ORIENTATION AND ANALYSIS OF GATHERED INFORMATION

MAIN PROCESSES	SUB-PROCESSES

ANALYSIS STAGE

- ORIENTATION & INFORMATION GATHERING
- DESIGN RESEARCH
- PROBLEM DEFINITION
- PROCESS TREES
- PROGRAMME OF REQUIREMENTS

CONCEPTUALISATION STAGE

- PRINCIPAL SOLUTIONS
- IDEA GENERATION
- CONCEPT DEVELOPMENT
- CONCEPT TESTING & SELECTION

MATERIALISATION STAGE

- CONCEPT DETAILING & REFINEMENT
- 3-D VISUALISATION / PROTOTYPE DEVELOPMENT
- DEVELOPMENT OF ENGINEERING DRAWINGS

Sub-processes:

- Design Brief
- Literature Research
- Observations
- Interviews / Focus Groups
- Story Telling
- Problem Definition

4.0 INTRODUCTION

This chapter discusses methods and techniques, which would be helpful to collect, analyse and structure information in an efficient and effective manner. Preceded by various forms of literature research, a user-centred approach is emphasised through the application of scenario-based and empirical research. This user centred approach proposes interviews, focus group analyses, and storytelling as powerful techniques to extract valuable information.
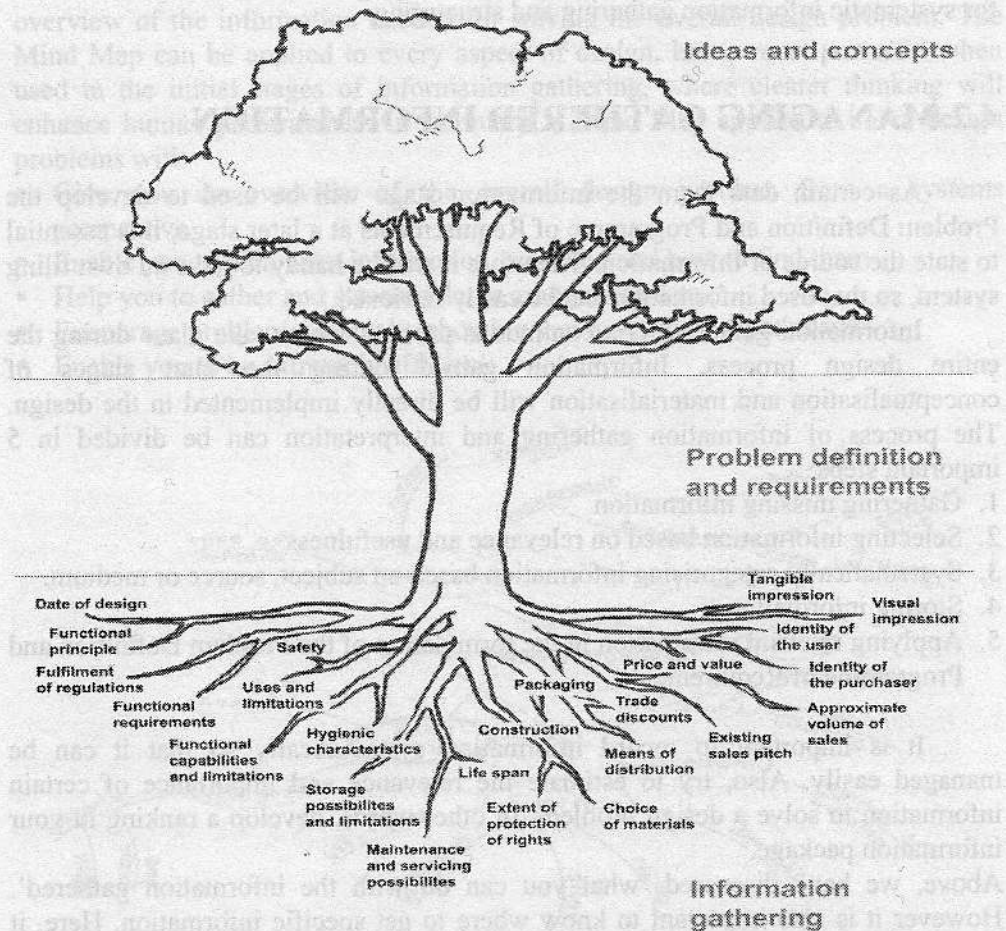
4.1 OVERVIEW OF THE ANALYSIS STAGE

Figure 4.1; *Information and requirements supporting the development of ideas is similar to that of a fruit bearing tree*

The first five steps of the design process are Orientation & Information Gathering, Design Research, Problem Definition, Process Trees, and Programme of Requirements. Together, they form the Analysis Stage. A definition of **analysis** is: to disassemble problems and data, and to restructure them in such a manner, that they can be used in the subsequent and creative design activities. An analogy can be drawn with a tree. The roots are the various types of information, which will be consolidated into a **Problem Definition** and **Programme of Requirements**, represented by the trunk. Ideas and concepts will develop well if roots and trunk are strong.

Orientation starts when the design project and additional information are issued. The design field will be quickly investigated; extra information needed determined and possible sources of information inventoried.

The Process Trees, which will be elaborated in chapter 6, is an efficient tool for systematic information gathering and structuring.

4.2 MANAGING GATHERED INFORMATION

As certain data from the information stage will be used to develop the Problem Definition and Programme of Requirements at a later stage, it is essential to state the source of information. Therefore it will be handy to have an own filing system, so that used information can be easily retrieved.

Information gathering is a continuous process, which take place during the entire design process. Information gained during the later stages of conceptualisation and materialisation will be directly implemented in the design. The process of information gathering and interpretation can be divided in 5 important steps:
1. Gathering missing information
2. Selecting information based on relevance and usefulness
3. Systematically categorising information based on subject, source or medium.
4. Storing information
5. Applying relevant information in the formulation of the Problem Definition and Programme of Requirements

It is important to record information systematically so that it can be managed easily. Also, try to estimate the relevance and importance of certain information to solve a design problem. In other words, develop a ranking in your information package.

Above, we have discussed 'what you can do with the information gathered'. However it is also important to know where to get specific information. Here, it depends on the creativity of the designer. Suggested are the following few sources:
• Your own knowledge and experience

- Other people (specialists, users, etc.)
- Documents (Encyclopaedia, books, periodicals, reports, standards, catalogues, patents, etc.)
- Objects (other related and existing products)
- Internet

4.3 MIND MAPPING

As factors time, financial resources and expected quality play an important role in the choice of sources, a recommended method of structuring and strategising information gathering is through the use of **Mind Mapping.**

A Mind Map is a powerful graphic technique which provides a quick and broad overview of the information needed for solving the overall design problem. The Mind Map can be applied to every aspect of design, but is most powerful when used in the initial stages of information gathering, where clearer thinking will enhance human performance. In summary, a Mind Map applied to solve design problems will:

- Give you an overview of the overall design problem from a systems perspective.
- Enable you to plan what information is needed and how to find them
- Help you to gather and structure large amounts of data
- Encourage problem solving by showing you new creative pathways.
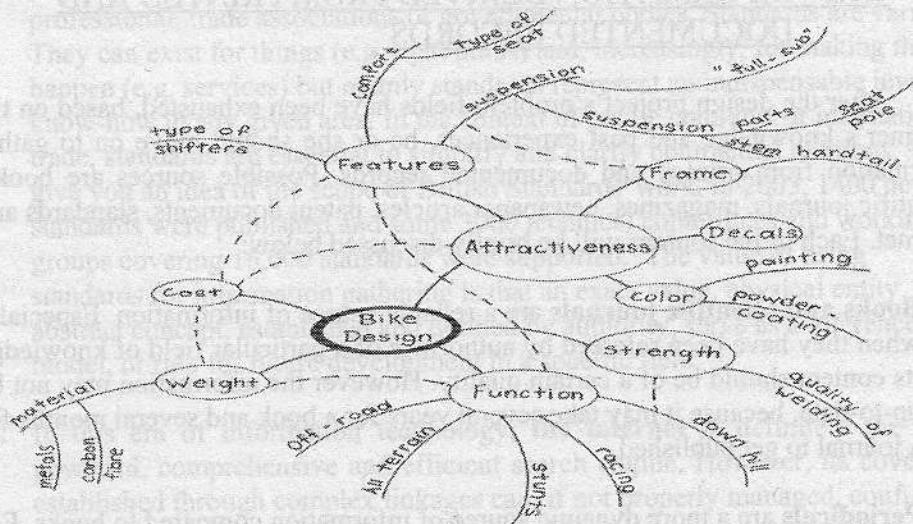- Enable you to be extremely efficient.

Figure 4.2; Example of a mind map

Sources of information can be classified according to a hierarchical system. In this top down approach, sources of information are divided into three main categories:

- Information derived form own experience and knowledge
- Information derived from printed and documented records
- Information derived through interaction with other people, e.g. interviews.

4.4 EXPERIENCE, LITERATURE AND INTERNET SEARCH AS A SOURCE OF INFORMATION

4.4.1 INFORMATION DERIVED FROM OWN EXPERIENCE AND KNOWLEDGE

This type of information is based on the past experiences, perceptions and values of the designer him- or herself. Although highly subjective, it is a valuable starting point to determine:

- What information is important or not, based on the scope of the design project
- What information is incomplete and should be further investigated
- The structure to classify information to facilitate design activity

4.4.2 INFORMATION DERIVED FROM PRINTED AND DOCUMENTED RECORDS

After the design project's problem fields have been exhausted, based on the designer's knowledge and past experiences, he or she should move on to gather information from printed and documented records. Possible sources are books, scientific journals, magazines, newspaper articles, patent documents, standards and Internet. Each of the sources will be briefly discussed below:

1. **Books and scientific journals** are a reliable source of information. Especially when they have been refereed by authorities of a particular field of knowledge its content should be of a certain quality. However the information may not be up-to-date, because it may take several years for a book and several months for a journal to get published.

2. **Periodicals** are a more dynamic source of information compared to books. For example, newspaper articles and magazines show current trends and

developments, which could be of direct relevance to the project you are currently working on. However, its content may include a component of subjectivity, which renders the information questionable in certain cases.

3. **Patent documents** are published by national, regional or international patent offices. They contain information on inventions, for which a patent is requested or has already been granted, or for which a utility model has been registered. There are several kinds of documents: publications of the unexamined application, publications of the examined application, patent specification, utility model and translations of all these documents or parts of them. All these kinds of documents are frequently grouped together under the term "patent" (Minnerman, 2004). Patent documents are a useful tool for the designer to find out what has been invented and designed in the past. It can also function as a source of inspiration for idea development and concept generation. Each year, more than one million patent documents are published, based on around half a million inventions, which is in sharp contrast to a small proportion of inventions described in other sources. This is why patent information is such an indispensable source of knowledge on the state of the art, and why it is so important for innovation. Unfortunately, the double nature of a patent document (i.e. the fact that it is both a technical document and a legal document) is frequently perceived as hindering the accessibility of its contents.

4. **Standards** are Guideline documentation that reflects agreements on products, practices, or operations by nationally or internationally recognized industrial, professional, trade associations or governmental bodies. Standards are varied. They can exist for things (e.g. light bulbs) and, increasingly, for making things happen (e.g. services) but mainly standards represent an indispensable level of know-how in any given area. In the context of public contracts or international trade, standards are essential to simplify and clarify contractual relations. To give you an idea of the scope of British Standards' work, in 2003, 1400 new standards were published and some 3000 technical committees and working groups covering 16,000 standards were supported. The value of using standards for information gathering is that an exact value, physical entity, or abstract concept, established and defined by authority, serve as a reference, model, or rule for future development in a specific field.

5. In this era of information technology, **the internet** is definitely the most powerful, comprehensive and efficient search engine. However, its coverage, established through complex linkages can, if not properly managed, confuse or distract the designer from his / her design objectives.

4.5   INFORMATION DERIVED THROUGH INTERACTION WITH OTHER PEOPLE

The main disadvantages in relying solely on documents and internet as sources of information are its limitations in terms of relative added value, potential for innovation and uniqueness. These sources of information are open to the public, do not reveal confidential and insightful data, and do not specifically connect to what is required for the project.

Using empirical research methods, unique highly valuable and targeted information can be obtained through interaction with people. These information gathering research methods can be classified under 'Observing the Product in Use', 'Interviews' and 'Story Telling', and are complementary with one another.

4.5.1   OBSERVING THE PRODUCT IN USE

Important details about users' needs can be revealed by observing them use an existing product or perform a task for which a new product is intended. For example, a table spoon is used to scope milk powder out of a tin. In most cases the rear end of the spoon is used to open the tin, as it would be difficult to do it bare-handed. When designing a new spoon, a flat rear end design would naturally be most favoured.

Observation can be distinguished into 'Participative', 'Overt' and 'Covert' observations.

A. For **Participative Observation**, it is required that the researcher becomes a participant in the culture or context being observed. This method of observation often requires months or years of intensive work because the researcher needs to become accepted as a natural part of the culture in order to assure that the observations are of the natural phenomenon. For the practice of Industrial Design, such a method would be difficult to implement, because of a limited availability of time and financial resources on one hand and the continuous challenge for early market introduction on the other hand.

B. The differences between **Overt and 'Covert Observations** (Stanton, 1998) are listed below in table 4.1:

Overt Observation	Covert Observation
The individual being observed is aware. This has the advantage of co-operation	The individual or group is not aware of being observed, or is initially aware, but may easily forget.
Success of this method of observation relies on the seriousness and reliability of the test subject.	One-way mirrors and video cameras are used. This may lead to ethical problems as people are watched without their consent
The subject may give his or her best, but most unnatural performance	Outcome is more accurate as the subject will be behaving more naturally

Table 4.1; Differences between 'Overt' and 'Covert' observations

C. **Overt and Covert observations** are distinguished from **Participative Observation** in a number of ways. Firstly, the observer doesn't typically try to become a participant in the context. He prefers to be as unobtrusive as possible so as not to bias the observations. Secondly, this suggests a more detached perspective. Thirdly, "Overt" and "Covert" tend to be more focused than participative observation. The researcher is watching certain sampled situations or people rather than trying to become immersed in the entire context. For instance when 'Covert Observation' is applied, one might observe the use of an iron under specific circumstances in a laboratory setting from behind a one-way mirror, looking specifically for unsafe actions during the process of use. The use of technologies, such as video recording equipment and one way mirrors would complement the experiment to obtain more accurate results. Fourthly, this type of observation tends not to take as long as participative observation.

In observations, where the observer adopts a passive role, qualitative as well as quantitative information can be acquired. However, when the observer takes a more participative role, observations are most likely limited to qualitative information gathering.

The qualitative aspect is determined by directly analysing user behaviour in relation to task and object within a specific environment. This will then be reflected upon the observers past experiences, values and perceptions. If certain elements of the observation are unclear or absent, surveys need to be conducted to connect the missing pieces.

The quantitative aspect of observations need to be determined through the use of recordings. The following example shows how the ease of embarkation and disembarkation from bus to bus shelter is determined through the use of video

recordings. After processing, time studies can be accurately conducted in relation to body movements and postures.
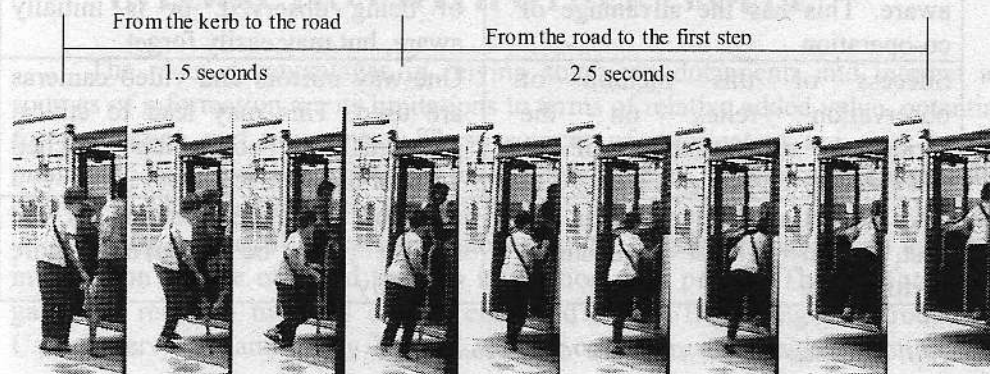

Figure 4.3; The use of adobe premiere for framing pictures for measuring performance time of elderly female passengers (the pictures are shown in every 0.5 second, (Hu Xia, MA Arch 2004).

In a recent final year project (Tan H. Y., 2004), elaborate observational studies were conducted on "Living Spaces for Dynamic People". In this project, the designer aims to study and address changes in modern day living, and the demands we make on our living spaces, to redefine the modern living space. It was an exploration and analysis in the changing roles of furniture, its flexibility, fluidity and mobility, while rediscovering the pleasure of shaping environments. Interestingly, the study led to a mapping of activities in relation to the need of certain furniture in specific areas of the living space. Prior to this, activities were analysed and tabulated based on body postures.
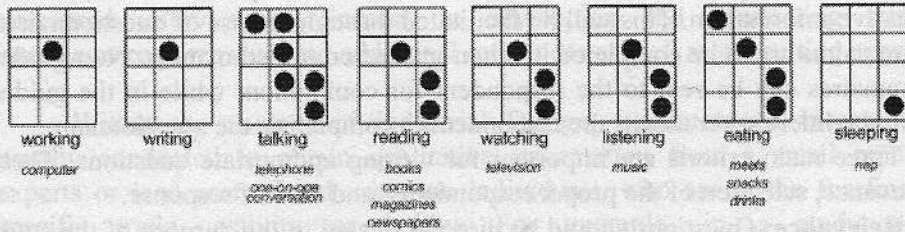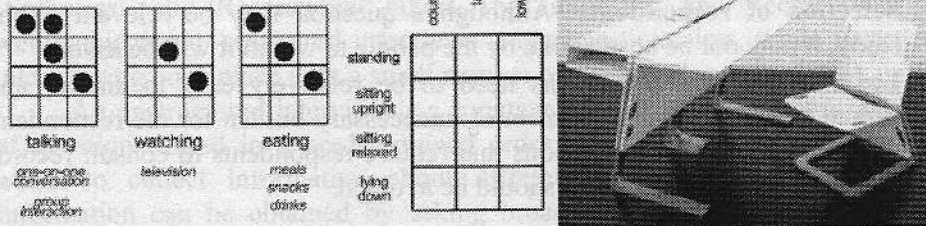
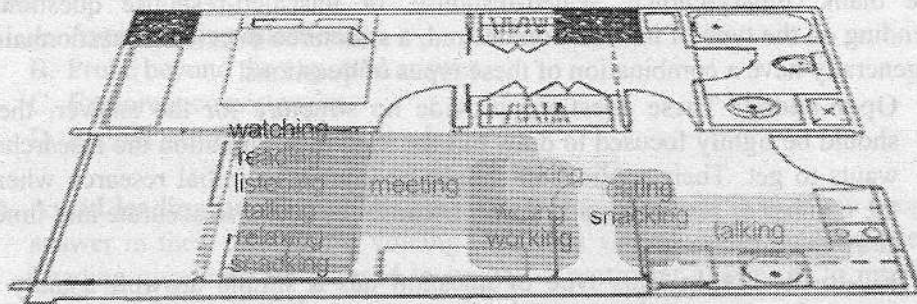Figure 4.4; Analysis of activities based on postures (Tan Han Yang, NUS BAID 2004)

Figure 4.5; Mapping activities in relation to the need of certain furniture in specific areas of the living space.(Courtesy of Tan HanYang, NUS BAID Student 2004)

4.5.2   STRUCTURED AND UNSTRUCTURED INTERVIEWS

From a designer's perspective, interviews can be applied complementary to observations. The most common techniques are structured and unstructured interviews.

Structured interviews are conducted to obtain qualitative as well as quantitative information. This will be facilitated through the use of questionnaires. Questionnaires are to be completed in a non-guided or guided manner. Non-guided questionnaires can be sent to the respondent for completion, while in the guided context, the interviewer assists the respondent in completing the questionnaire.

Three main criteria are important for writing appropriate questions. These are relevance, selection of the proper respondents, and ease of response.

- **Relevance:** Questions should be directly related to the purpose of the study and have a good chance of producing the desired data
- **Selection of respondents:** Although a question may be relevant to the study, it may not be answerable by the people to whom it will be asked.
- **Ease of response:** Questions need to be relatively easy to answer and should not create embarrassment or unnecessary burden for the respondent. For example, types of questions that require respondents to consult records or other information sources should be avoided.

Important considerations in deciding on the format of questions include how the question is to be delivered (mail, telephone, face to face), the type of information the respondent is expected to provide, and the possible alternative responses. Making these decisions will result in the selection of open-ended, fill-in-the blank, binary-choice, scaled-response, or unscaled-response questions. Depending on the type of information desired, a structured interview questionnaire will generally have a combination of these types of questions.

- **Open-ended:** These questions provide no structure for the answer, they should be tightly focused to draw out the kind of information the researcher wants to get. Their application should be limited to initial research where the number of respondents is small, because they require accurate and time-consuming transcription.
- **Fill-in-the-blank:** This type of question has a simple answer, usually a name, frequency, or quantity, which is the kind of information these questions are good at obtaining.
- **Binary**: These questions are applied for obtaining factual information that falls into the yes-no, true-false category of answer.
- **Scaled response**: These consist of a list of alternative responses, based on rating and ranking, that increase or decrease in intensity according to an ordered fashion.
- **Un-scaled response**: In this type of questions, the respondent is asked to choose one or more options from a list. However to cater for some flexibility, the option "Others", complemented with a required explanation, is usually included

The reader should be made aware that the above are just guidelines for structured interviewing. Success in developing and conducting structured interviews requires studying additional references as well as consulting experts.

Within the context of Industrial Design, **unstructured interviews** are usually conducted to obtain qualitative information from a small number of experts or lead users. Lead users are individuals, who are in the forefront of a specific trade, activity or hobby. For example, in a study on the compartmentalisation of backpacks, subjects were classified into 'Expert', 'Enthusiast', and 'Recreational' hikers. The 'Enthusiast' and 'Recreational' group were subjected to structured interviews using questionnaires, while unstructured interviewing book place with a small number of Experts (Liem A., 1994).

An unstructured interview is a spontaneous conversation, not a specific set of questions asked in a predetermined order. The interviewer has a focus and wants to collect information about different aspects of the belief system. Information can be obtained by asking broad questions in a natural and free-flowing manner. The number and type of questions need not to be consistent among the participants.

In summary, there is no one right way to do an unstructured interview. It can go in any direction. Some general rules for conducting unstructured interviews are:

A. Avoid leading questions
B. Probe beyond the expected answer
C. Explore inconsistencies
D. Record participants' own words.

A. Avoid leading questions: The best way to ask questions is to allow people to answer in their own terms, voicing their own views, values, and experiences. Leading questions are phrased to suggest a particular answer or to imply that one answer is expected or more correct. For example:

- *What fears do you have when using a hand drill?*
- *What actions do you take to have a better control over your hand drill?*
- *What will you do, when you drill wrongly or hurt yourself?*

These questions are phrased to elicit answers connected to fear, actions, and treatments. Non-leading questions on the same topics would be asked in this way:

- *How do you feel when using a hand drill?*
- *What do you do to improve the use of the hand drill?*

It takes practice to ask non-leading questions. In design non leading questions are preferred to obtain a most objective view on a certain situation or use of a product.

B. Probe beyond the expected answer: To probe means not to stop too soon when discussing an important topic. Ask the same question in a number of different ways to better understand beliefs and assumptions. An advantage of unstructured interviews is the opportunity they provide for rich insight and understanding beyond common answers.

C. Explore inconsistencies: In some cases, respondent's statements appear to contradict their previous statements or explanations. This is caused by the fact that all people hold some beliefs that are not completely consistent with their other beliefs. It would also be possible that they misunderstood the question, resulting in an apparent contradiction. Therefore, it is important to explore apparent inconsistencies in greater depth to clarify a misunderstanding or gain new information.

D. Record participants' words: When taking and rewriting notes, reproduce the respondent's own words and phrases as faithfully as possible. As you cannot record everything a person says during the interview, focus on new words or pieces of information and on subjects that seem unclear or confusing. If a certain order is followed when rewriting your notes, it will be easier to summarize and compare the information obtained from all the participants. For example, you might follow the outline of your interview guide, adding information that identifies and gives some background about the respondent. In terms of managing information, it is useful to make a form for each respondent that leaves plenty of space to add information collected during follow-up visits. Field notes should be reviewed and rewritten as soon as possible after each interview. You should not wait until the end of the day, as what is said may be forgotten after several conversations. The time spent on reconstructing each interview is as important as the time given for interviewing.

4.5.3   FOCUS GROUP DISCUSSIONS

The use of carefully constituted focus groups can provide valuable information about the use of a product in a real-life situation. The power of focus group discussions is revealed through the cross-fertilisation of insights and ideas. This may lead to interesting views on additional functions and design changes.
For a focus group discussion to function well, it needs to be carefully structured, based on a predetermined agenda. The number of participants should be in-

between 8-12. More than 12 will become unmanageable, while a small group may be dominated by a handful of forceful individuals.

As focus group discussions can be applied at various decision making stages of the design process, a more detailed structure will be shown in "Chapter 10: Concept Testing and Evaluation".

4.5.4 STORY TELLING

In comparison to observational studies and surveys, which are partly subjective, this technique is based on the belief that most powerful information is derived from individual's exceptional and unusual stories. By encouraging the respondent to tell his or her own experiences through visual cues, the element of subjectivity will be almost eliminated. In the most ideal situation, the interviewer should not interrupt with questions, but adopt an observing and recording role. In short: Let the story evolve through visuals!

A case study of a hand phone shows the various steps which will be applied in "Story Telling".

Step 1: A wide range of visuals will be randomly presented to the respondent.

Figure 4.6: Randomly Selected Visuals as an Initial Aid for Story Telling

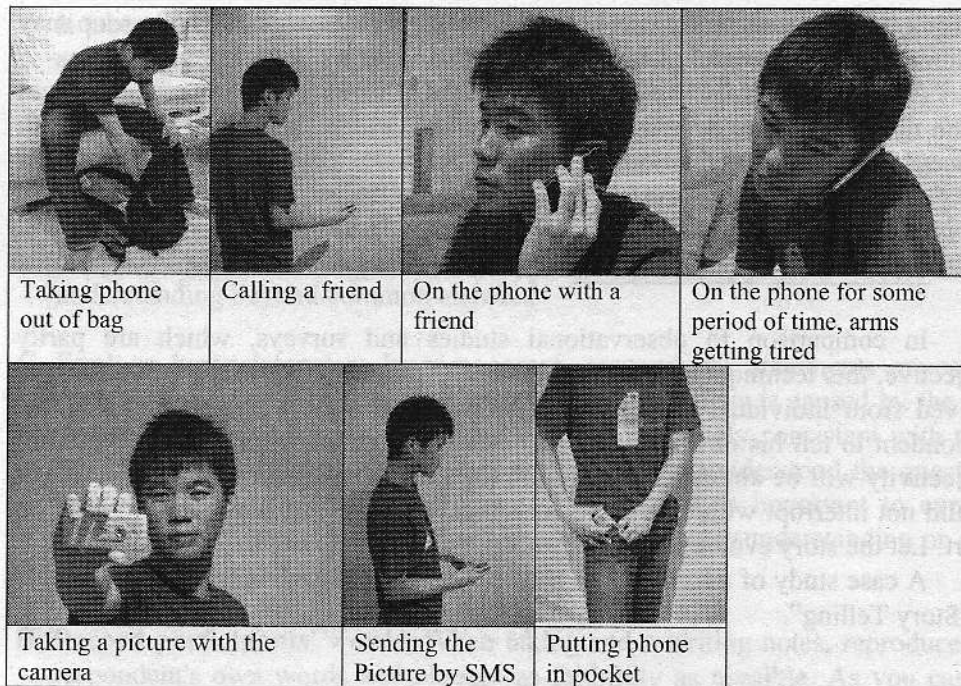**Step 2:** The respondent develops his / her story out of the presented visuals
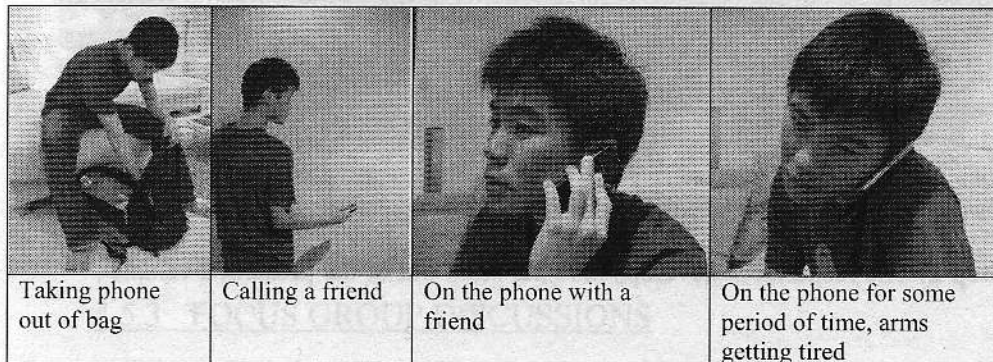
Taking phone out of bag	Calling a friend	On the phone with a friend	On the phone for some period of time, arms getting tired

Taking a picture with the camera	Sending the Picture by SMS	Putting phone in pocket

Figure 4.7: Developing a story based on presented visuals

Step 3: The story is not complete yet. The respondent will elaborate further on his / her unusual experiences, making the story much richer.

Taking phone out of bag	Calling a friend	On the phone with a friend	On the phone for some period of time, arms getting tired

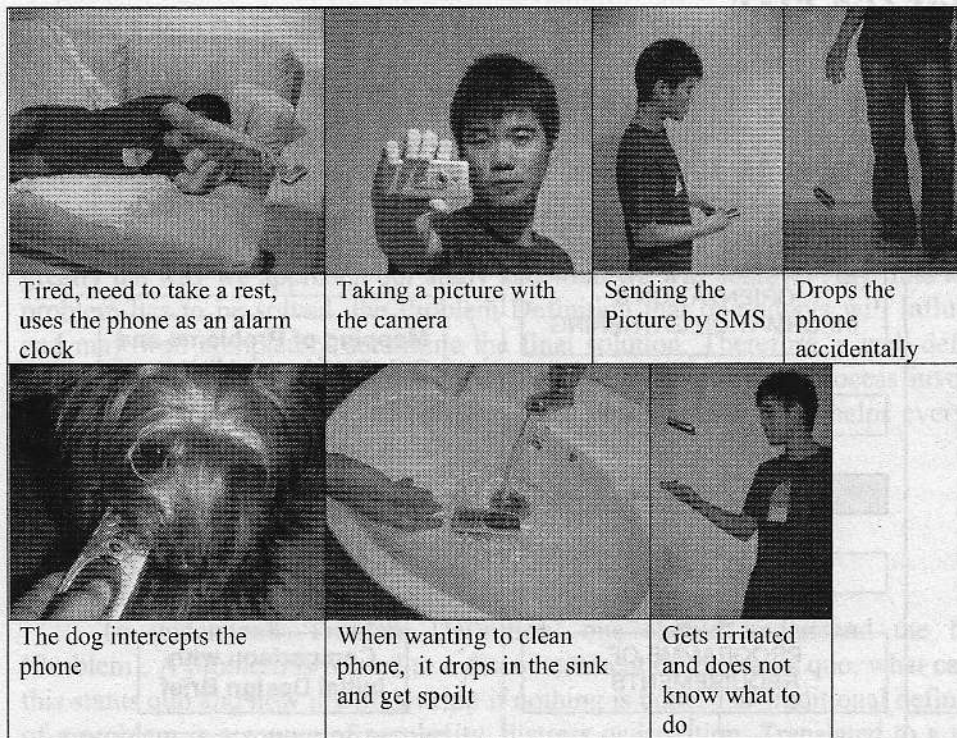|			
Tired, need to take a rest, uses the phone as an alarm clock	Taking a picture with the camera	Sending the Picture by SMS	Drops the phone accidentally
The dog intercepts the phone	When wanting to clean phone, it drops in the sink and get spoilt	Gets irritated and does not know what to do	

Figure 4.8: Elaboration of story through exeptional experiences

4.6 DISCUSSION

Structured information gathering and analysis is important for the development of good design. Reference to the wide variety of sources and techniques available, the designer should carefully determine, analyse and select the information, which is relevant for his or her design project.

The techniques discussed in this chapter vary from literature search through interviews, to story telling. Each of these techniques can be applied in isolation. However, a certain level of value-add will be achieved when these techniques are used complementary to each other, in the order of observational studies, followed by interviews and story telling.

The designer may start with a thorough analysis of existing documents. This will give him or her a broad, as well as an in-depth understanding of the problem fields. The introduction of user-centred research as an element in information gathering would be useful in terms of extracting project specific insights, which can not be obtained only through literature studies. Advanced techniques, such as focus group interviews and story telling can be applied to gain exceptional and unusual information from an objective point of view.