allora in questo caso il tema, il dato non è un progetto, però tu che tratti questo dato che sei un progettista lo tratti da una maniera tale che gli dai una trasparenza, un'evidenza che altrimenti non aveva. Faccio l'esempio di ergonomia, ci può essere una ricerca di ergonomia che di per se non è un progetto, è una ricerca con le sue evidenze, ricerca sul campo, etc. però se è fatta da uno che ha un background di psicologia o un dottore farà i suoi schemini e quello è per dire nella norma. Potrebbe essere, anche io sarei molto favorevole, che uno che facesse una ricerca analoga, però la fa qui, facesse con un progetto di comunicazione su come questa cosa qui può essere facilmente comunicata quindi in questo caso l'oggetto specifico primario della ricerca non è progettuale però viene strettamente integrato con attività progettuale di comunicazione di quello che ha fatto. Per cui a volte sono certe cose che quasi cambiano la loro natura per il modo in cui sono comunicate, perché sarebbero potute rimanere degli aspetti da supertecnici o comunque non facilmente visibili invece vengono rese visibili.

APPENDIX C:
FORMAT OF THE STRUCTURAL SCHEMA

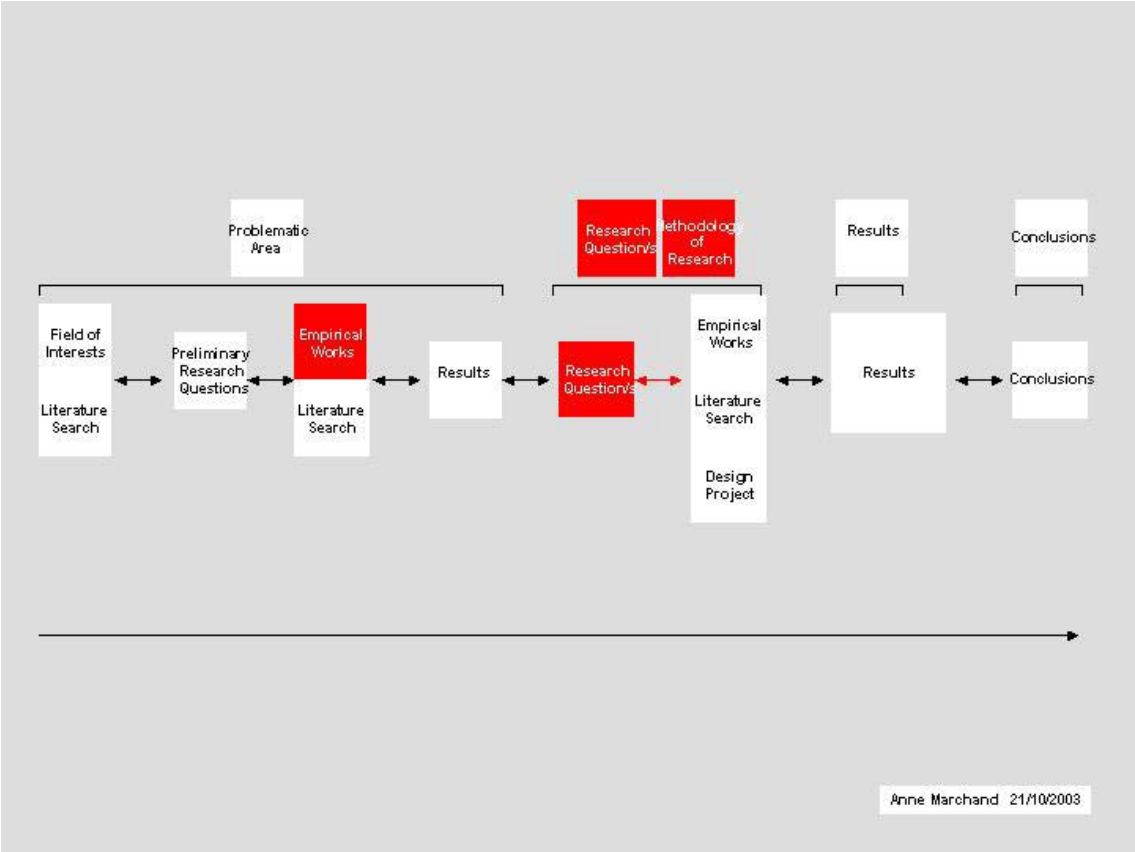
APPENDIX C: FORMAT OF THE STRUCTURAL SCHEMA
For the schematic representations of research processes including design project(s).



APPENDIX D:
SCHEMATIC REPRESENTATIONS OF RESEARCH PROCESSES

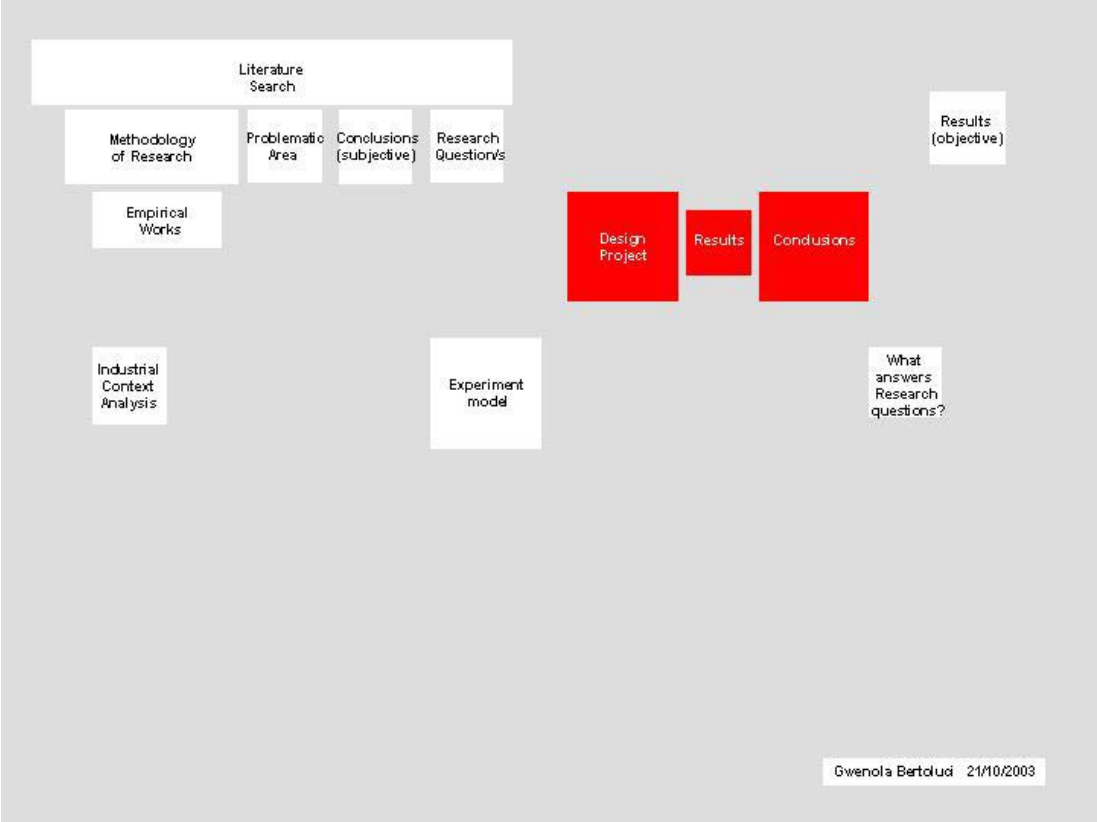
APPENDIX D.1: STRUCTURAL SCHEMA BY ANNE MARCHAND
Schematic representation of the research process including design project(s).

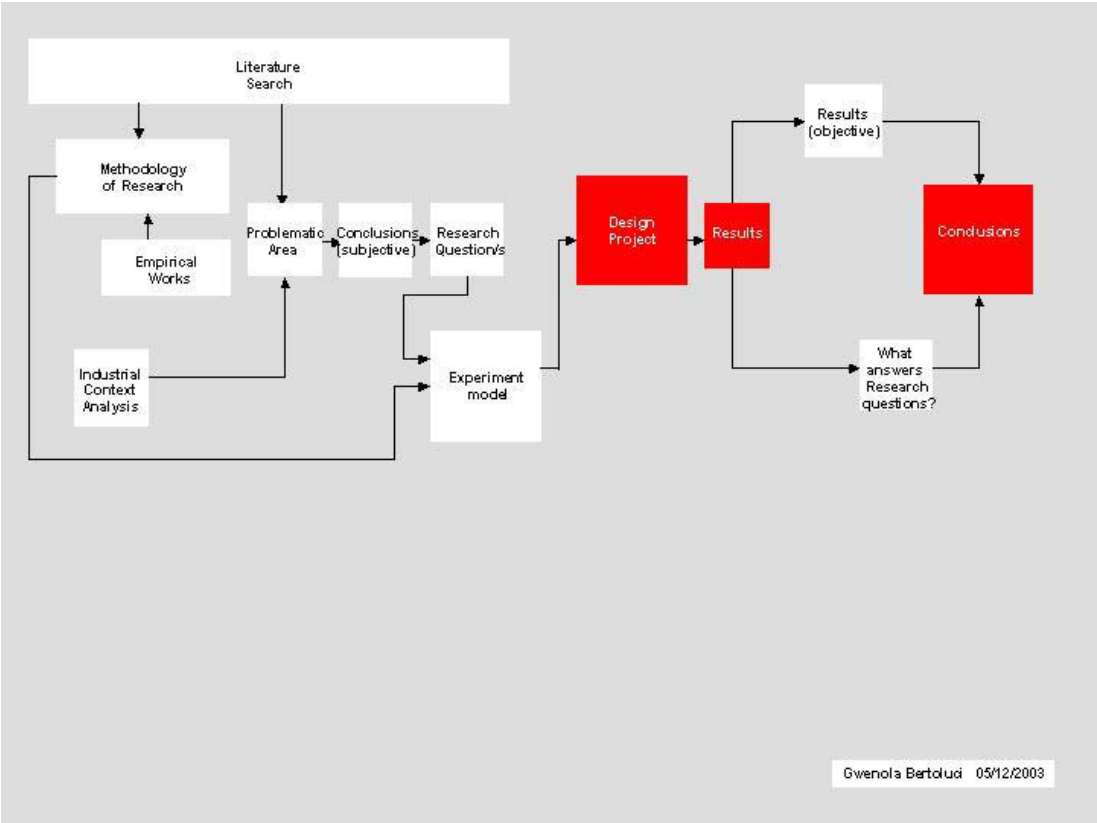
Marchand, A., 2003. *Bionique en Design: Approche Revisitée et Perspectives Nouvelles*. M.Sc. thesis. University of Montreal.



APPENDIX D.2: STRUCTURAL SCHEMA BY GWENOLA BERTOLUCI
Schematic representation of the research process including design project(s).

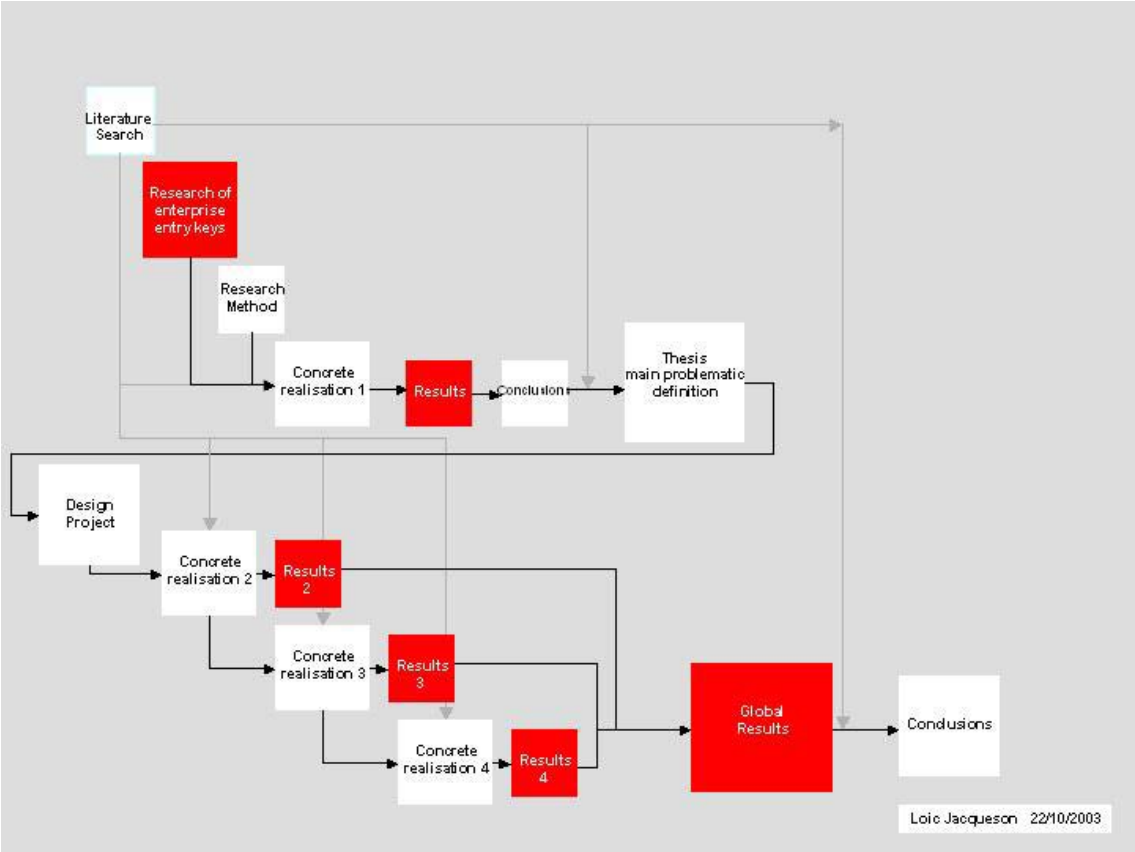
Bertoluci, G., 2001. *Proposition d'une Méthode d'Amélioration de la Cohérence des Processus Industriels.* Ph.D. thesis, ENSAM Paris.





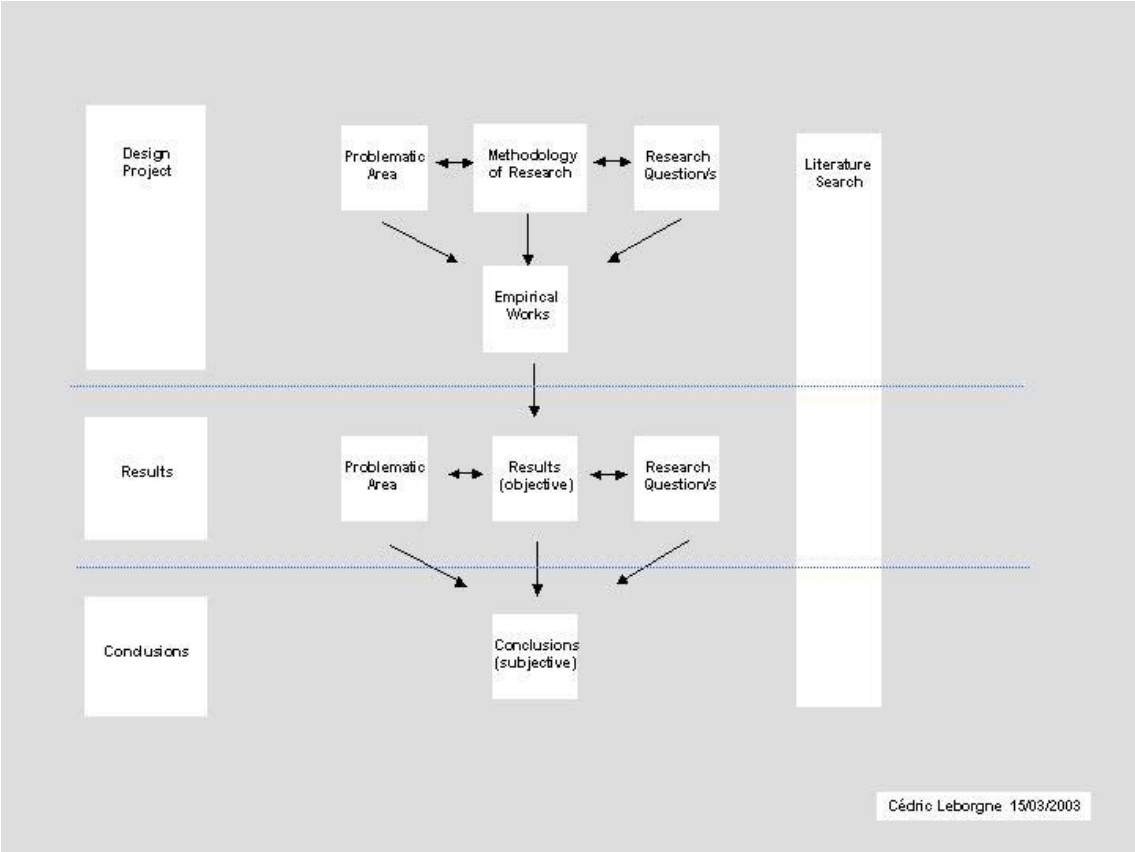
APPENDIX D.3: STRUCTURAL SCHEMA BY LOIC JACQUESON
Schematic representation of the research process including design project(s).

Jacqueson, L., 2002. *Integration de l'Environnement en Entreprise: Proposition d'un Outil de Pilotage du Processus de Création de Connaissances Environnementales.* Ph.D. thesis, ENSAM Paris.



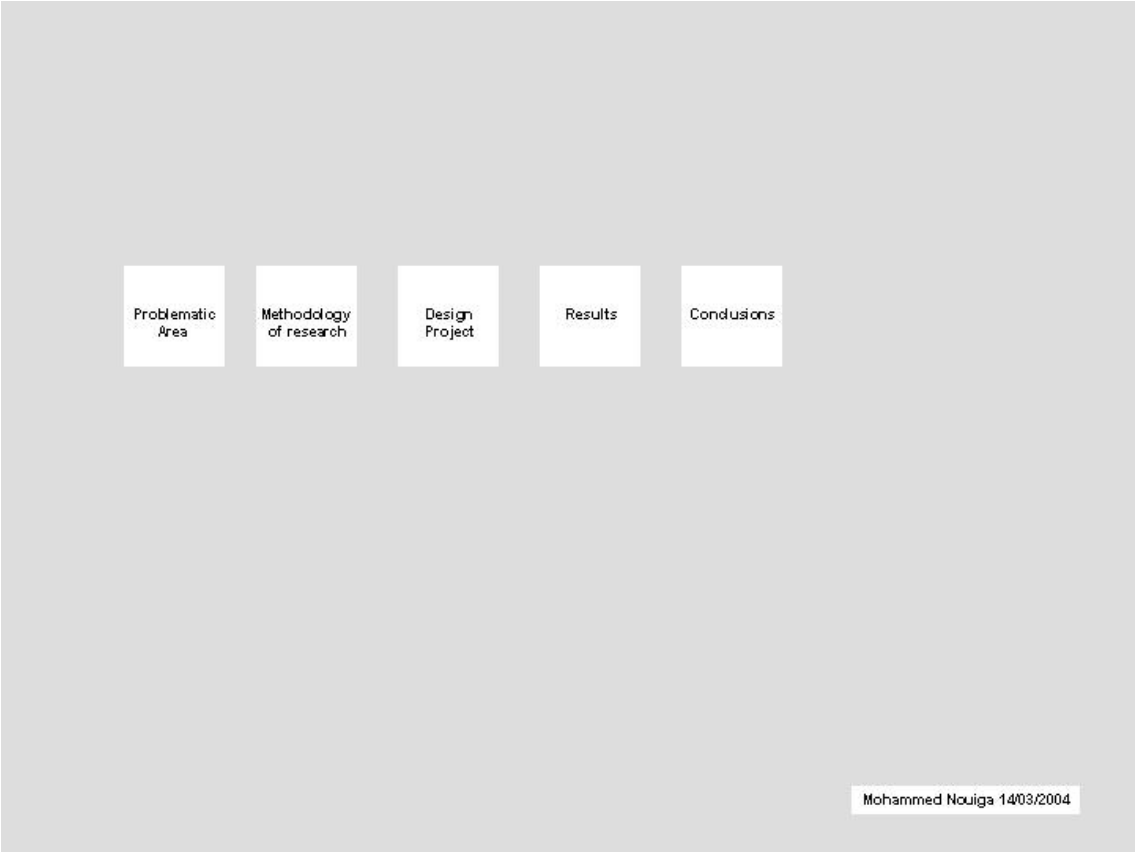
APPENDIX D.4: STRUCTURAL SCHEMA BY CEDRIC LEBORGNE
Schematic representation of the research process including design project(s).

Leborgne, C., 2001. *Proposition d'une Démarche Anthropocentrée de Conception de Produits Nouveaux Basée sur l'Usage et Destinée à une Meilleure Intégration, par l'Ergonome, des Besoins et des Attentes des Usagers*. Ph.D. thesis, ENSAM Paris.



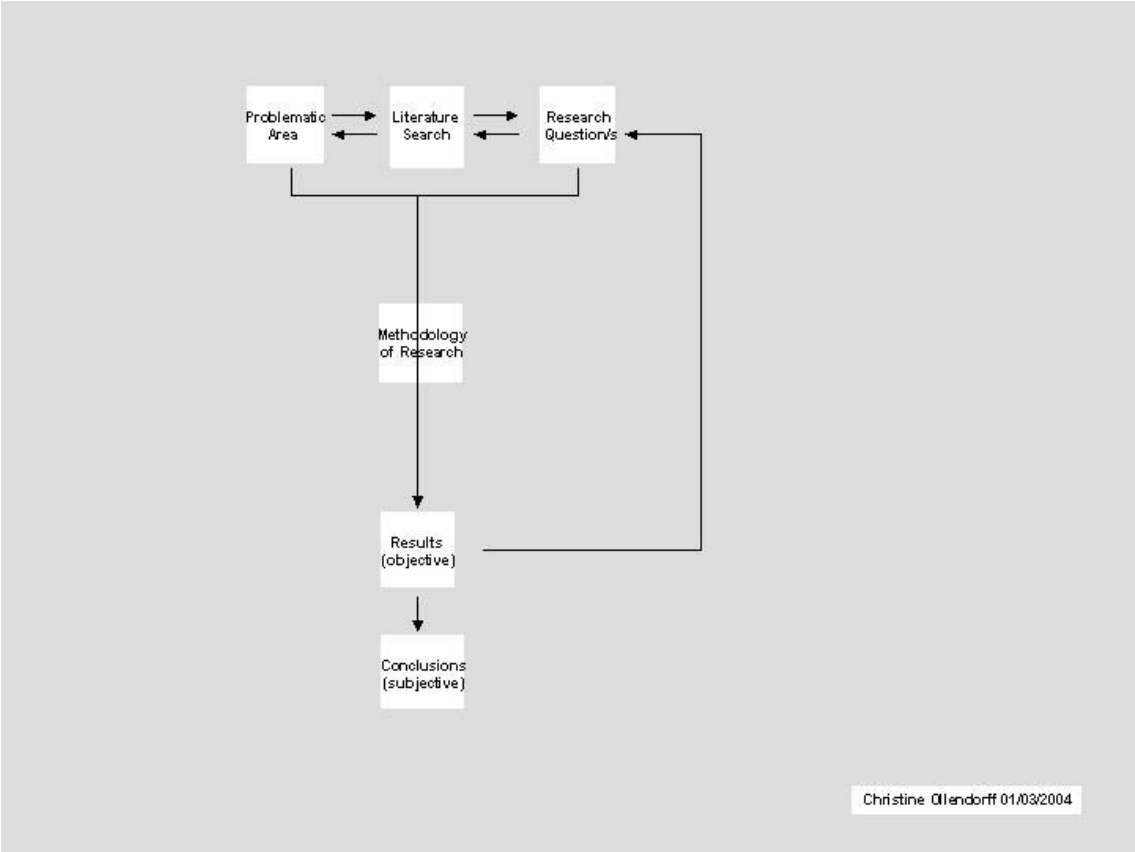
APPENDIX D.5: STRUCTURAL SCHEMA BY MOHAMMED NOUIGA
Schematic representation of the research process including design project(s).

Nouiga, M., 2003. *La Conduite du Changement par la Qualité dans un Contexte Socioculturel. Essai de Modélisation Systémique et Application à l'Entreprise Marocaine*. Ph.D. thesis, ENSAM Paris.



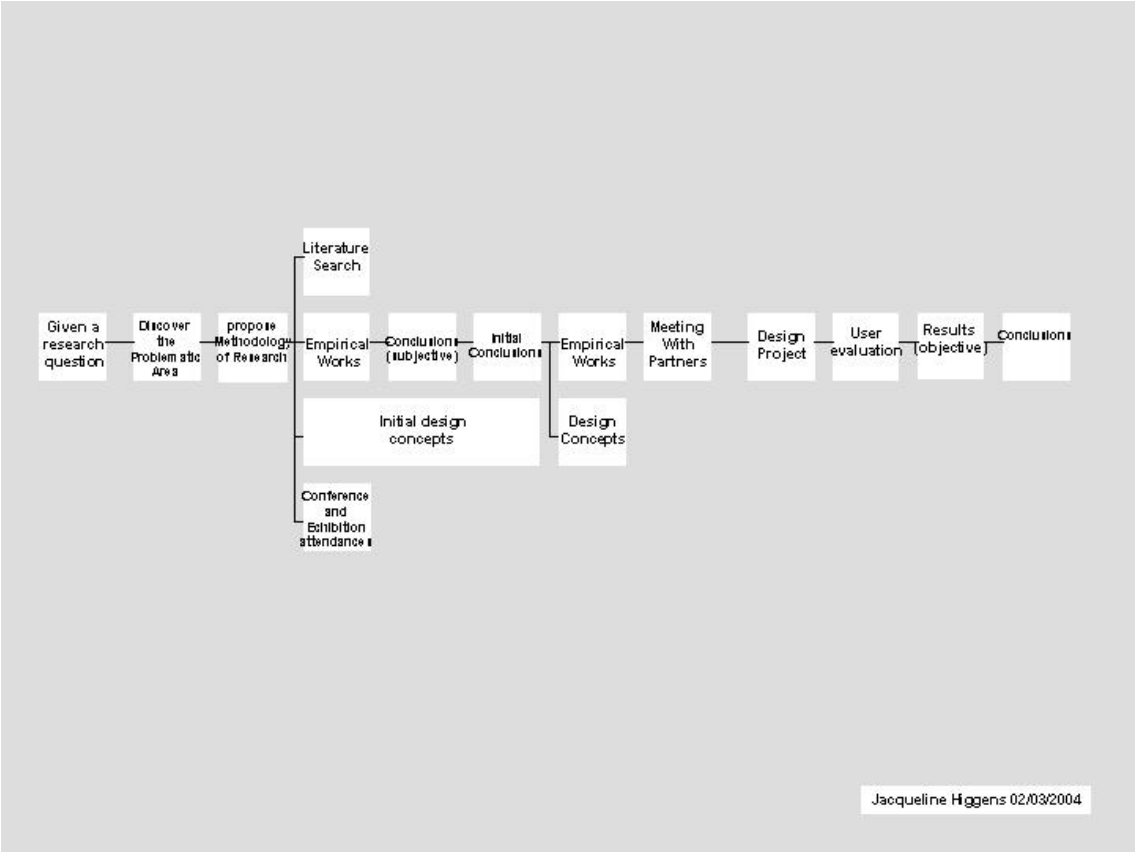
APPENDIX D.6: STRUCTURAL SCHEMA BY CHRISTINE OLLENDORFF
Schematic representation of the research process including design project(s).

Ollendorff, C., 1999. *Construction d'un Diagnostic Complexe d'une Bibliothèque Académique*. Ph.D. thesis, ENSAM Paris.



APPENDIX D.7: STRUCTURAL SCHEMA BY JACQUELINE HIGGINS
Schematic representation of the research process including design project(s).

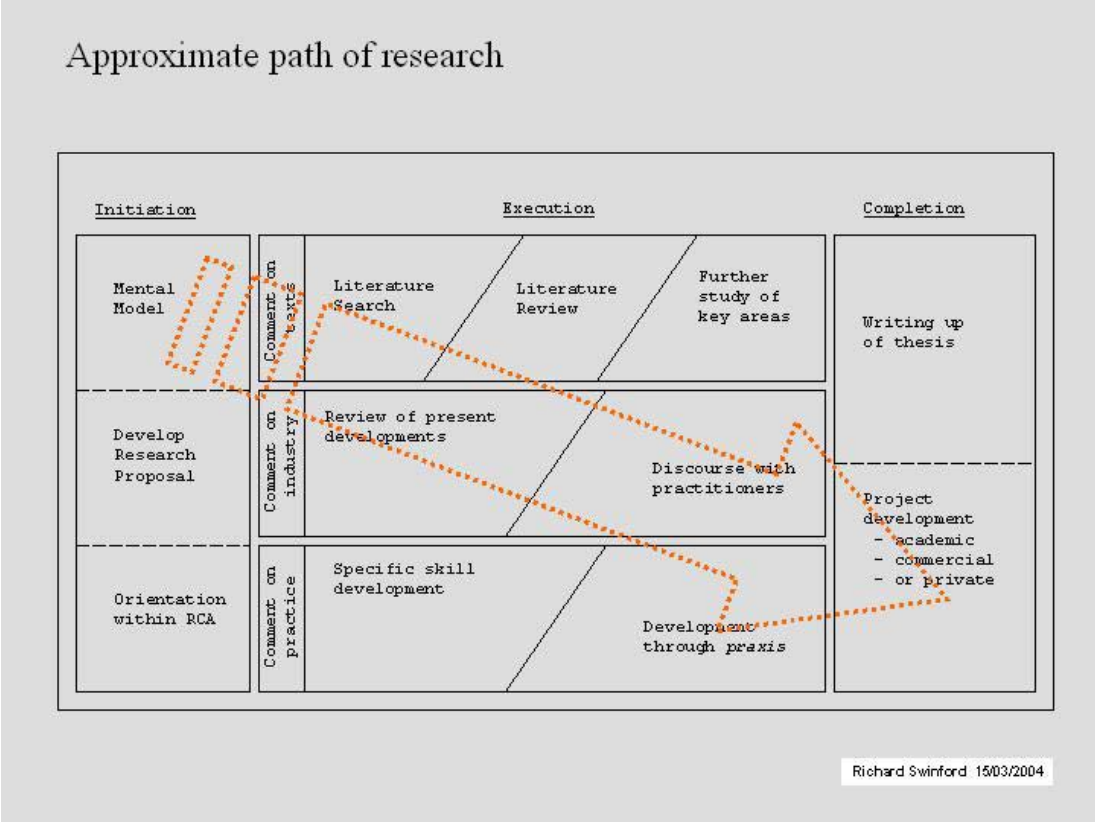
HIGGINS, J. 2003. *Multi-Sensory Memorabilia: New Ways for Visually Impaired People to Save and Share Personal Memories* [online]. London: Royal College of Art. Available from: http://www.hhrc.rca.ac.uk/programmes/ra/2003/jac.html [accessed 12 March 2004].[1]

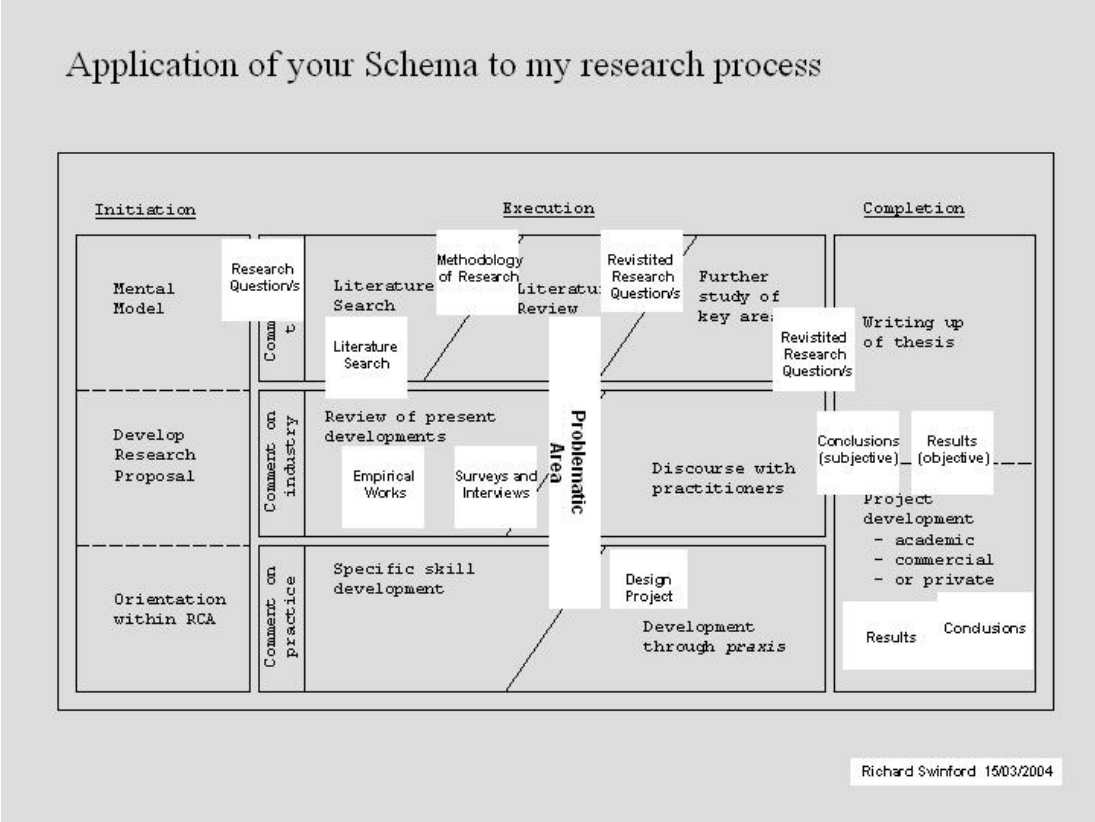


1. This is a two year academic research project developed by a new graduate from the interaction design department at the Royal College of Art.

APPENDIX D.8: STRUCTURAL SCHEMA BY RICHARD SWINFORD
Schematic representation of the research process including design project(s).

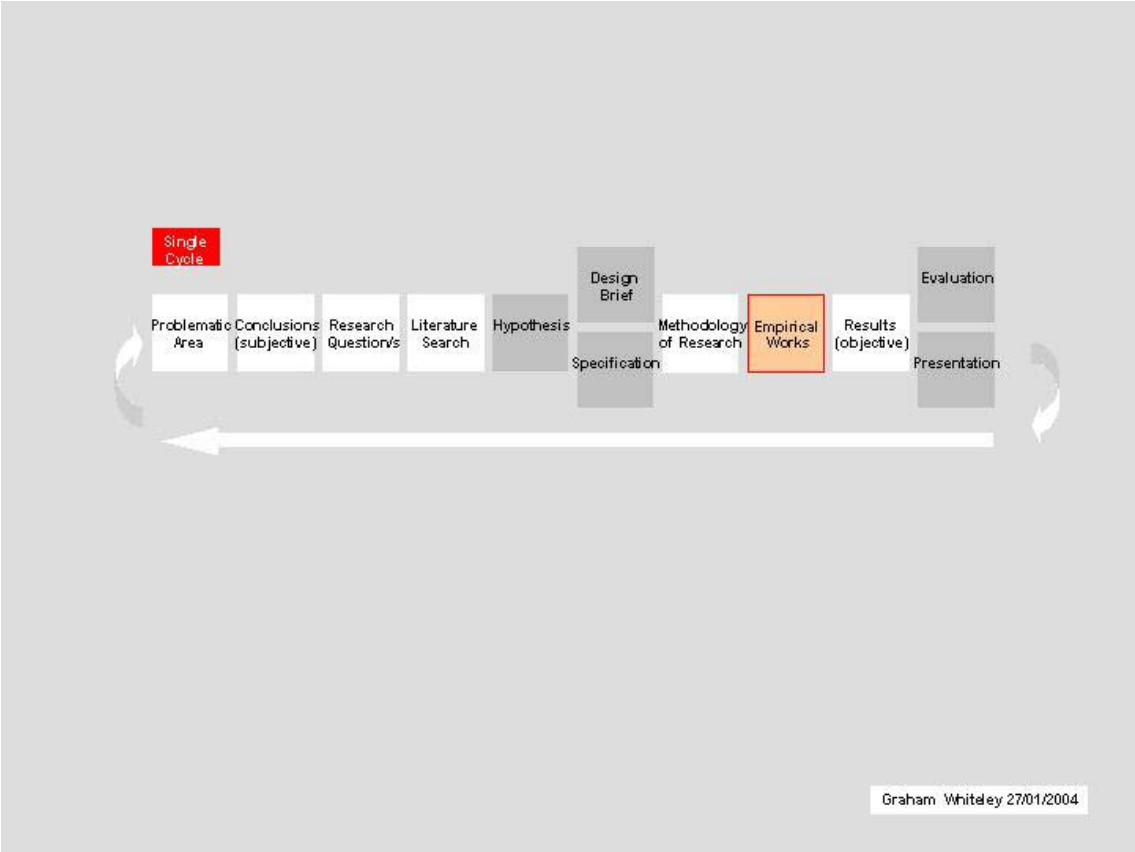
Swinford, R., 2004. *Personal Communication Devices. Realising the Extensions of Man*. M.Phil. thesis, Royal College of Art.





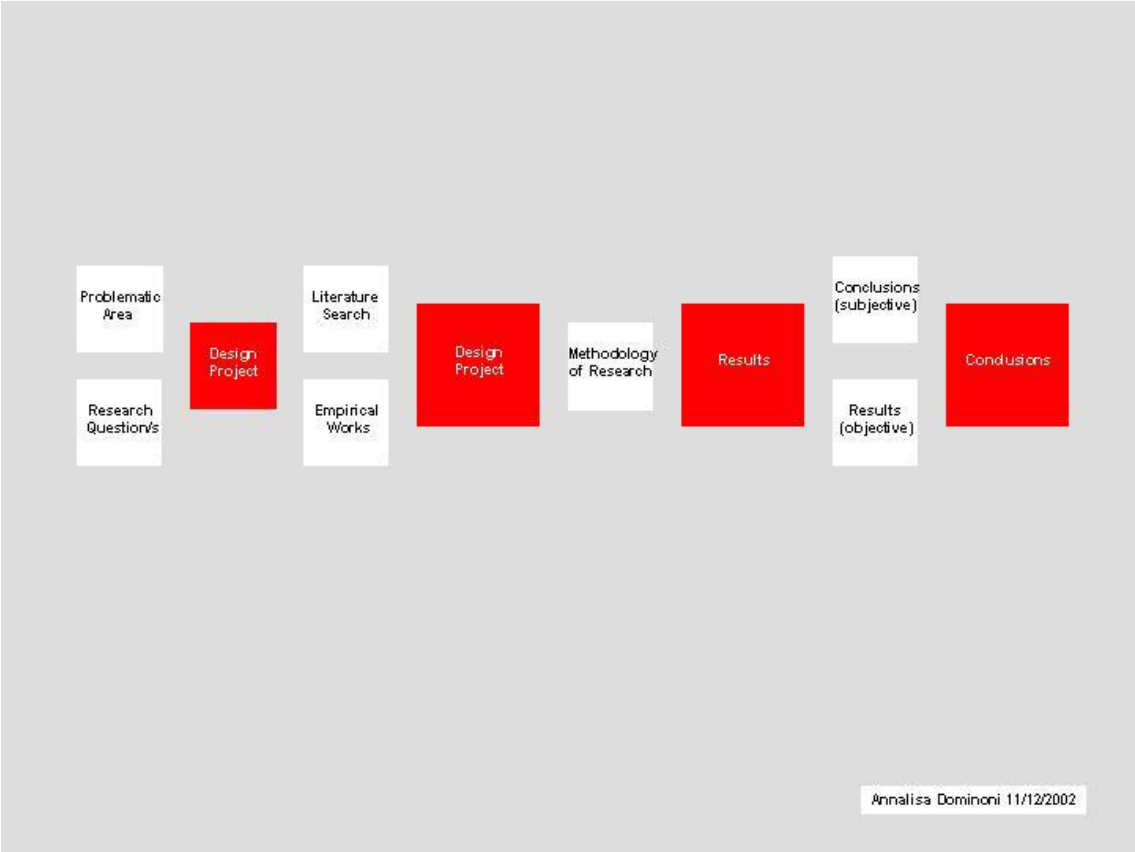
APPENDIX D.9: STRUCTURAL SCHEMA BY GRAHAM WHITELEY
Schematic representation of the research process including design project(s).

Whiteley, G. P., 2000. *An Articulated Skeletal Analogy of the Human Upper-Limb*. Ph.D. thesis, Sheffield Hallam University.



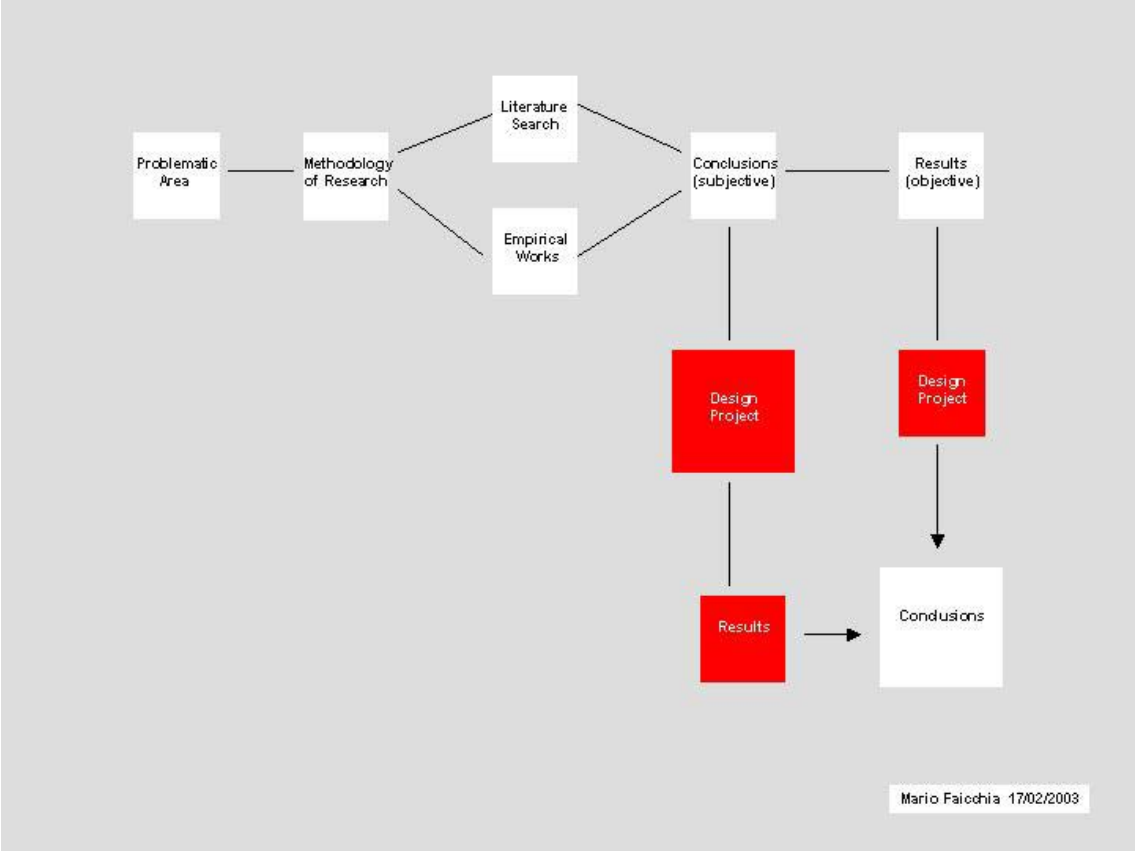
APPENDIX D.10: STRUCTURAL SCHEMA BY ANNALISA DOMINONI
Schematic representation of the research process including design project(s).

Dominoni, A., 2001. *Disegno Industriale per la Progettazione Spaziale.* Ph.D. thesis, Politecnico di Milano.



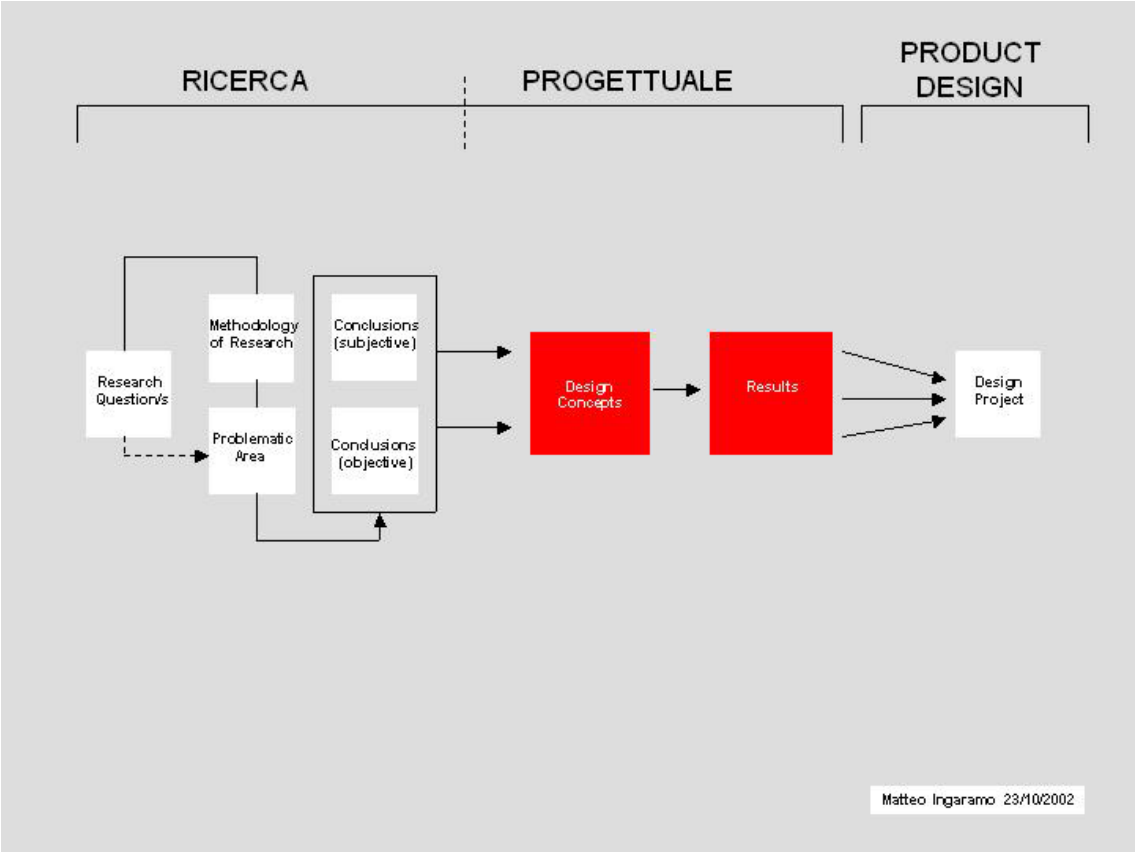
APPENDIX D.11: STRUCTURAL SCHEMA BY MARIO FAICCHIA
Schematic representation of the research process including design project(s).

Faicchia, M., 2002. *Weightless Projects. Projects for Space*. Ph.D. thesis, Politecnico di Milano.



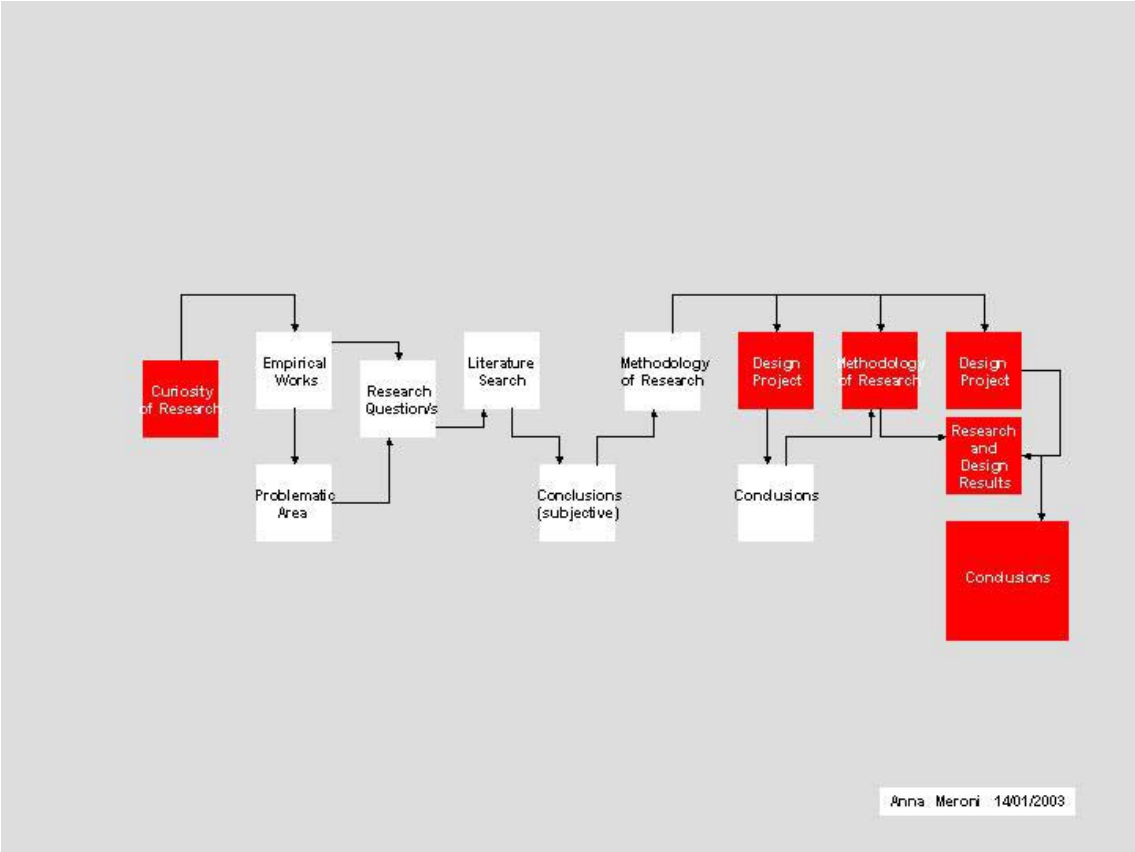
APPENDIX D.12: STRUCTURAL SCHEMA BY MATTEO INGARAMO
Schematic representation of the research process including design project(s).

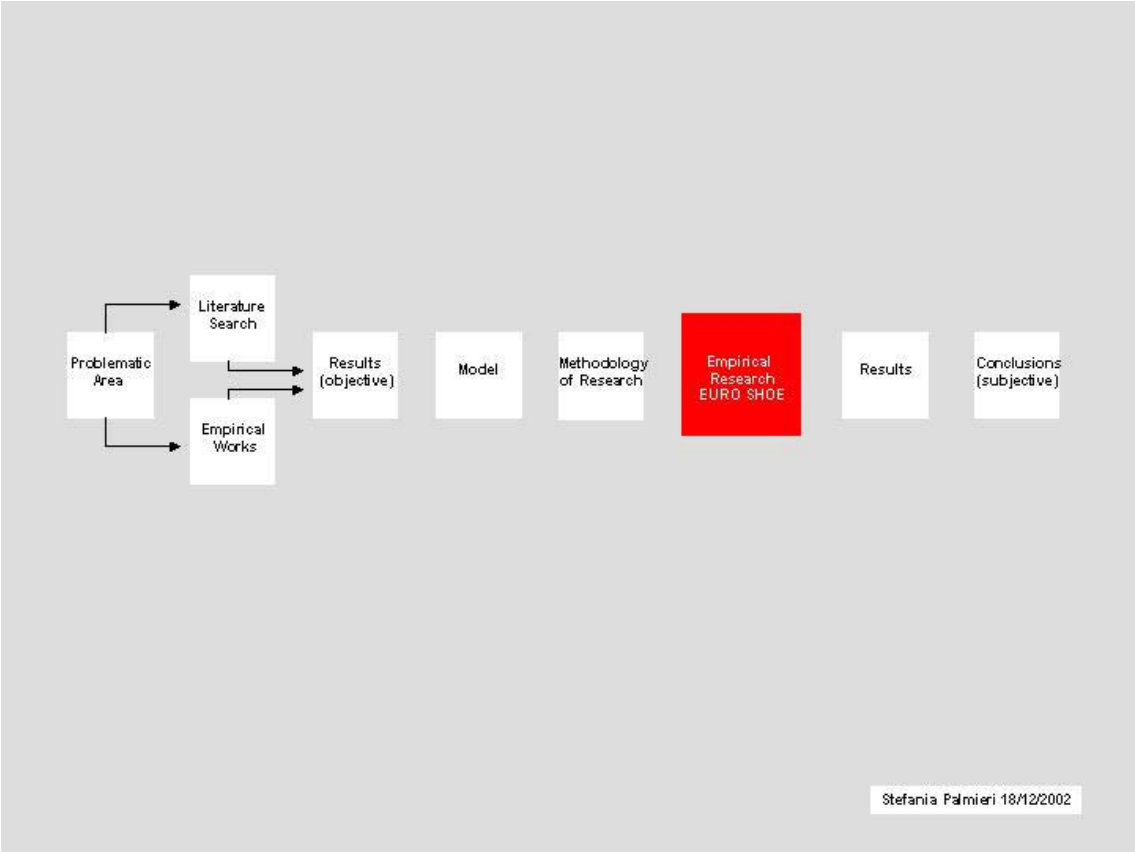
Ingaramo, M., 2002. *Lo Sviluppo delle Attrezzature per il Lavoro Intellettuale: un Percorso di Ricerca Progettuale tra Metodo e Pratica*. Ph.D. thesis, Politecnico di Milano.



APPENDIX D.13: STRUCTURAL SCHEMA BY ANNA MERONI
Schematic representation of the research process including design project(s).

Meroni, A., 2000. *Il CiboDisegnato. Un Nuovo Ambito Disciplinare per il Disegno Industriale*. Ph.D. thesis, Politecnico di Milano.



APPENDIX D.14: STRUCTURAL SCHEMA BY STEFANIA PALMIERI
Schematic representation of the research process including design project(s).

Palmieri, S., 2001. *Progettare con il Cliente. Nuove Modalità di Interazione con il Cliente nei Processi Progettuali*. Ph.D. thesis, Politecnico di Milano.