

# The Design and Implementation of Copy/Paste Functionality in a Mobile Phone

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Sony Ericsson

## Master's Thesis

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# Abstract

The mobile phone has become a widespread device and the manufacturers compete with each other to include more and more functionality. It has evolved from being a calling device to handle a lot of different things such as browsing the web and taking pictures. At the same time the input and output interfaces have not changed much, thereby making it increasingly difficult to keep the mobile phone user friendly.

The objective of this Master's Thesis is to find a solution for the users of the Sony Ericsson mobile phones to move data within and between the existing applications with some sort of copy/paste functionality. As a final stage of this thesis a prototype of the chosen solution is to be implemented in an existing mobile platform.

From several brainstorming sessions with the authors and some with other company employees, criteria were set up and formed into target specifications. A thorough literature study was made and formed, together with the specifications, the base for the creation of a number of different concepts.

The concepts were evaluated and rated according to how well they could be included in the chosen platform and how well they would function in a usability perspective. Three concepts were chosen to be tested further, *Copy/Paste*, *Copy/Paste/Clipboard/Latest data* and *Fetch*. Prototypes were made in a simulator and tested on users to evaluate which concept to implement.

The results showed that both the *Fetch* and the *Copy/paste* concepts got high marks in the test. The *Copy/paste* concept was the preferred one and this concept was, with some modifications from the original concept, implemented into the Sony Ericsson T610.

# Sammanfattning

Mobiltelefonen har fått en väldig spridning och tillverkarna tävlar med varandra för att inkludera mer och mer funktionalitet. Den har utvecklats från att ha varit ett verktyg att ringa med till att hantera många olika saker som t.ex. att surfa på nätet och att ta bilder. Samtidigt har in- och utmatningsgränssnitten inte ändrats nämnvärt, vilket lett till allt större problem med användarvänligheten.

Målsättningen med detta examensarbete var att hitta en lösning för användaren av Sony Ericssons telefoner att flytta information inom och mellan de olika applikationerna med någon sorts kopierings och inklistringsfunktion. Som en sista del av arbetet implementerades en lösning i en existerande mobilplattform.

Kriterier sattes upp med hjälp av flera idémöten med författarna och några med anställda på företaget. Dessa kriterier ledde sedan fram till att mål fastställdes. En ordentlig litteraturstudie gjordes och tillsammans med målen bildade den grunden till framtagandet av ett flertal koncept.

Koncepten utvärderades och rankades efter hur väl de skulle kunna inkluderas i den valda plattformen och hur bra de var ur ett användarvänligt perspektiv. Tre koncept, *Copy/Paste*, *Copy/Paste/Clipboard/Latest data* och *Fetch*, valdes ut för ytterligare testning och prototyper gjordes i en simulator. Dessa testades på användare för att utvärdera vilket av koncepten som skulle implementeras.

Resultaten visade att både *Fetch* och *Copy/paste* fick höga poäng i testet. *Copy/paste* var det mest önskvärda och implementerades med några ändringar i Sony Ericsson T610.

# Preface

This Master's Thesis, entitled "*The Design and Implementation of Copy/Paste Functionality in a Mobile Phone*" was prepared as a compulsory part of the Master's education in Electrical Engineering at Lund Institute of Technology and at the Department of Computer Science at Lund University.

The work has been carried out at Sony Ericsson Mobile Communications AB in Lund between February and June 2003.

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*Jessica Erlandsson*  
*Martin Johansson*

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# 1 Introduction

## 1.1 Background

In the mobile phones of today<sup>1</sup>, the wide range of applications tend to turn the phones into handheld computers. The phones appear to be losing some of the primary usage area, i.e. calling, and the applications require more text input than they did before.

From the use of computers, many people have experience from copy/paste when they are writing documents or handling different files. Shortcut commands or menu alternatives make this function available in several ways.

The complexity of mobile phones makes it necessary for new functions to be intuitive and thereby easy to use or else they will cause problems and confusion for the users and probably not be used at all.

This thesis was carried out at Sony Ericsson Mobile Communications AB in Lund in co-operation with the Department of Design Sciences, the Division of Ergonomics and Aerosol Technology at Lund Institute of Technology, Lund University.

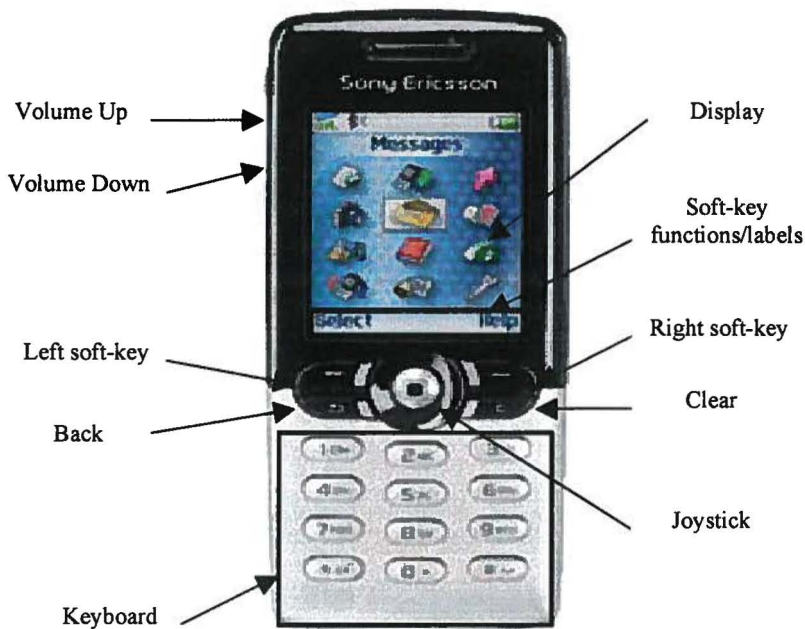
Sony Ericsson Mobile Communications AB [14] offers mobile multimedia consumer products for people who appreciate the possibilities of powerful technology. By creating an enticing brand and taking the lead in bringing new ways of using multimedia communications while mobile, Sony Ericsson can create compelling business opportunities for its operator customers.

## 1.2 Problem

The applications in a mobile phone use different kinds of information, e.g. text strings, phone numbers or e-mail addresses. This information is tied to the application and can in many cases only be manipulated from the same application as in which it was produced. It is desired to allow the user to transfer this information between applications and in that way make it easier for the user to collect and manipulate the information.

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<sup>1</sup> Spring/summer 2003



**Figure 1 - The Sony Ericsson T610**

The limitation of input devices in a mobile phone makes it even more important to have an easy access to the information for copying rather than producing it once more. They also make it harder to navigate inside the phone or switch applications. Due to these hardware restrictions with few keys, the new feature<sup>2</sup> with multi function keys – *soft-keys* – are of high interest for this thesis. These keys can have different functionality depending on the context and a description of their current functionality is always visible at the bottom of the display. In Figure 1, a Sony Ericsson T610 is shown with labels of the different parts.

Because of the limited size of the display it must be very easy and intuitive for the user to copy/paste the desired information. Unfortunately, the development of mobile phones is very fast and no common user interface or terminology is set between the manufacturers. Compared to computers it is hard to use a pointing device and it is impossible to have several windows open beside each other in the display.

Throughout the report the terms copy/paste are used to describe the functionality of extracting information from one place and inserting it in another place.

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<sup>2</sup> The first Sony Ericsson mobile phone with soft-keys, is the T610, released during spring 2003.

### **1.3 Purpose**

The purpose of this thesis is to investigate, develop and implement copy/paste functionality in a mobile phone as user friendly as possible.

### **1.4 Objective**

The objective of this thesis is to make a study how copy/paste functionality can be useful for users of mobile phones. With this study as a starting point the function should be designed and implemented into a mobile phone.

The implementation is desired to be as general as possible to make it possible to use it in all applications, that can manipulate information. This objective is to bring consistency to the functionality and avoid any unexplainable exceptions for the user.

### **1.5 Delimitations**

Delimitations for the implementation is to develop a prototype within the existing Sony Ericsson T610 platform. This phone has an ordinary numeric keyboard and no ability to use a pen or similar for text input, as in phones with touch screens.

This thesis will concentrate on manipulating information within the phone. The functionality is supposed to be used for all different formats in the phone, but the main focus will be on text, since it appears to be the most commonly used format for copy/paste.

## 2 Theory on Usability Oriented Design

### 2.1 Design Methodology

#### 2.1.1 Introduction

According to Preece et al [9] human-computer interaction design should be highly iterative, user-centered and integrate knowledge from different disciplines. A method including this and prompting for ease of use with products is the User-Centered Design (UCD) approach, which is widely employed within Sony Ericsson.

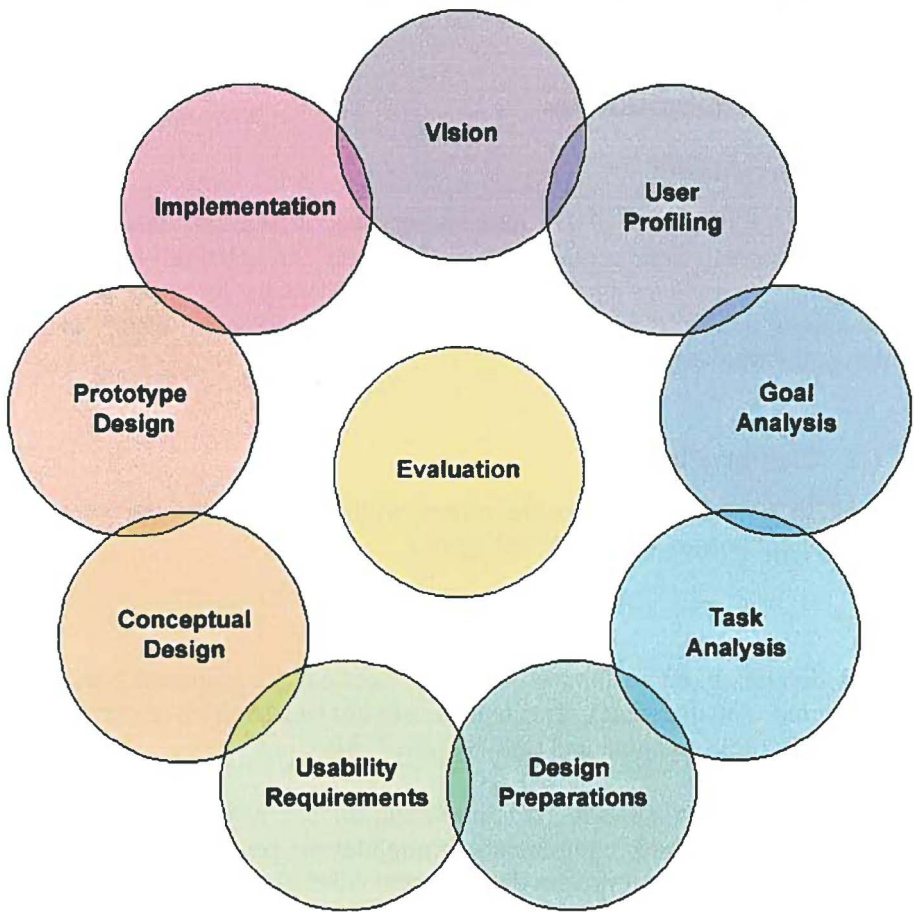
#### 2.1.2 Design Phases

The UCD process involves several phases with evaluation playing a central part. The different phases are visible in Figure 2.

##### *Vision*

In this first phase, the vision the customer has about the proposed system should be captured. The different user categories should be identified to serve as a base for the user profiling, goal and task analysis [13].

To develop the best solutions, it is important there is a willingness to question, change, remove or add requirements throughout the process [13]. Besides that, it has been proven that software development costs are heaviest at the beginning and at the end of the development cycle. Effective requirements estimations are therefore one way to decrease overall software development costs [11].



**Figure 2 - The User-Centered Design process, reprinted with permission [13].**

### ***User Profiling***

It is important to determine what user group the product will target. Multi function products are used in different ways by different people; the way the products are used is based on education, computer and work experience, culture, abilities and so on. If a product is aimed to satisfy everybody it is possible that no one will be satisfied. To do the user profiling as precise as possible one imaginary person, *a persona*, is targeted instead of a group. If a group is used it is a risk that the design will aim to satisfy the edges of the group, with the same result as in designing for everybody. The target should be someone in this group and if this person is completely satisfied it is likely that people with similar background will be satisfied as well [13].

*"The broader target you aim for, the more certainty you have of missing the bull's eye. If you want to achieve a product satisfaction level of 50%, you cannot do it by making a large population 50% happy with your product. You can only accomplish it by singling out 50% of the people, and striving to make them 100% happy." – Alan Cooper [2].*

A persona is accordingly a hypothetical user archetype that represents the needs and goals of several users; personas are *not* average users. Several personas can be used and if there are personas who the design is *not* developed for they are called *negative personas* [13].

### ***Goal Analysis***

Goals and tasks have a close connection; goals are the reason why tasks are performed. The design should be goal directed – not only task directed, and it should help the user to achieve goals with minimum effort. Users do not often care about how they achieve the goals, but only about if the method or task is convenient, reliable and easy. A goal analysis can be run as a brainstorming session [13].

### ***Task Analysis***

Task analysis concerns what tasks people do to reach their goals [9]. The analysis has to be carried out without making any assumptions about the design of the application or function [13].

In addition to undertaking tasks, users also perform actions or operations such as pressing a key on a keyboard or moving a mouse. These would not usually be considered tasks since they do not require thought. Task analysis techniques may be grouped together in various ways, but probably the most important distinction is whether the technique aims to represent the cognition, practice or logic of the task [9].

An important determinant of the success of any particular design is the procedural knowledge possessed by users – their "how-to-do-it" knowledge. Given that the user has understood what needs to be done (in general terms) in order to accomplish his/her goal, this analysis attends to the actions that then have to be undertaken [9].



## ***Design Preparations***

In this phase, the material gathered from all the previous phases is analyzed and produces a set of interaction design recommendations [13].

The four main design principles of good direct manipulation interface design are affordances, constraints, mappings and feedback [9].

- **Affordance** is defined by Norman [8] as *“a technical term that refers to the properties of objects – what sorts of operations and manipulations can be done to a particular object”*. What does the object invite the user to do?
- **Constraints** limit the number of possibilities of what can be done with the product [9]
- **Mappings** is said to be good if the controls of the system and their outcomes appear natural and intuitive to the users. Bad mappings appear if the relations are inconsistent or incompatible [9].
- **Feedback** is, according to Norman, the *“sending back to the user information about what action has actually been done [and] what result has been accomplished”* [7].

Scenarios, i.e. a concise textual description of a persona using the design in a realistic context of use to achieve a goal, should be created. Efficient scenarios should be broad rather than deep; i.e. it is more important that a scenario is described from start to finish than that it covers every possible detail. The scenarios should also be credible [13].

## ***Usability Requirements***

Usability can be defined as the sum of all properties that make a system efficient, easy to learn and easy to use [13]. The ISO 9241 standard [4] defines usability as: *“the effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments”*.

- **Effectiveness** – the accuracy and completeness with which users achieve specified goals.
- **Efficiency** – the resources expended in relation to the results achieved.
- **Satisfaction** – the comfort and acceptability of use.



Preece et al [9] express usability in a similar way:

- **Learnability** – the time and effort required to reach a specific level of use performance. Learning is an active process, we learn most naturally by doing and following examples. Active learning involves using analogies, making errors and trying to explain the system's behavior.
- **Throughput** – the tasks accomplished by experienced users, the speed of task execution and the errors made
- **Flexibility** – the extent to which the system can accommodate changes to the tasks and environments beyond those first specified
- **Attitude** – the positive attitude engendered in users by the system

*"If the user can't use it, it doesn't work"* – Susan Dray [13].

There are several types of usability requirements, all placing emphasis on effectiveness, efficiency and satisfaction, some of them are the following [13]:

- **Benchmarking** – the function can be evaluated against a comparable competitor product and as a minimum requirement, the new design should not do worse than a competitor.
- **Usability standards** – For example the European Telecommunications Standards Institute (ETSI) has stated that *"75% of a target user group should be able to accomplish a task in a system on their first attempt, whereas 90% should succeed within the second attempt."*
- **Satisfaction requirements** – Measured using questionnaires. For some applications, efficiency and productivity may not be as important as having fun or being cool. A good target is, for any application, to exceed customer expectation.

## ***Conceptual Design***

Conceptual design concerns what the system must do in order to achieve its purpose and the necessary structure that is required [9]. In this phase the first concrete design activities take place. The conceptual design should be viewed at as a middle step between analysis and prototyping, looking at the overall design of an application or function [13].

To help generate designs or to serve as input to the design there are several techniques. Some of them are [13]:

- Brainstorming – gather a group of people and generate ideas.
- Lateral thinking – generate alternatives, diverging to different possible solutions instead of converging to only one solution, which may later show to be the wrong one. In fact, the initial design is often wrong.
- Look at differences and similarities between the application and other phenomena, other fields or other technologies. Let them be the source of inspiration.

Sketches, storyboards<sup>3</sup> and prototypes are good methods to visualize the design [13].

## ***Prototype Design***

The design requires evaluation, preferably with representative users conducting real tasks in a realistic context of use. To be able to do this, a prototype has to be created [13].

The purpose of prototyping is to eliminate the possibilities of uncertainty and misunderstandings regarding the design. Another purpose is to find problems and solutions at an early stage of design, before the specification and implementation phases have started. With a prototype it is easier to find out if the design overlooks any user goals [13].

Low fidelity prototyping involves the use of materials that are further away from the final version and tend to be cheaper and faster to develop. For example, a software version of the interface with cut down functionality would be of higher fidelity than storyboards [9].

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<sup>3</sup> A combination of scenarios and user interface sketches

There are several choices of how to form the prototype [13]:

- **Paper prototypes** – a very basic prototype constructed with pens, paper, glue, post-it notes, tape and/or transparent overhead film et cetera.
- **Mock-ups** – wooden blocks or plastic models where screen dumps on paper or drawings on post-it notes represent the user interface.
- **Animated GIFs** – detailed dynamic behavior like animations can be simulated using software to generate animated GIFs displaying the behavior.
- **Computer simulations** – to get a more realistic view with more life-like navigation, input selection and/or other details of the function, a high fidelity prototype can be created.

### ***Implementation***

The software implementation should be a continuous and escalating process running in semi-parallel with the earlier phases to build up a fully functional application. It is important to include the results from the evaluations throughout the process and to take care of new problems, that arise during the implementation [13].

### ***Evaluation***

Evaluation plays an essential role in every phase of the design, but may differ depending on where in the process it is performed. Usability, utility and user experience cannot be plastered on top of a ready-made design; it has to take a natural part in every development phase [13]. Four main reasons for doing evaluation can be identified [9]:

- Comparing designs – which is the most suitable?
- Understanding the real world
- Engineering towards a target – is it good enough?
- Checking conformance to a standard

To split up the varying evaluation methods, they can be classified into five groups: observation and monitoring, experimenting and benchmarking, collecting users' opinions, interpreting situated events and predicting usability [9]. Some advantages and disadvantages can be viewed in Table 1, and different evaluation methods are described in section 2.2.

**Table 1 - Some advantages and disadvantages of evaluation techniques, authors' interpretation from Preece [9]**

Method	Advantages	Disadvantages
Observing and Monitoring	Widely applicable, highlights difficulties	Can affect users' behavior
Experiments and benchmarking	Provides measurements to guide design	Requires expensive Facilities
Users' opinions	Inexpensive	May get low response rate
Interpretive	Reveals what really happens in the field	Requires sociological Expertise
Predictive	Most forms do not require a working system	Some forms have a narrow focus

## 2.2 Evaluation Methods

During the UCD process it is important to evaluate the system repeatedly. A large range of evaluation methods can be used, some of them are presented below.

### 2.2.1 Eight Golden Rules

These rules [10] act as a guideline while creating an interface design, but to be useful they must be interpreted, refined and extended for each environment.

#### 1. Strive for consistency

This rule is the most frequently violated one, but following it can be tricky because there are many forms of consistency. Consistent sequences of action should be required in prompts, menus, and information boxes. There should also be a consistency of color, layout, capitalization, fonts, and so on throughout the whole application.

#### 2. Enable frequent users to use shortcuts

As the frequency of use increases, so do the user's desire to reduce the number of interactions. Abbreviations, special keys, hidden commands and macro facilities are appreciated by frequent knowledgeable users. Short response times and fast display rates are also important.

#### 3. Offer information feedback

There should be system feedback for every user action. For frequent and minor actions the response can be modest whereas, for infrequent and major actions, the response should be more substantial.

**4. Design dialogs to yield closure**

Sequences of actions should be organized into groups with a beginning, middle and an end. The informative feedback at the completion of a group of actions gives users the satisfaction of accomplishment and an indication that it is clear to prepare for the next group of actions.

**5. Offer error prevention and simple error handling**

The design should be developed in such way that users cannot make serious errors. For example, do not allow letters in a numeric entry field and prefer menu selections to form filling. If users make an error, the system should detect the error and offer simple, constructive, and specific instructions for recovery.

**6. Permit easy reversal of actions**

Actions should be as reversible as possible. This feature reduces anxiety and encourages exploration of unfamiliar options since the user knows that errors can be undone.

**7. Support internal locus of control**

Experienced operators strongly desire the sense that they are in charge of the system and that the system responds to their actions. The users should be the initiators to actions rather than responders. Surprising system actions or inability to produce the actions desired build anxiety and dissatisfaction.

**8. Reduce short-term memory load**

The limitation of human information processing in short-term memory<sup>4</sup> requires displays to be kept simple. Sufficient training time should be offered for codes, mnemonics and sequences of actions.

### **2.2.2 The GOMS Evaluation Model**

The goals, operations, methods and selection rules (GOMS) model developed by Card et al. [9], consists of descriptions of the methods needed to accomplish specified goals. The methods are a series of steps consisting of actions that the user performs to fulfill tasks. When there is more than one method available to accomplish a goal, the GOMS model includes selection rules which helps to choose the appropriate method depending on the context.

GOMS models may be constructed after the implementation of a system or during the design. As with all models a GOMS model must be appropriate for its purpose, which Kieras [9] suggests are: producing an evaluation of the naturalness, completeness, consistency and efficiency of the design; predicting human performance with a design and providing suggestions for improving the design.

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<sup>4</sup> The rule of thumb is that humans can remember  $7 \pm 2$  chunks of information.

Once the GOMS model analysis has been completed it can be used in a number of ways, for example:

- Predicting the quality of an existing system or a prototype
- Checking for consistency of methods
- Checking that most frequent goals are achieved by relatively quick methods
- As a quantitative evaluation technique
- Choosing between alternative designs

### **2.2.3 Keystroke Level Model**

One of the most widely known analytic methods is the keystroke level model, (KLM) also developed by Card et al. [9]. This is an example of a single-layer model and it deals with short tasks, usually just single commands, and has very simple user operations embedded in the task sequence. The purpose of the keystroke level model is to enable designers to calculate task performance times that can be achieved by experienced users, i.e. it gives the designer an idea of the minimum performance time for specified commands, such as keystrokes.

### **2.2.4 Heuristic Evaluation**

In a heuristic evaluation, reviewers examine the system or prototype as in a general review or usage simulation. But their inspection is guided by a set of high-level heuristics (recognized usability rules), which guide them to focus on key usability issues of concern [9]. Some advantages and disadvantages are visible in Table 2.

### **2.2.5 Cognitive Walkthrough**

A cognitive walkthrough involves one evaluator or a group of evaluators inspecting a user interface by going through a set of tasks and evaluating its understandability and ease of learning [13]. This method is also used to predict the problems that a defined user group will encounter doing a specified task [9]. Cognitive walkthroughs are suitable for evaluating storyboards, but also at later stages in the design [13]. Some advantages and disadvantages are visible in Table 2.

*“A user interface is that part of an electronic appliance which serves the information exchange between user and appliance. It consists of controls, displays and an intrinsic structure. If human and machine are considered as a whole, one talks about a human-machine system” - K. Bauman [1].*

**Table 2 - Some advantages and disadvantages of three evaluation methods, authors' interpretation from Preece [9]**

Method	Advantages	Disadvantages
Heuristic evaluation	Identifies many problems. Identifies very serious problems Low costs	Requires user interface experience Requires several evaluators
Cognitive Walkthrough	Helps define users' goals and assumptions. Can be used by software developers	Needs task definition methodology Tedious Misses general and recurring problems
Usability testing	Identifies serious and recurring problems Avoids low-priority problems	Requires user interface experience High cost Misses consistency Problems

### 2.2.6 Usability Test

A product is tested to find problems, and if problems have been predicted by a heuristic evaluation or another review they should be candidate concern for a usability test [3].

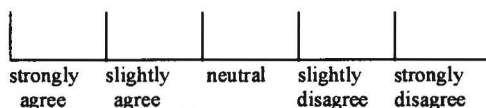
One of the problems with usability engineering is that the test conditions are rather artificial and not representative of the real world. It is however good for fine-tuning product upgrades [9].

#### *Preparations*

Preparations for a usability test are very important to get the most out of the test. One of the most important preparations is to define goals for the test. Papers to prepare in addition to the product are [3]:

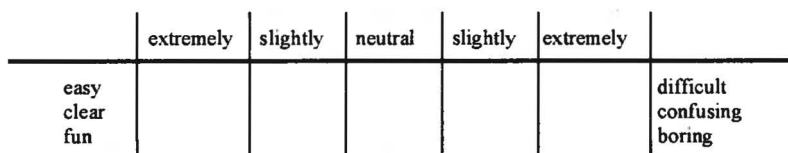
- legal forms to protect the rights of the organization and the participant
- questionnaires for the participant to fill out
- a training script to bring all participants to the same level of experience
- task scenarios

Questionnaires can be created in several different ways. One way is to measure the strength of agreement with a Likert scale, as is in Figure 3.



**Figure 3 – A Likert scale, authors’ interpretation from Preece [9]**

A good test scenario is, according to Dumas & Redish [3], short, in the user’s words and unambiguous. It should give the testers enough information to do the task and it should be directly linked to the tasks and concerns. To evaluate the tasks a form can be filled in. One kind of attitude scale is the semantic differential, which has bi-polar adjectives at the end points of the scale. An example is shown in Figure 4.



**Figure 4 – An example of a semantic differential, authors’ interpretation from Preece [9]**

When all preparations are done for a usability test, a pilot test can be run. A pilot test is a small study to test out the procedures to be used in a larger scale study. Pilot tests are important for determining whether the experimental design is suitable before time, effort and money are invested in a full-scale evaluation [9].

## ***Participants***

The participants in a usability test must represent the targeted user group. *“To get useful results from a usability test, you must know the users – and potential users – of the product”* – Dumas & Redish [3].

Dumas & Redish [3] have stated that *“A typical test includes 6 to 12 participants”*. They also have set up a few reasons why people tend to use company employees as participants and then some thoughts about them, visible in Table 3. *Their conclusion is that company employees may not represent the actual users because they are familiar with company products and the jargon the company uses.*



**Table 3 – Reasons and buts with company employees as participants in a test [3]**

Reason	But
Tighter security for an unreleased product	Outsiders can sign a confidentiality Agreement
Lower costs	The costs may actually be higher since the participant is in the lab and not at his/her regular job
Recruiting is easier	The participant needs to be able to take some time off from his/her ordinary assignments

### ***The Test***

To really get to know how the tester reacts on the concept it is important to ask the participants to think out loud during the whole test [3].

*“‘User observation through thinking out loud’ results in our being able to ‘see inside’ our user’s conscious minds, to understand what errors in process are taking place.” - B. Tognazzini [12].*

When performing a test with users, it is important to introduce the participant in the correct way and not scare him/her off. Gomoll & Nicol have written a list of instructions to guide the test leader through a simple user observation [12]:

- 1. Introduce yourself.**
- 2. Describe the purpose of the observation (in general terms).**  
Set the participant at ease by stressing that he/she is helping out to improve the product by trying it out at an early stage. It is the product that is being tested, not the participant. If trouble spots are located they help to go back and improve the product.
- 3. Tell the participant it is OK to quit at any time.**  
Participants should never feel like they are locked into completing tasks.
- 4. Talk about the equipment in the room.**  
Explain the purpose of each piece of equipment (hardware, software and so on) and how it will be used in the test.
- 5. Explain how to “think aloud”.**  
Ask the participants to think out loud during the testing of the product and tell the tester that it is the best way for the developers to get a lot of important and useful information. Listening to the users while they are working makes it easier to understand their expectations for the product, as well as their intentions and their problem-solving strategies. In this way it will be easier to develop help instructions for future users.

**6. Explain that help will not be provided.**

It is very important to let the tester work with the product without any interference or extra help. This is the best way to see how people really interact with the product. If any help should be offered, it should be decided before the test begins to provide all testers with the same instructions.

**7. Describe the tasks and introduce the product.**

Explain what the participant should do and give the participant written instructions for the tasks. If the prototype has to be demonstrated, be sure not to demonstrate the tasks about to be tested.

**8. Ask if there are any questions before the test is started; then begin the observation.**

Make sure the participant is at ease with the situation.

**9. Conclude the observation.**

When the test is over, explain to the participant what the objective of the test was and answer any remaining questions the tester may have. Discuss any interesting behavior noticed during the test with the participant.

**10. Use the results.**

The purpose of observing users is to see what parts of the product might be difficult or ineffective. Review all the taken notes carefully and thoroughly. Look for places where the participants had difficulties and see if it can be determined how the product could be changed to alleviate the problems. Also look for patterns in the participant's behavior that might explain whether the product is correctly understood or not.

### ***Evaluation of the Test***

When the usability test has been carried out the usability goals should be evaluated by Shneiderman's five measurable human factors [10]:

- 1. Time to learn** – How long does it take for typical users to learn how to use the commands relevant to a set of tasks?
- 2. Speed of performance** – How long does it take to carry out the benchmark tasks?
- 3. Rate of errors by users** – How many and what kinds of errors do people make in carrying out the benchmark tasks? Although time to make and correct errors might be incorporated into the speed of performance, error handling is such a critical component of system usage that it deserves extensive study.

4. **Retention over time** – How well do the users maintain their knowledge after an hour, a day or a week? Retention may be linked closely to time to learn and frequency of use plays an important role.
5. **Subjective satisfaction** – How much did the users like using various aspects of the system? The answer can be ascertained by interview or by written surveys that include satisfaction scales and space for free-form comments.



### **3 Method**

The choice of design methodology for this thesis was easy due to the central part the user takes in the process and in the problem definition. Besides that, as earlier described, the User-Centered Design process is a widely spread method and it is used within Sony Ericsson. Accordingly the UCD process was used with continuous evaluation. The phases were divided into the four following chapters as follows:

#### **Understanding the Users and the Task**

##### **Vision**

The vision of copy/paste functionality was developed without prior experience from copy/paste in a mobile phone. Brainstorming sessions were held, one with experts included and some among the authors.

##### **User Profiling**

According to the theory in section 2.1.2, the target user group is delimited to one persona.

##### **Goal Analysis**

The goals for this thesis were developed during brainstorming session.

##### **Task Analysis**

In a mobile phone tasks are carried out by pressing certain keys and to evaluate in what order the keys have to be pressed and if the order follows the user's "how-to-do-it knowledge" a heuristic evaluation was done.

A benchmarking was carried out where both in-house and comparative products were tested. In order to get a closer look at what things a user is able to copy in a mobile phone and a how the user can mark the things to be copied, two lists were set up.

#### **Design and Evaluation of Different Concepts**

##### **Design Preparations**

To find the best design for copy/paste functionality, the results from the earlier phases were gathered and put together as design requirements. The design should follow the interaction principles described in chapter 2, the Eight Golden Rules of interaction design, and affordances, constraints, mappings and feedback. A list of design requirements was set up and six scenarios for the persona - described in user profiling - were developed.

### **Usability Requirements**

The usability requirements were listed and compared to the theory in section 2.1.2.

### **Conceptual Design**

Without, at first, considering the different design and usability requirements eleven concepts were developed during several brainstorming sessions. It was important not to consider the requirements in order to be as broad-minded as possible and find new ways of the copy/paste functionality. The concepts were evaluated with almost every evaluation method in section 2.2, especially the Keystroke Level Model, section 2.2.3. As result of the evaluation, three of the best rated concepts were prototyped to be tested in a usability test.

## **Prototype and Usability Test**

### **Prototype Design**

To test the result of the conceptual design, a high fidelity prototype was created as a computer simulation and a usability test, described in section 2.2.6, with nine participants was carried out. A pilot test was done to evaluate the test and the questionnaires. The nine participants were mainly in-house co-workers with as little technical background as possible.

When all participants were done, the test was evaluated and a final concept to implement was found.

## **The Implemented Concept**

### **Implementation**

For the first time, the technical restrictions were taken into consideration. The one concept, the result of the user testing, was implemented in the same platform as the Sony Ericsson T610.

## 4 Understanding the Users and the Task

### 4.1 Vision

Applications in mobile phones based on text input and/or text handling are increasing; therefore copy/paste functionality is more valuable than ever. The ability to move information within or between different applications will most definitely be attractive among many users who use their phone for more than just calling.

In the present situation copy/paste functionality is probably most commonly used among computer users where the user can choose between *Copy*, *Cut*, *Paste* and *Clipboard* e.g. in Microsoft Windows. One of the tasks of this thesis is to find out if the functionality in a mobile phone should be similar to that in computers.

The vision with this thesis is to develop copy/paste functionality as self instructing as possible.

#### 4.1.1 Why Copy/Paste is Needed in a Mobile Phone

Helander et al. [5] have stated “*A key component in any modern user interface is the ability to copy or cut information in one part of an application and then paste it into a different part of the same or a different application*”. The Sony Ericsson T610 platform does not have the ability to keep more than one application open at the same time, i.e. when a new application is opened the previous one has to be closed. This is a difference from computers where a lot of applications can be open and the windows might be placed beside each other on the desktop. The lack of multitasking in a mobile phone increases the need for a clipboard, where several clips from one application can be stored to be pasted into another application.

The main reasons why copy/paste functionality is needed in a mobile phone are:

- Saving time for the user since text input with a mobile phone is time consuming
- Making text input of similar appearance easier with increased speed
- Making the ability to move text between applications possible, for example from a text message to the calendar or a contact
- Decreasing the use of human memory when information has to be moved within the applications of the phone
- Increasing the ability to handle files of different appearance, e.g. pictures, sounds or movie clips.

## 4.2 User Profiling

The main target group for copy/paste functionality is everyone who sends messages with their phone or at least uses applications where text input is required. The negative user group, not targeted, are people without any prior experience from computers and people who use their phone for nothing but calling.

According to the theory in section 2.1.2 a persona has been chosen to represent the targeted users; the persona chosen for this thesis is Ranja visible in Figure 5. She has just turned eighteen and is taking her last year in upper secondary school. Her major is business, which is a subject that interests her and which she wants to continue with after graduation. Ranja is traveling a lot but her friends are still very important to her. This combination gives her mobile phone a very central role in her life.



**Figure 5 - Ranja**

Ranja is not very interested in the latest technology but she thinks that a small phone is very practical because it is easy to carry around. She thinks the best invention in the mobile phone industry is probably the vibrator signal which discreetly notifies her that someone is contacting her.

Apart from calling, the applications she uses in her mobile phone are the phonebook and the messaging services.

She has no real interest in computers but uses them to check her e-mails and to write papers for school. She tried to use ICQ and Lunar storm for some time but lost interest after a few months.

## 4.3 Goal Analysis

The main goal is to save time for the user when working with text or files, e.g. pictures, sounds or contacts, in a mobile phone. The procedure to write text can, as previously described, be very time consuming if the user is not very used to do it, especially when it comes to handle large amounts of text e.g. e-mails, text messages. The function should appear intuitive for the user and make him/her use copy/paste instead of, for example, writing the text line once more.

The solution should be measured by different usability principles and implemented in a phone where soft-keys are available. In section 5.1 and 5.3 the requirements for the solution describe more tangible goals.



## 4.4 Task Analysis

When using copy/paste functionality the user needs to perform a few tasks. The most essential tasks - independent of design - are to move a cursor and mark something, choose *Copy*, move the cursor again into the right position and choose *Paste*.

Feedback is important to let the user know whether a task has been completed or not. For marking, the feedback might be to see something getting marked with another color on the screen and at the same time see the cursor move in the direction chosen by the user. When copying, the marking may disappear and when pasting, the information the user has copied becomes visible.

## 4.5 Benchmarking

### 4.5.1 Introduction

To get a look of what copy/paste functionality currently exists on the market, a test of in-house and competitors' products was made. The reason was to evaluate the existing products and to get new ideas regarding how to mark information and the extension of the current functionality.

The tested products were divided as the following:

- Three in-house products, the T68i, the T610 and the P800, were included to indicate the difference compared to the competitors, especially the T610, since the same platform was to be used within this thesis. The P800 has a touch screen similar to a handheld computer.
- Four competitor mobile phones were chosen, the Nokia 7650, the Siemens S55, the Panasonic GD87 and the Orange SPV. These phones are somewhat new to the market and might contain copy/paste functionality.
- Two handheld computers, the Palm Pilot and the Philips Nino, to evaluate the difference between these, the Sony Ericsson P800 and Windows.
- From the world of computers, the Windows Office XP was chosen since many mobile phone users are used to the programs this system includes, in some way.

### 4.5.2 Comparison

The test included a check if the following functions were available:

1. Copy
2. Paste
3. Insert – is it possible to insert something into a message?
4. Cut
5. Clipboard – is it possible to copy several things and then choose what to paste?
6. Copy files – e.g. pictures, sounds or contacts
7. Copy between applications – if something is copied from a message, is it possible to paste it into another application?
8. Format recognition – does the copy/paste function include a test of the format of the copied information? For example is it possible to paste a text string into a phone number input?
9. Consistency between applications – does the copy/paste functionality appear in the same way in different applications? Is *Paste* visible in the menu even if nothing has been copied? If a string has been copied, is *Paste* visible in a phone number input field?
10. Switch open applications – is it possible to have several applications opened at the same time?
11. Mark text
12. Several copy/paste commands – is it possible to do copy/paste in more than one way?
13. Number of steps it takes to copy from a text message to a contact.
14. Menu depth required to reach a text message draft from the main menu.
15. Number of options in the menu while writing text, e.g. add symbol, input method, insert item. If given in a sum several menus can be reached by different buttons.

The comparison is visible in Table 4. A tick indicates that the function exists in the product. **Note!** The test was carried out with intuition; if the function is hidden in the product it might not have been found.

**Table 4 - Comparison of copy/paste functionality**

Function Model	Copy	Paste	Insert	Cut	Clipboard	Copy Files	Copy between appl.	Format rec.	Consistency	Switch open appl.	Mark text	Several commands	Steps to copy	Menu depth	Number of options
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sony Ericsson T68i			✓								✓				
Sony Ericsson T610			✓								✓			4	11
Sony Ericsson P800	✓	✓	✓	✓	✓		✓	✓	✓		✓		10	3	11
Nokia 7650	✓	✓	✓	✓			✓	✓		✓	✓	✓	5*	3**	6+7***
Siemens S55	✓	✓	✓	✓		✓	✓	✓			✓		13	4	10+5****
Panasonic GD87	✓	✓	✓	✓			✓				✓	✓	11	5	6
Orange SPV										✓					
Palm Pilot	✓	✓		✓			✓		✓	✓	✓	✓			
Philips Nino (Windows CE)	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓			
MS Office XP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			

- \* Five steps if the contact is already open, eleven if the contact has to be opened, including the copy command, i.e. one step is counted for holding one button down and pressing another for *Copy*.
- \*\* Three steps if the text message is not yet open; one step if the text message has been left opened.
- \*\*\* Six options when pressing *Options*; seven options when pressing the *ABC-button*; nine options when a piece of text has been marked and the *ABC-button* is pressed again.
- \*\*\*\* Ten options in the menu and five more options in a menu visible when holding the *\*-button*.

### ***How the test should have been performed***

A few scenarios should have been written to test each product in the same way. Some of the products had to be tested rapidly, which might have affected the result by not including all possible contents of the products. The test still gives a clear signal that Sony Ericsson is one step behind the competitors regarding copy/paste functionality in mobile phones without touch screens.

### 4.5.3 Comments on some of the Benchmarking Products

While the comparison was carried out some important notes were taken about some of the products. These notes serve as complement to Table 4.

**Sony Ericsson T68i and T610:** Mark text is carried out by pressing the volume-button and moving the joystick, i.e. a two-hand method.

**Sony Ericsson P800:** This phone functions almost like a handheld computer. It has a touch screen and good functionality for copy/paste.

**Nokia 7650:** This phone has a very useful menu-button. With this button it is possible to get back to the main menu, whenever the user wants, without losing any information in the present application. When selecting the icon in the main menu, with which the user normally reaches a list of applications including the previous one, the previous application is opened in the same state as it was left.

Strings containing characters and numbers can be copied, cut and/or pasted in every application, where it is possible to modify text. It is only possible to copy one string at a time. The copy/paste functionality automatically detects if the string in memory is a text or a number and does not let the user paste a text string into a number field.

The Nokia 7650 provide powerful copy/paste functionality which makes it easy to switch between applications to get the information needed, despite the small displays in mobile phones. A disadvantage is that both hands are needed to use the functionality. When holding the *ABC-button* and moving the joystick, text is marked and the soft-key options *Copy* and *Paste* are visible at the bottom of the display. When pressing the *ABC-button* without moving the joystick, only *Paste* shows.

**Siemens S55:** To use the copy/paste functionality in this phone, the *\*-button* has to be pressed for a second to make an option menu visible. Three of the five options are *Mark text*, *Copy* and *Paste*. This menu was found at random and would probably not have been found if the tester was unaware of the functionality.

When selecting *Mark text*, “MARK” is visible in the top left corner and the text is marked. To copy, the *\*-button* has to be pressed again. This time two of four options are *Unmark text* and *Copy*. *Paste* is visible in the *\*-menu* in some input fields where pasting of the copied item is impossible, due to the format of the copied item. When trying to paste anyway, an error message saying “No file to paste” appears. If different formats are copied before the first has been pasted, e.g. a phone number and some text, the phone automatically notices the difference and the text can be pasted into a text input field while the phone number can be pasted into a phone number field. The phone also has a file system where a user can copy and move files.

**Panasonic GD87:** The copy/paste functionality in this phone is very smooth and easy. To copy/paste text strings, the user can mark text in one application and this text is stored in the memory until something else is copied. *Paste* is available in several applications. *Copy* is available as an option as soon as a character is written. Attachments are available with an insert function. When writing text, the options vary between six and eight with what kind of input method is being used. Three out of six options are *Cut*, *Copy* and *Paste*. This product does not use soft-keys for the copy/paste functionality.

In **Microsoft Office XP** the clipboard contains 24 clips.

## 4.6 Evaluation

### 4.6.1 Possible Things to Copy

During the comparison, different ideas about what information that might be copied in a mobile phone arose along with ideas about how to perform the functionality. In the existing applications of a Sony Ericsson T610, the following things might be copied in the future:

- Messages or parts from messages (text, picture, e-mail)
- Contacts
- Calendar events
- Parts from chat sessions
- Notes
- Sounds
- Pictures
- Folders
- V-cards
- Shortcuts (URLs)
- Screen savers
- Themes
- Games and high score lists
- Files
- Bookmarks
- Memos
- Stopwatch times
- Calculator results
- Phone settings
- WAP pages or parts from WAP pages
- Log ins for WAP-pages
- WAP settings
- Information from other Bluetooth-units
- Information from other IR-units

**Conclusion:** Out of all varying kinds of information and according to the benchmarking, copy/paste functionality is very important.

#### **4.6.2 Possible Methods for Marking and Copying**

When the user wants to copy a piece of information it has to be marked in some way. Two methods, which can be much further developed, are:

##### **1. One Hand Method (Similar to the method used in the Panasonic GD87)**

- From *More*, visible as a soft-key whenever input is possible, choose *Copy*, the labels of the soft-keys change to *Start* and *Cancel*.
- Navigate to the desired starting point and press start, the labels of the soft-keys change to *Copy* and *Cancel*.
- Move the cursor with the joystick to the desired end. The text between the starting point and the cursor gets highlighted.
- Choose *Copy*, the highlighting disappears and the labels of the soft-keys go back to the same state as before the function started.

##### **2. Two Hand Method (Similar to the method used in the Nokia 7650 and the Sony Ericsson T68i)**

- Navigate to the desired starting point.
- Press a certain key, e.g. volume, while navigating to mark the item. The item is meanwhile getting highlighted.
- When the key is released the labels of the soft-keys are changed to *Copy* and *Cancel*.
- Choose *Copy*, the highlighting disappears and the menus go back to the same state as before the function started.

#### **Advantages and Disadvantages**

The one hand method is more intuitive and easy to do for an inexperienced user. Though it is more time consuming since the user needs to open and select from a menu.

The two hands method is hard to find but much faster to use. Most functions in a mobile phone are possible to perform with only one hand. It might not be desirable for a user to start using two hands.

# **5 Design and Evaluation of Different Concepts**

## **5.1 Design Requirements**

A very important preparation for the design is to set up requirements for the solution. The requirements were developed with help of the Eight Golden Rules, section 2.2.1, and with results from the previous phases. There were no considerations taken into technical restrictions such as the required amount of memory for the implementation.

The design requirements for copy/paste functionality are:

1. Consistency – the function should look the same and be reached in the same way, independent of the current application.
2. Shortcuts – the copy/paste function should be reached in several ways to attract different users.
3. Offer feedback from the performed actions.
4. Error prevention should be developed to avoid confusion for the user.
5. Reversal of actions – it should be easy to cancel the operation.
6. Minimum user memory load – the function should be intuitive.
7. Few menu options – in the phones today there are already too many menu options, which might confuse the user; when implemented this function should acquire as few menu option as possible.
8. Implementation – to be able to implement the functionality easily in several different applications the implementation should be as general as possible.
9. Copy/paste within the same application – it should, for example be possible to copy/paste between two different text messages.
10. Copy/paste within the same message – it should, for example be possible to copy one sentence from the top of the message to the bottom or copy a word and paste it several times in the message.
11. Copy/paste between applications – it should, for example be possible to copy/paste between the phone book and a message or a WAP-page and the organizer.
12. Flexibility — it should be possible to copy/paste a picture, a sound, a number or another file as well as text.

13. Mark text – it should be possible to mark text in at least one way where preferably only one hand is used.
14. Clipboard – it should be possible to copy several things from one open application and store it in a clipboard to paste it into another application. This will save time and effort for the user.

## **5.2 Top Six Scenarios**

For the use of copy/paste functionality six scenarios were developed. They describe the persona, Ranja, in different typical situations:

### **1. Include a contact in a message**

Ranja's friend Maria calls from her mobile phone and asks for Salam's new address. Ranja doesn't remember it but she knows she has it stored in her phonebook. She tells Maria she will send her a text message with Salam's address and new phone number. Ranja starts writing a new text message and switches application to the phonebook where she copies Salam's address and phone number; she then continues with the text message and pastes the information.

### **2. Writing many similar messages**

Ranja decides to have a party and wants her friends to come. Some of her friends promised to help her with different things and she therefore wants to invite them over at different times. She also wants her friends to bring different things for example popcorn and music. Ranja writes the first message to Michael and asks him to bring popcorn and arrive when the party starts at eight. She copies the invitation part from the message before sending it to him. Then she inserts the copied part into a message to Maria, and adds a comment about how Maria promised to come and help her with the food at seven. When the second message has been sent she continues inserting the invitation and adding a comment to all the messages until everybody is invited.

### **3. Between messages**

Ranja receives a picture message with a really funny joke. She wants to send an e-mail to Victor and include the joke. Ranja copies the joke and switches application to write a new e-mail. In the message box she writes him a message and pastes the joke at the end.

### **4. From message to calendar**

Ranja receives a text message from Helen who wants to meet her next Monday. To remember this meeting Ranja copies the text in the text message and paste it into the calendar.



### **5. Information between a WAP-page and an application**

Ranja is on her way to a party at Christian's place. She has the information about him stored as a contact in her phonebook, but does not know his address. She uses a WAP-page to find his address, and on the page she is required to enter his first and family name. Instead of writing it she copies the name from the phonebook and pastes it into the search field. The search is successful; Ranja finds the address and copies it into her phonebook for future use.

### **6. Moving files within the phone or between units**

Ranja is using her phone as an mp3 player. Her friend in school, Peter, is a composer and has composed a new song he wants Ranja to listen to. She borrows the memory stick from his mp3 player and plugs it into her mobile phone. Peter has only one stick and wants to use it, therefore she needs to copy the newly written song from his stick to the memory of the mobile phone. Ranja copies the song and pastes it into a new folder called "Cool mp3s".

## **5.3 Usability Requirements**

In addition to the design requirements, some requirements about the usability of a copy/paste functionality have to be stated. This is done to remember the users during the design and implementation. Some of the usability requirements are similar to some design requirements because they are important and thought of in different ways.

1. Easy and fun to use – the function should appear very intuitive and a targeted user should be satisfied with the functionality with a positive attitude.
2. Minimum rate of errors – if the functionality is intuitive, the user should have no rate of errors.
3. Time saving – it should be time saving to copy a text string instead of writing it with text input.
4. Keystrokes/time – to be easy and time saving the number of keystrokes and the time it takes to do the procedure should be minimized.
5. Short learning time – the function should have minimal learning time.
6. Shortcuts – different users think that different key combinations are intuitive, if shortcuts are available, more users will be satisfied. A good shortcut would include both text marking and the copy/paste functionality.

## 5.4 Generated Concepts

### 5.4.1 Introduction

During brainstorming sessions different concepts were developed. The concepts have been split up as the *Mark and Copy* group, section 5.4.2 and as the group of *Navigation concepts*, section 5.4.3.

*Mark and Copy* includes four different solutions of how to do the marking of the information that is to be copied. The *Navigation concepts* describe eleven solutions of menu options, i.e. how the user navigates in the phone, and their significance. All concepts have been developed without taking too much consideration to different usability rules. The reason for this is to be as broad-minded as possible and to create new solutions that are not yet on the market. Instead, the usability rules play an essential part in the evaluation of the concepts.

A *more-menu*, *More*, is a menu of options visible as a soft-key label whenever input is available in the phone. In the text message application it consists of options like add symbol, input method, insert item etc.

### 5.4.2 Mark and Copy

#### A Soft-key options.

When the option *Copy* or similar is selected in *More*, the soft-key labels are changed to *Mark* and *Cancel*. If *Cancel* is pressed the phone returns to the previous state, this can be done throughout the function. When the cursor is positioned at the desired starting point, *Mark* is selected and the cursor changes its shape into marking (boldface). The soft-key with *Mark* changes to *Copy*, while *Cancel* remains. With the joystick it is possible to navigate the cursor in the message. The information between the starting point where *Mark* was pressed and the current position is highlighted and copied when the *Copy* button is pressed. To paste, the option *Paste* is selected in *More*.

#### B Volume and Joystick #1.

All commands in this concept are carried out without adding anything to any menu. To copy, the cursor is positioned at a desired starting position with the joystick, when pressing the volume button the mark text mode is activated. As long as the volume button is pressed it is possible to mark text with the joystick. When the desired text is marked, the volume button is released and the information will automatically be copied.

To insert the copied material the user navigates to the desired insertion point and holds the volume button while moving the joystick.

### **C Volume and Joystick #2.**

While volume is pressed the joystick is moved. This starts the copy process just like the one in the soft-key options concept. Both the buttons can be released after the initialization of the marking mode and the rest of the process will be performed only with the joystick. In this way, similar commands can be used both for *Copy* and *Paste*. The following examples of shortcuts are based on the functionality to mark text in a Sony Ericsson T68i or the released T610:

*Copy1*: volume up + joystick

*Paste1*: volume down + joystick

*Copy2*: volume + joystick left/right

*Paste2*: volume + joystick up/down

### **D Long Joystick.**

After pressing the joystick for a few seconds, an edit menu appears on the screen. From this menu it is possible to choose the same commands as in concept A.

## **5.4.3 Navigation Concepts**

### **1. Copy / Paste**

This concept will add two new options to *More*. The command *Copy* lets the user select information, which will be pasted somewhere else with *Paste*. This place can either be within the current application or in a completely different one.

*Paste* is disabled from the beginning, i.e. grayed out, but is enabled when an insertion of the information is possible. This insertion is possible when the copied information is of a format that matches the place where it is supposed to be inserted; for example, if a text string is copied it cannot be pasted into a phone number input, but it can be pasted into a message. When *Paste* is selected, the information will be inserted at the current cursor point. The information will stay in the memory until something else is copied and multiple pasting of the same information is thereby made possible.

## 2. Copy / Paste / Clipboard

This is an extension of the first concept with the extra command *Clipboard*. The first two commands have not been altered in any way from navigation concept #1.

The clipboard supports multiple copying and gives the user a choice which one of the five previous copied items that is to be pasted. When the first item is copied, *Clipboard* gets enabled in *More*, where it was previously disabled. When *Clipboard* is chosen, a list of the most recent copies is displayed. If there are any copied items without a matching format, they are disabled. When an item is selected, it is inserted in the same way as if *Paste* was chosen.

When the clipboard contains five items and a new item is copied, they are sorted as First In, First Out (FIFO), i.e. the oldest copy is removed from the list and the new one gets the top position. Five items are regarded as enough for the use within a mobile phone and it is the maximum number that can be visible in a menu in a Sony Ericsson T610, without having to scroll.

## 3. Copy / Paste / Databoard

This concept is similar to #2 with a few small exceptions. The first is the clipboard, which has changed name to *Databoard*. The *Databoard* option is enabled when the first item is copied, just like the clipboard. If *Databoard* is chosen, a menu like the clipboard will show up with one extra option, *Latest data*. When this option is selected, the data from the previously used application will show up as a note in the application *Notes*. In this text it is possible to perform copy/paste as in concepts #1 and #2.

## 4. Copy / Paste / Recent

The options *Copy* and *Paste* are the same as in concept #1. To make navigation easier between applications the option *Recent application* is added in *More*. When this option is chosen, the previous application will be started. To copy/paste between these two applications is thereby very efficient, just like when using a computer with several windows open.

## 5. Copy / Paste / Switch

The options *Copy* and *Paste* are the same as in concept one, but when the user is leaving an application he/she has to answer the question: "Do you want to close the application?" If the application is left open it can be reached from other applications. In *More* the option *Switch* is added, which – if selected – displays a list of currently open applications. If one application is selected in this list the user will be transferred to it and the present one will automatically be added to the list of currently open applications.

## 6. Copy / Paste / Dynamic main menu

The dynamic main menu concept has two options in *More*, i.e. *Copy* and *Paste*, and the navigation system within the telephone is changed.

If a user presses *Long back*<sup>5</sup>, when navigating from application X to the main menu, a shortcut between the main menu and application X is created. The next time the user selects the icon in the main menu – from which application X is reached from – the application X is opened, since it was left open when the user pressed *Long back*. This will increase the speed to navigate between two different applications but will not improve the navigation between two different applications under the same icon e.g. two e-mails.

## 7. Fetch

This concept only requires one *More* option. When selecting the *Fetch* option the user will get a list of possible applications to fetch information from. Within the chosen application it is possible to copy something which immediately is pasted where *Fetch* was chosen. This means that instead of copy something first and then paste it, the user is in the place where the paste is to be made, fetching the thing to be pasted.

## 8. Fetch / Clipboard

This concept includes two options, *Fetch* and *Copy to clipboard*. The *Fetch* command works in the same way as in concept #7, but with the addition of a choice to fetch from the clipboard as well as from an application.

With the *Copy to clipboard* option, the user can copy information for later use to the clipboard in the same way as in concept #2.

## 9. Fetch / Databoard

The options *Fetch* and *Copy to databoard* are the same options as in concept #8, with the change of names from clipboard to databoard. The databoard has the same functionality as in concept #3.

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<sup>5</sup> If the user presses the Back-button on a Sony Ericsson T610 for approximately one second, the main menu appears in the display.

#### 10. Copy / Paste / Set paste-mark / Copy to paste-mark

This concept is a hybrid between concepts #1 and #7. *More* contains four new options; the first two are *Copy* and *Paste* which appear in the same way as in concept #1.

*Set paste-mark* is the third option, which is used to create a sort of bookmark, to which something is copied, just like in concept #7, where something is fetched to the current cursor point. If a new paste-mark is set, the old one is deleted, even if they are set in different applications.

The fourth option in *More* is *Copy to paste-mark*, which is disabled before the first paste-mark has been set. The option has the same functionality as *Copy* when selecting what to copy. Then the copied item is automatically pasted to the paste-mark, and the application with the paste-mark gets focus.

#### 11. Copy / Paste / Paste to recent

This concept has three options in *More*. The first two are *Copy* and *Paste* as in concept #1; the third is a more automated variation of concept #10. Before *Paste to recent* can be selected, something has to be copied. When the option is selected, the copied item is pasted to the last cursor point of the previously used application.

### 5.4.4 Shortcuts

To mark and copy and to paste, shortcuts should be offered. A one-hand method for copy/paste functionality can be used via *More*, and it is therefore possible to offer shortcuts where both hands have to be used. The *Mark and Copy* concept III – to press the volume while the joystick is moved – follows the most usability rules. It is only a two-hand method to start the functionality, then one hand can be used to fulfill the goal to copy information. Another good thing is that when started, the functionality of copy is the same as the one reached from *More*.

A paste shortcut should be offered in the same way. The best alternatives, given in 5.4.2, appears to be the ones where *Mark and Copy* is reached by pressing the volume button and moving the joystick sideways, and where paste is reached by pressing the volume button and moving the joystick up and down. This choice is based on that it is easier to navigate the joystick, than it is to find the up/down volume button. To move the joystick sideways to mark something seems intuitive and the information to be pasted is fetched from before (up/down).

## 5.5 Analytical Evaluation of Concepts

The best way to evaluate the different concepts is to let target users test them. Since user testing is a time consuming evaluation method, only three concepts were to be tested with users, within this thesis. To nominate three concepts among the eleven generated, other evaluation methods are used. The first method is the Keystroke Level Model, section 2.2.3, the second is weighted score. Weighted score is a method where the different concepts are compared and the best concept is given the best score. The results of these two methods were further evaluated by different usability rules.

### 5.5.1 Keystroke Level Model, KLM

This method is used to get an estimation of the time required to perform the task for each concept. Three scenarios were developed – similar to three of the top six scenarios in section 5.2 – to test the concepts equally. The keystrokes might differ depending on the menus, but in the long run this evaluation can serve as a guideline of the least time consuming concept.

#### Scenario A

Ranja receives a text message, which she thinks is funny. She starts to write a new e-mail to Bob, and includes the joke from the text message she just received.

#### Scenario B

Ranja receives a text message with the name and address of the place where her friend's party is supposed to be next Friday. She does not want to accidentally erase this information and therefore she saves the information as a contact.

#### Scenario C

Ranja copies a piece of information from a note in the application *Notes* and pastes it at another position in the same note.

The result is presented in Table 5 and a more detailed version of the keystrokes is in appendix A. All keystrokes for each concept are summed up and the concept with the lowest sum got the best weighted score, i.e. score five. The result might vary with the choice of scenarios but it still reflects the time spent with navigation, i.e. keystrokes. Concept #3 requires an outstanding low amount of keystrokes.

**Table 5 - Weighted score, number of keystrokes**

Concept	No. of keystrokes of scenario			Sum	Weighted score*
	A	B	C		
Copy/paste #1	16	23	4	43	1
Clipboard #2	16	16	4	36	2
Databoard #3	5	15	4	24	5
Recent #4	7	18	4	29	4
Switch #5	11	20	4	35	3
Dynamic main menu #6	7**	18	4	29	4
Fetch #7	8	22	8***	38	2
Fetch/Clipboard #8	7	16	6	29	4
Fetch/Databoard #9	6	15	6	27	4
Paste-mark #10	9	20	4	33	3
Paste to recent #11	7	18	4	29	4

\* The Weighted score is based on the sum of the keystrokes as follows.

Sum	Weighted score
-25	5
26-30	4
31-35	3
36-40	2
41-	1

\*\* To get advantage of the dynamic main menu the scenario was altered to that the joke had previously been saved as a note. Otherwise the result would have been the same as concept number 1.

\*\*\* It is assumed that a message, which has not been saved, can be found in drafts.



## 5.5.2 Weighted Score Comparison

The scale in this evaluation is graded from one to five where **five is the top score**. The scores were set during careful weighting of the different concepts, and the best concept got the best score, all scores are visible in Table 6. When all the different concepts were tested with the criteria below, a total score for each concept was summarized.

### Criteria

- A** The weighted score from the KLM evaluation, Table 5.
- B** Consistency between applications and the existing user interface, i.e. if the concept differ much from the interface today with a tree-structure of applications. This criterion also reflects if the concept differs from the concepts that the users are used to.
- C** Possibility to handle files as well as text, i.e. if it is possible to do format recognition of the copied piece of information.
- D** Number of menu options required.
- E** Estimated learning time.
- F** Simplicity - difficulty to implement, rated with help from an expert of the Sony Ericsson T610 software platform.

**Table 6 - Concept evaluation with weighted score**

Concept	Criteria						Sum
	A	B	C	D	E	F	
Copy/paste #1	1	5	3	4	5	5	23
Clipboard #2	2	5	3	3	5	4	22
Databoard #3	5	3	2	3	3	2	18
Recent #4	4	2	3	2	4	1	16
Switch #5	3	2	3	1	4	1	14
Dynamic main menu #6	4	2	3	2	4	1	16
Fetch #7	2	3	5	5	4	4	23
Fetch/Clipboard #8	4	3	5	5	3	3	23
Fetch/Databoard #9	4	3	4	5	2	2	20
Paste-mark #10	3	4	4	2	2	2	17
Paste to recent #11	4	1	4	3	1	2	15

## ***Result***

The results from the evaluation are subjective but the two concept groups with copy/paste and fetch were in all the top spots. Three concepts – in reality four but two were united to one – were chosen for further evaluation, i.e. usability testing:

### **I. Concept #1 – Copy / Paste**

In all the criteria, except for the KLM evaluation, this concept had very high scores. The reason for the low score in KLM was because the concept follows the existing menu system, which is not optimised for these kinds of tasks.

### **II. Concepts #2 & #3 – Copy / Paste / Clipboard / Latest Data**

These concepts were chosen because they are based on concept #1, but in combination they contain several interesting aspects. A clipboard has to be evaluated in some way and the databoard is interesting due to the much higher score than all the other concepts in counted keystrokes. Since databoard and clipboard are similar except for *Latest data*, the option *Databoard* was altered to *Latest data*. This option contains only the function for latest data, and does not include any clipboard.

In combination these concepts have four options in the *More-menu*, *Copy*, *Paste*, *Clipboard* and *Latest data*. To avoid making the *More-menu* too long – it already contains eleven options – the options were grouped together as *Edit*. The choice of *Edit* was based on that the user can find *Copy*, *Cut*, *Clipboard* and *Paste* under *Edit* in MS Windows and this is a way to evaluate if the participants in the test relate to Windows when using a mobile phone.

### **III. Concept #7 – Fetch**

At least one of the three *Fetch* concepts needs to be further evaluated. Because the clipboard is tested with concepts #2 & #3, the simplest version of the *Fetch* concepts is chosen.

## ***Discussion***

The scores could have been estimated with more expertise knowledge. The number of keystrokes varies depending on submenus, not yet created, when the evaluation was performed.

### 5.5.3 Heuristic Evaluation

The three concepts were evaluated once more before prototypes for the usability test were developed. The reason for this was to make sure, the concepts follow some basic interaction rules. Accordingly the concepts were evaluated with the **Eight Golden Rules**, section 2.2.1:

#### Concept I – Copy/Paste

1. The consistency for copy/paste is easy to maintain. The options are always visible in *More*. If *Copy* and/or *Paste* are disabled, it is due to the lack of something to mark, or a difference in the formats of the field and the copied item. The functionality is the same in any application.
2. The shortcuts might be difficult to find for the user, since the volume-button is not normally associated with text input. When found, the shortcuts are time-saving and easy to use.
3. For *Copy*, feedback is provided by changing labels of the soft-keys, and for *Paste* the information becomes visible on the screen.
4. When the user selects *Copy*, the soft-keys guide him/her with *Start* and *Copy* to fulfill the goal; with *Paste*, no dialog is needed.
5. There must be something to mark before *Copy* can be chosen in *More*. The copied item has to be of the right format when *Paste* is selected. If the options cannot be selected, they are disabled, i.e. grayed out.
6. Reversal of the copy function is easily done, either by pressing *Cancel* or by using *Back*. *Cancel* is a soft-key function during the whole copy process. *Paste* can be reversed by deleting the pasted information.
7. The user is in command during the entire procedure: select *Copy* – move cursor – select *Start* – move cursor – select *Copy* – end, move cursor - select *Paste* – end.
8. The soft-keys provide the user with guidelines; the user needs to remember what has been copied to remember where to paste it. The entire function consists of seven stages.

## Concept II – Copy / Paste / Clipboard / Latest Data

This concept is similar to concept I when using copy/paste, and therefore this evaluation only covers the clipboard and latest data.

1. *Latest data* is a consistent option in *More*, but the option varies depending on what data the user previously was working with, e.g. a message, a note or a contact. The data is, however, always opened in *Notes*.
2. No shortcuts will be offered for the clipboard or the latest data functionality at this stage.
3. The feedback of latest data is that it opens the latest used data in *Notes*. The soft-key labels *Mark* and *Cancel* guide the user in a similar way as in the first concept. When something is copied the application – from which *Latest data* was chosen – is displayed again and the user can select *Paste*. Feedback offered when using the clipboard, is that several things can be copied and that they are visible when the option *Clipboard* is chosen. If the clip is of the right format it is enabled and can be pasted.
4. *Latest data* offers a dialog with the soft-key labels *Mark* and *Copy* in *Notes*. When *Copy* is chosen the dialog is closed and the user has (hopefully) fulfilled his/her goal to copy. The *Paste* dialog when using the clipboard is minimal. The user can clearly see if the clip is of the right format, i.e. if it is enabled or disabled.
5. Error prevention is offered since the user cannot paste something of the wrong format.
6. The user can use the same reversal actions as in the first concept.
7. *Latest data* might be confusing for the user since the latest data is opened in *Notes*; this is a new feature which the user probably has not used before.
8. The user does not need to remember anything else than what has been copied and where to paste it.

### Concept III – Fetch

1. The option *Fetch* is always available in the *More-menu*. The applications that the user is able to fetch information from might differ, depending on the format of the field the user wants to receive the fetched information in. If an application contains information of a currently undesired format, it is disabled in the list of applications. When an application has been selected, the user will recognize the navigation, since it is the same as when navigating from the main menu.
2. A shortcut will be offered at a later stage in the development process.
3. Feedback is provided in the shape of what information that is fetched – the information is visible immediately. When marking information, it gets highlighted.
4. The dialog consists of a guide through the chosen application and the soft-keys change labels when a piece of information is getting marked and is about to be fetched. It is only possible to mark something and to fetch it, while the user is in fetch-mode. Therefore it is not possible to edit the information, which yields closure to the dialog.
5. Error prevention is offered since an item of the wrong format cannot be fetched.
6. The user can always use *Back* to reverse an action. If something has been fetched, the user can erase it.
7. If formats are understood, the user is in total control and the user understands why a text string cannot be fetched into a phone number input.
8. The user only needs to remember what he/she intends to fetch.



## 6 Prototype and Usability Test

### 6.1 Prototype Design

At first it was decided that the user test should be performed as a low-fi prototype test with post-it notes, just to test the basic principles of the three concepts. When the possibility to do an easy simulator, based upon pictures in a slideshow, appeared, the decision was altered. The test should be carried out with a computerized simulator and a slideshow of pictures for each concept with almost the same interface as the Sony Ericsson T610, shown on a computer screen. The tester should use the mouse to press the keys of the simulated phone and a new picture should appear on the display of the simulated phone every time the tester pressed a key. The simulator had to be restricted only to test the copy/paste functions; therefore the tester was not able to press other keys on the simulator than the ones there were pictures developed for. If the simulator should have been implemented as a real phone it would have taken a couple of weeks to develop. Even if the restriction will make the tester a bit confused about the disabled buttons, the simulator is definitely a more realistic test environment than a paper prototype. “...when you have access to interactive prototyping tools, it is preferable to use them in place of paper prototypes” [3]. The three chosen concepts, *Copy/Paste*, *Copy/Paste/-Clipboard/Latest data* and *Fetch*, were prototyped with the help of Macromedia Director and MS Photoshop and can be viewed in appendix D.

### 6.2 Usability Test

#### 6.2.1 Goals

The main questions to be answered with the test are the following:

1. Which concept do the testers like the best?
2. Are few keystrokes a better advantage than little learning time? I.e. do the participants react upon the number of keys pressed or do they prefer a concept they recognize from computers?
3. How do the testers want to mark text? Are they prepared to use both hands?
4. Is *Fetch* a good name for the function, does the user know what it means?
5. Will the testers need any help using the concepts? If so, when and with what? If help is needed, the design definitely needs to be improved.
6. Do the users compare the copy/paste functionality with the functionality in a computer?

7. How much time do the testers spend on each concept? Is there a concept which is more efficient than the others or is any of them more time consuming?
8. How do the testers use the clipboard? Do they use it?
9. Do they understand what *Latest data* contains? Do they use it or do they go all the way with only copy/paste?
10. Do the participants notice that editing, while in fetch-mode, is not possible? Do they want to edit?
11. Do the testers see a point in using copy/paste in mobile phones when they are done with the tasks?
12. Do they find it easy to copy/paste? Is it harder than just writing the text once more?
13. Is there enough feedback?
14. Is the copy/paste functionality desirable by the users?
15. Do 90% of the users perform the test without mistakes during the second scenario? (Section 2.1.2, Usability Standards according to ETSI)
16. Do the testers understand *Edit*?

### 6.2.2 Preparations

To know how easy the participant thought a task had been a form of semantic differential scales was created. The scales were rated from one to five where one is very difficult and five is very easy. The form was given to a participant to fill in after each fulfilled task. Since two scenarios were to be tested with three concepts each, the form consisted of six similar scales. The form, in Swedish, is to be viewed in appendix B.

A questionnaire based on the goals of the test was created for the participant to answer when the test was completed; several questions were to be answered in Likert scales, section 2.2.6, to make it easy for an evaluation of the form. The Likert scales were rated from one to five with *strongly disagree* rated as one and *strongly agree* as five. The questionnaire in Swedish is to be viewed in appendix C, unfortunately, there were two questions numbered as four by mistake. No questionnaire was given to the testers before the test to avoid letting them know it was copy/paste functionality that was to be tested, to avoid prejudices and to let them think out loud what actions they thought they would perform.



## Scenarios

All tests were carried out in Swedish, since this was the mother tongue of all the participants. The scenarios handed to the testers were the following:

### Scenario 1

Swedish

Du håller på att skriva ett e-post meddelande till Joe. Du kommer att tänka på det roliga textmeddelande du fick tidigare under dagen och vill ta med slutklämmen i ditt meddelande.

English

You are writing an e-mail to Joe. Earlier you received a funny text message and you want to include the punch line of it in your e-mail.

### Scenario 2

Swedish

Du har fått ett SMS med ett namn och en adress. Du vill spara denna information som en ny kontakt i din telefonbok.

English

You just received a text message including a name and an address. You want to store the information as a new contact in your phonebook.

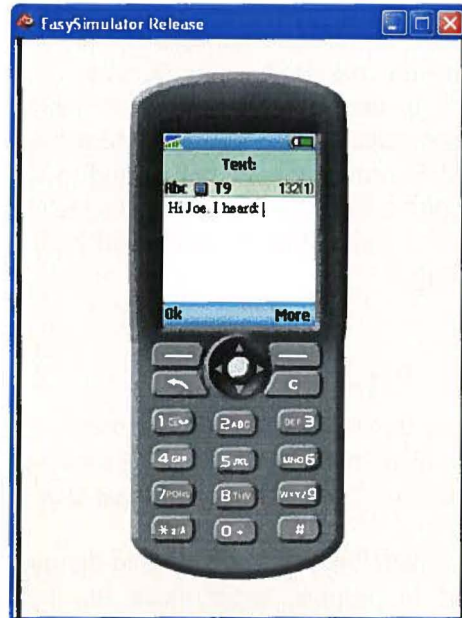


Figure 6 - The simulator with the first picture of the first scenario

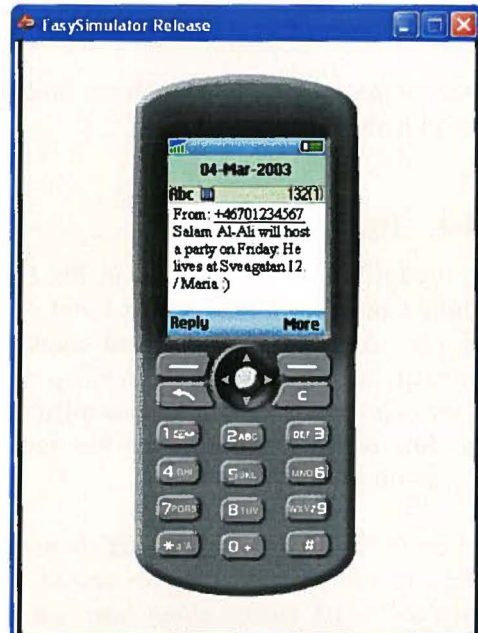


Figure 7 - The simulator with the first picture of the second scenario

The scenarios were constructed in this way to be as short as possible and to include as few pictures for the simulator as possible to save time for the development of the simulator. In the first scenario the tester was to include just the punch line of the joke because every time the tester wants to move the cursor in the text, a new picture has to be made. The second scenario was mainly created to indicate if the testers would manage a task better after having tested the concept once before and to show the advantage of a clipboard. The first picture of each scenario, which was displayed to the user, is visible in Figure 6 and Figure 7. In appendix D, the three concepts are presented with scenario 1.

### **6.2.3 Participants**

Within the boundaries of this thesis, company employees are acceptable as participants but it may have an impact on the results of the test, further reading in section 2.2.6; in-house participants are still among the targeted users though.

To evaluate the test, the form and the questionnaire before the participants were called in, a pilot tester made the test. When finished, the form and the questionnaire were improved.

To do the usability test without too many reflects of the users' startup problems, three subgroups of testers were created, one to start with each concept; all subgroups contained three testers and seven out of nine participants were company employees, mainly without technical background.

Some company employees with technical backgrounds were informally tested as a reference group.

### **6.2.4 The Test**

The usability test was located in the User Experience Lab at Sony Ericsson Mobile Communications AB in Lund. The lab is constructed with two rooms, one user room and one control room. The user room is equipped with a computer, a microphone and a video camera and on one wall there is a big mirror. The control room houses all the technical equipment for viewing and recording the test. Observers in this room can watch the test through the one-way mirror or on TV.

The tester was placed in the user room with a test leader and an inspector was seated in the control room to record and observe the test. The test leader explained some basics about user testing, section 2.2.6, and the participant approved the video recording by signing a paper. The test leader showed the simulator and told the tester it was just a simple simulator, which would work exactly like a phone. But only when the tester pressed the right keys, things would happen on the screen, since the simulator was built up with multiple screen pictures, one picture for every pressed key.

The test started with a “warming up”-session to let the tester try the simulator and get acquainted with clicking the keys and with the menu system. The tasks were to change the alarm signal from funky to glitter, to send a text message to Cessan (listed as a contact) and to change Adam’s (listed as a contact) work number.

Three different concepts were to be tested,

- I.** Copy/paste
- II.** Copy/Paste/Clipboard/latest data
- III.** Fetch

As previously described, the nine testers were divided into three groups, each starting the test with different concepts. The order of the tasks was:

- 1. Scenario 1 for the first concept
- 2. Scenario 2 for the first concept
- 3. Scenario 1 for the second concept
- 4. Scenario 2 for the second concept
- 5. Scenario 1 for the third concept
- 6. Scenario 2 for the third concept

The tests were taped on video with two pictures visible on the screen. The main picture was of the simulator from the computer screen, which the user was clicking, and in the upper right corner the face of the tester was visible.

## 6.2.5 Results from the Test

The results from the test are compared to the goals of the test and to Shneiderman's five measurable human factors, section 2.2.6.

### *The Goals versus the Outcome of the Test*

The goals for the usability test were set up as questions to be answered in section 6.2.1. Below are the answers, with references to the results from the questionnaire in appendix C, and the results from the task evaluation in appendix B:

#### **1. Which concept does the testers like the best?**

The testers definitely liked fetch best. In question #3 the participants rated the three concepts from one to three, the results are in Table 7 and concept III was rated as #1. Concept III was also rated the most intuitive concept by seven out of nine testers in question #4, Table 9.

**Table 7 - Ratings of the three concepts, the best concept has the lowest score**

Concept	Sum of scores	Rank
I Copy/paste	25	3
II Copy, paste, clipboard, latest data	17	2
III Fetch	11	1

#### **2. Are few keystrokes a better advantage than little learning time? I.e. do the participants react upon the number of keys pressed or do they prefer a concept they recognize from computers?**

Concept I did not appear as time-saving as concept III. Statements like "*Ah, do I have to go back all the way again to copy the next item*", proved that concept I needs improvements. Concept II was a bit confusing for the participants; *Edit* is *not* a good name in *More* for copy/paste functionality. Whether copy/paste, clipboard or latest data was used can be viewed in Results from task evaluation in appendix B. The testers who found latest data and used it liked it. Those who used the clipboard were relieved to be able to copy several things; a clipboard improves concept I a lot regarding the keystrokes, but it also needs design improvement – an option of its own might be redundant. When concept III was understood it was very appreciated. The answer to the question is thereby hard to determine.

**3. How do the testers want to mark text? Are they prepared to use both hands?**

The testers liked the way they were able to mark text in, i.e. a combination with the soft-key and the joystick, visible in appendix D for each concept. In question #15 only one new method of selection was suggested and it was to double-click the joystick. A two-hand method is accepted by the participants – score 3.1/5 in question #5 – but not overwhelming.

**4. Is *Fetch* a good name for the function, does the user know what it means?**

Fetch was accepted by the users and they did understand it had something to do with getting information pasted. A few testers thought fetch ought to be called *Fetch from* and/or *Fetch to*.

**5. Will the testers need any help using the concepts? If so, when and with what? If help is needed, the design definitely needs to be improved.**

Help was offered if the testers did not understand the scenarios, if anything having to do with the simulator was difficult or if the start of the scenarios were confusing. No extra help was needed and no user filled in that more help had been wanted during the test, question #14.

**6. Do the users compare the copy/paste functionality with the one in a computer?**

Apparently the participants did not connect the functionality with computers, but everyone recognized the options *Copy*, *Paste* and *Clipboard*. All testers use computers on a daily basis, and an average of three shortcuts are used for copy/paste in computers – question #18 and #19.

**7. How much time do the testers spend on each concept? Is there a concept which is more efficient than the others or is there one which is more time consuming?**

Concept III and latest data were the fastest concepts. No time could be estimated since it varied a lot among the testers.

**8. How do the testers use the clipboard? Do they use it?**

Four testers used the clipboard in scenario #2, no one in scenario #1. Those who used it rated it 4.5/5 in the task evaluation – task #5.

**9. Do they understand what *Latest data* contains? Do they use it or do they go all the way with only copy/paste?**

In the first scenario six testers used *Latest data* and rated it 3.3/5 – task #2. Only one tester used *Latest data* in both scenarios.

**10. Do the participants notice editing while in fetch-mode is not possible? Do they want to edit?**

No tester wanted to edit while in fetch-mode, they just followed the soft-keys and marked and copied.

**11. Do the testers see a point in using copy/paste in mobile phones when they are done with the tasks?**

The participants thought copy/paste is a good feature to have in mobile phones, it was rated 4.1/5 in question #1. The concepts got positive responses from the testers and they rated the possibility that they will use the functionality *often* to 3.1/5 – question #4.

**12. Do they find it easy to copy/paste? Is it harder than just writing the text once more?**

Due to the navigation system in a Sony Ericsson T610 the testers sometimes thought it was ungainly to copy/paste between applications. During the test this was not a big problem though, because the scenarios were developed to include as little navigation as possible.

**13. Are there enough feedback?**

No participant reacted on lack of feedback, but one comment regarding the navigation were noted. One tester wanted to mark something before selecting *Copy* in the menu, just like the tester does when using computers.

**14. Is the copy/paste functionality desirable by the users?**

The desire is proven with question #1 where an average tester rated the possibility to copy/paste information to 4.1/5. During the test the functionality was especially appreciated with the second scenario where more text had to be copied.

**15. Do 90 % of the users perform the test without mistakes during the second scenario?**

Due to the difference between the scenarios and the appearance of the simulator it was impossible to measure the rate of mistakes. All 27 tasks – nine participants with three tasks each - but one, were carried out without help, which gives the rate of 96%.

**16. Do the testers understand *Edit*?**

Edit is not a good name as a menu option – no tester made any audible connection to the menu in Windows.

***Time to Learn***

All tasks, but one, were carried out without much help from the test leader, i.e. the learning time was short. The testers had some problems with understanding the scenarios and the varying concepts were confusing. When the ease of use of each task was rated, the scores varied a lot, depending on what concept the user started out with. The participants, who started with concept I, were most generous with their scores; most testers compared the second and third tested concept with the first one where they had rated the first concept quite modest; in Table 8, the scores are compared. Concept III was rated very high when the testers had tried another concept first. The exact time to learn could not be estimated.

**Table 8 – Scores given the different concepts depending on when they were tested.**

Concept	Start	Middle	Last
I Copy/paste	22	15	21
II Copy, paste, clipboard, latest data	20	20	22
III Fetch	16	23	30

***Speed of Performance***

The speed of performance varied for all the participants. Some got the picture right away, some took it easy, thinking their actions through and some pressed all keys available. Out of all 27 tasks, only one participant gave up on a task, concept III scenario #2, due to the variation of scenarios in combination with concepts.

***Rate of Errors***

Almost every user tried to insert an object, but when noticing copy or fetch as an option they tried them out. It is hard to know for sure what they would have done with a real phone since the simulator was not implemented for more operations than the concepts to be tested. A variation of the rate of errors could be traced to what concept the participants started with, i.e. they mixed them up and got hooked on for example to fetch when they should have copied.

***Retention over Time***

The questionnaire showed an average rate of 4.0/5 that the participants believed themselves to remember how to copy/paste in a month; the rate for fetch was 4.4/5.

## ***Subjective Satisfaction***

In the questionnaire, the participants got to rate the concepts in order of precedence with the best one as #1. The results are found in Table 7 and concept III is the superior concept. Some users never found latest data or the clipboard, instead they used concept II as the first one. The testers also got to fill in if they thought a particular concept was more intuitive, i.e. easy to use. The result is in Table 9 and the best concept according to the users is concept III, since 78 % rated this concept to be the most intuitive.

**Table 9 - Most intuitive concept according to the participants**

Concept	Score	Percentage
I Copy/paste	1	11%
II Copy, paste, clipboard, latest data	1, latest data	11%
III Fetch	7	78 %

### **6.2.6 Conclusions from the Test**

An overall impression is that the copy/paste functionality was very welcomed and many had been waiting for this possibility in mobile phones.

The scenarios might have had an impact on the result. Some testers did not really understand the task and some did not understand where in the navigation system of the simulated phone they were positioned from the first picture of the scenario and were a bit confused.

The choice of testers (in-house attendees) might affect the result. All, except two, had a connection to Sony Ericsson, but no differences could be found between employees and testers from outside the company. Some questions about prior experience with Sony Ericsson mobile phones should have been asked. The reference group, with technical background from within the company, who was tested, had a different result than the chosen participants; most of them solved the tasks very fast, but they too liked concept III best.

During the test, the participants had a certain task to solve and they knew the task had a solution. The testers, who started with concept III, had more difficulties to solve the task, than the ones who started with concept I. In reality this could conduce to that the functionality would not be found, if concept III was chosen to be implemented.



For every concept tested, the participants rated the concepts higher and higher; the main reason for that is that the participant has a better knowledge of what tasks have to be performed to complete the scenario. They also had a better knowledge about where to find options and where the starting position of the scenario was.

In *More*, the option *Copy* was confusing. An option to avoid this confusion could be *Mark & Copy*, but before implementing it needs further evaluation, since *Copy* is the option the users are used to.

Final conclusion of the test was that a combination of all concepts, copy/paste with a clipboard and fetch, would be the best. Fetch could, for instance, be offered as an option *Insert text* under *Insert item* in *More*. Unfortunately, when the prototype of fetch was developed, it was obvious that the concept will be impossible to implement in a Sony Ericsson T610 platform; since the platform does not support multi tasking. It was tested anyway to evaluate it for a later platform. Therefore, the concept for implementation within this thesis was *Copy/paste with a Clipboard*.



## 7 The Implemented Concept

### 7.1 Design of the Concept to be Implemented

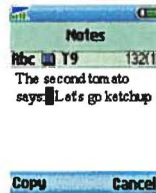
The conclusion from the usability test was to implement a concept with *Copy*, *Paste* and *Clipboard*. During the evaluation, it was recommended to redesign the option *Clipboard*. Therefore, the implementation was designed to have a clipboard made visible when *Paste* is selected. To maintain the mapping between what is selected and the outcome, the clipboard is displayed as *Paste*, not *Clipboard*, as in Figure .



**Figure 8 -**  
**More-menu,**  
**copy option**



**Figure 9 -**  
**Mark and**  
**Cancel**



**Figure 10 -**  
**Mark mode**



**Figure 11 -**  
**The clipboard**

The shortcuts were chosen to be:

*Copy*: Volume + joystick left/right

*Paste*: Volume + joystick up/down

since the present shortcut to mark text in a Sony Ericsson T610 and T68i, is to use the volume key and move the joystick. Moving the joystick laterally to mark and copy something is believed to be intuitive. To use a similar shortcut for paste, moving the joystick up or down seems to be the best way at present, the user moves the joystick up to fetch something from the past.

When the copy functionality has been activated with the shortcut, the volume button can be released and the functionality is the same as if it were chosen from *More*; the use of two hands is hereby minimized. The paste shortcut inserts the latest copied information, if it is of the right format. If not, the clipboard of the five latest copies appears, with the clips of the allowed format enabled.

The shortcuts were not tested during the usability test since two buttons cannot be pressed at the same time in the simulator.

## ***Heuristic Evaluation***

The new concept with an automatic clipboard need evaluation before the implementation can start. Below is evaluation according to design principles and usability requirements described.

## ***Affordance***

The menu option *Copy*, Figure 8, invites the user to make a copy of something, this statement is a result of the usability test where all participants but one chose *Copy* to mark something and then copy it. When *Copy* has been selected, the soft-keys change labels to *Mark* and *Cancel*, Figure 9, which invites the user to move the cursor to the desired starting point, press *Mark* – the soft-key with *Mark* change labels to *Copy*, Figure 10 – when the user moves the cursor, the information is marked. When all information to be copied is marked, the user presses *Copy* and the function ends. The phone enters the previous state, i.e. the state before *Copy* was selected.

To paste the copied information, the user moves the cursor to the desired insertion point and selects *Paste*. If more than one copy has been made, a menu of the five latest copies is visible as in Figure 11, and the user can choose which one to paste; the latest copy appears as the first option in the menu. When an option is selected, the phone enters the previous state, i.e. the mode before *Paste* was selected, with the pasted item visible.

## ***Constraints***

At present the user is constrained to copy inputs of different kinds, i.e. no files can be copied. The small amount of memory in the phone, adds constraints to the size of the copied information.

## ***Mappings***

The usability test implies the mappings of copy/paste are very good. Some of the participants were distracted by the difference between the scenarios and the concepts though, which might have an influence on the scores.

A *Mark and Copy* option is probably better mapping than just *Copy*. The hesitation is due to the well-known *Copy* option from MS Windows.

### ***Feedback***

When something has been copied the feedback is poor, some participants made the copy twice to be really sure the copy was made. The present feedback appears as a change of soft-key labels indicating the end of the copy mode and the cursor is back to normal, blinking at the end of the previous marking.

The feedback of *Paste* is obvious since the pasted information is visible. If the insertion point is of another format than the copied information, *Paste* is disabled in *More* and is not selectable.

### ***Effectiveness***

The accuracy of the copy/paste concept is good and the goals are easily achieved. A drawback might be if the user tries to paste something of the wrong format and does not understand why the menu option is disabled – an information note should notify about the reason.

### ***Efficiency***

To use copy/paste is much more efficient than using the existing input methods over and over again.

### ***Satisfaction and Attitude***

The ability to copy/paste within a mobile phone scored 4,1 out of five among the participants, i.e. a rate of 82% thought copy/paste is a usable functionality within a mobile phone; but only 62% believed they would use the functionality.

### ***Learnability***

Copy/paste is a well-known functionality from the use of computers. The participants had very little learning time and knew the meaning of the options before they tried them out. The participants thought they would easily remember how to copy/paste in a month; the total score was 4,0 out of five.

## ***Throughput***

Experienced users have the opportunity to use shortcuts – one for *Copy* and one for *Paste*. The shortcuts ought to be tested, but due to shortage of time this thesis will not cover that.

When using *Paste* via *More*, a clipboard is displayed if more than one copy has been made, if this does not suit every user, the shortcut offers the possibility to paste the most recent copied item. Only if that item is of the wrong format, the clipboard is displayed to show which clips that are enabled. The errors made with copy/paste should be minimal.

## ***Flexibility***

It is possible to copy several – five – pieces of information from one application and paste them into another. Further development should make it possible to copy/paste files as well as text strings.

## **7.2 Implementation**

To be able to implement copy/paste in a real phone, there is an enormous size of information to go through. Approximately two weeks of this thesis were used to get to know the environment and its features, to implement a dummy version of copy/paste and get to know how to handle soft-keys.

The code was written in C and as a reference during the process, the Kernighan and Ritchie book [6], was used. Below the different parts of the implementation are described in detail.

### ***More***

The soft-keys have different functionality, depending on what the user is doing. If the user only has one option, it will show as the left soft-key. If two options are possible, the second is visible as the right soft-key. If more than two options are possible, the primary is shown as the left soft-key and *More* is shown as the right soft-key. If *More* is chosen, the rest of the options are listed in a menu.

When the user is editing text, a number of possible options, e.g. *Insert object* and *input method*, are shown. The options differ, depending on what kind of input the user is editing. *Copy* and *Paste* were added as options to the menu, visible in the text edit mode.

The options in *More* can either be enabled or disabled. If an option is enabled, the user is allowed to select and use it but if it is disabled, the user is not allowed to use it and a message will be displayed if it is selected.

The possibility to disable options is used with the two new alternatives. *Copy* will be disabled, if the text edit field is empty, i.e. if there is nothing to copy. As soon as a character is written or inserted in some way *Copy* will be enabled. *Paste* is disabled when nothing has been copied or if none of the copied items match the format of the text edit.

### ***Mark Mode***

When *Copy* is selected in *More*, the user gets in the marking state, visible in Figure 10. It looks the same way as the regular text edit mode and text can still be edited as before. The difference is that the soft-keys are changed from *Continue* and *More* to the labels *Start* and *Cancel*. If *Cancel* is selected, the phone returns to the text edit mode.

In the usability tests the label was *Mark*, not *Start*. The reason for the change of names is that the current language vocabulary in the phone does not contain the word *Mark*. If a new name is chosen, it can either be inserted into the vocabulary or be hard coded. Insertion into the vocabulary is needed to translate the option when the user switches languages in the phone, up to 30 languages are available. It is not a good option to hard code the name, since the name will not change with everything else, if languages are switched. Instead of inserting a new word into the vocabulary it was decided to choose *Start* and concentrate on other parts of the implementation.

The purpose of the mark mode is to navigate to a desired starting position for the selection. If *Start* is selected, the copy mode will be entered.

### ***Copy Mode***

The copy mode is reached either by pressing *Start* in the mark mode or by using the copy shortcut. It still looks like the text edit mode, but with some differences. The most obvious difference is that the soft-keys have the labels *Copy* and *Cancel*. Other things that differ are that it is only possible to navigate, not to edit the text, and the text between the cursor and the previously saved position is highlighted.

When entering the copy mode, the first thing that happens is that the cursor position is saved. This is to detect where the highlighting starts, and when *Copy* is selected, the highlighted part of the text string, along with information about size and what kind format the string has, is stored in the clipboard. When copied, the program returns to text edit mode. If *Copy* is chosen without any highlighted information, nothing is copied. The sequence diagram of *Copy* is in Figure 8.

If *Cancel* is pressed the program will return to text edit mode without copying anything to clipboard.

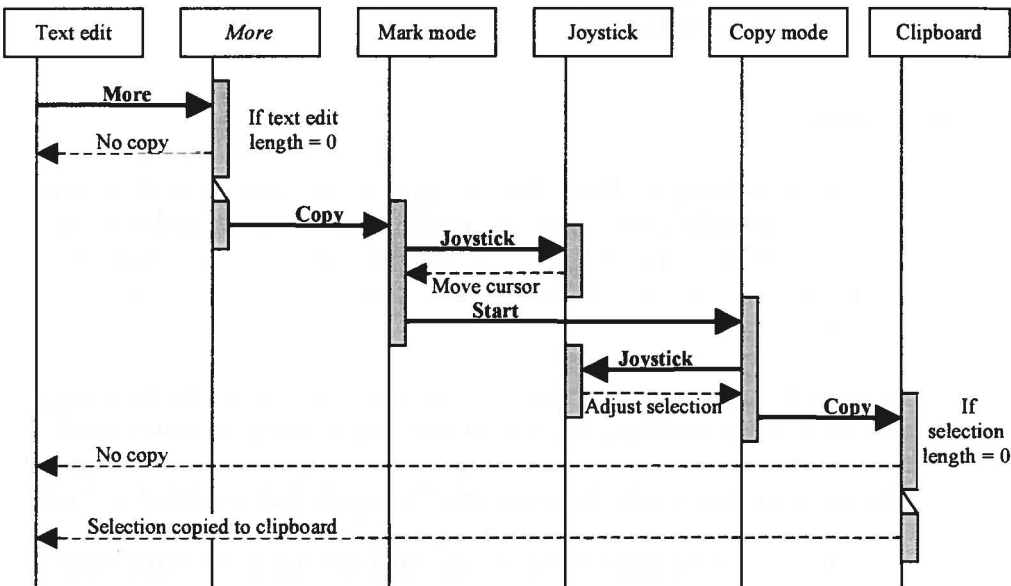
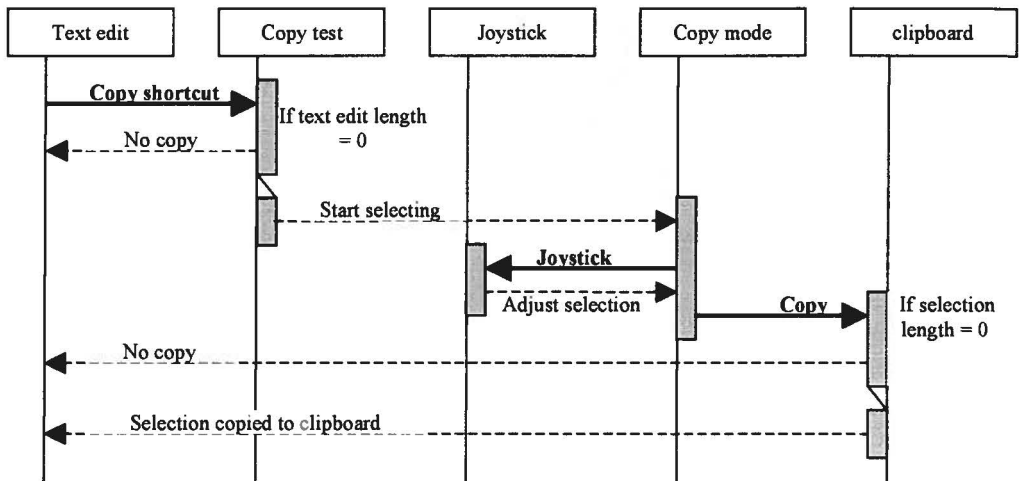


Figure 8 - Sequence diagram of copy with the soft-keys

*Copy Shortcut*

To speed up the use of *Copy*, it was decided to implement a shortcut command, the sequence diagram is in Figure 9. This shortcut is reached with the combination of pressing one of the volume buttons and moving the joystick sideways. When the shortcut is used, the copy mode is started. The starting position of the selection is, in this case, the position where the cursor was, when command was executed.



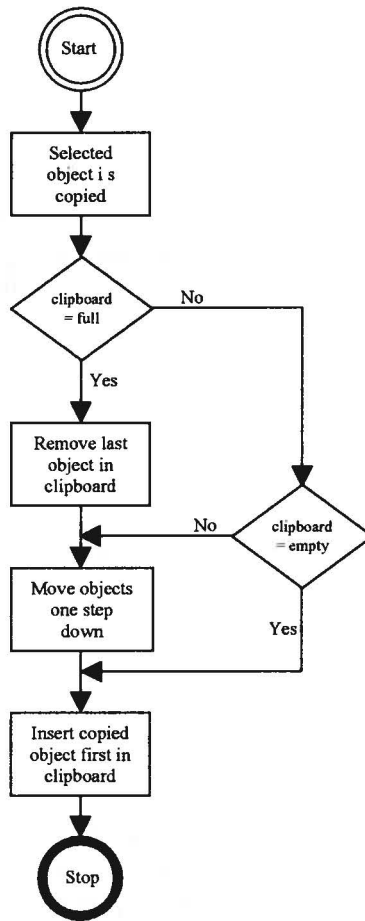


**Figure 9 - Sequence diagram of copy with shortcut**

### ***Inserting into the Clipboard***

The information about size and format of a string, is collected in a struct and saved in the clipboard.

If the clipboard is full, the object in the last position is erased. Thereafter, all the objects are moved one position down in the list and the new object is placed in the first spot. If the list is empty, the object is placed in the first position. A state diagram of the functionality when inserting into the clipboard is visible in Figure 10.



**Figure 10 – State diagram of Inserting into the clipboard**

***Paste***

When *Paste* is selected in *More*, two different scenarios can occur. If the clipboard only contains one object, it is pasted and the program returns to the text edit mode. The other case is if more than one object has been copied into the clipboard and the clipboard menu gets visible.

## Clipboard Menu

When the clipboard is shown, the user can choose between the objects in the menu. The copied string is displayed as an option, and if the string contains more than 32 characters, the first 32 will be visible in the menu.

When the menu is visible, the soft-keys have the labels *Paste* and *Delete*. *Paste* will insert the string at the current cursor position. *Delete* is used to remove the object permanently from the clipboard. A sequence diagram of *Paste* is visible in Figure 11.

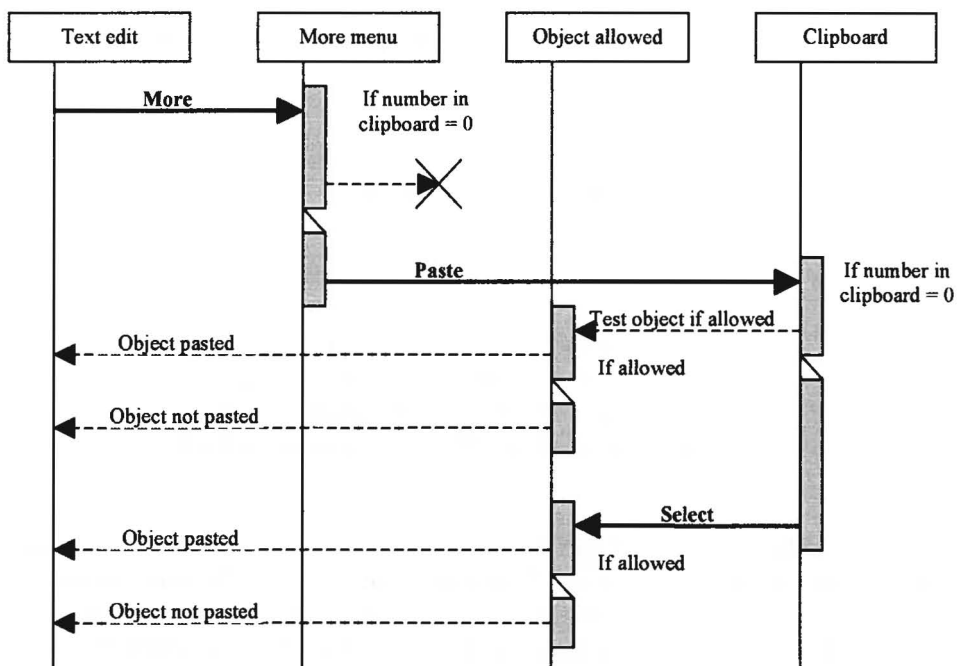
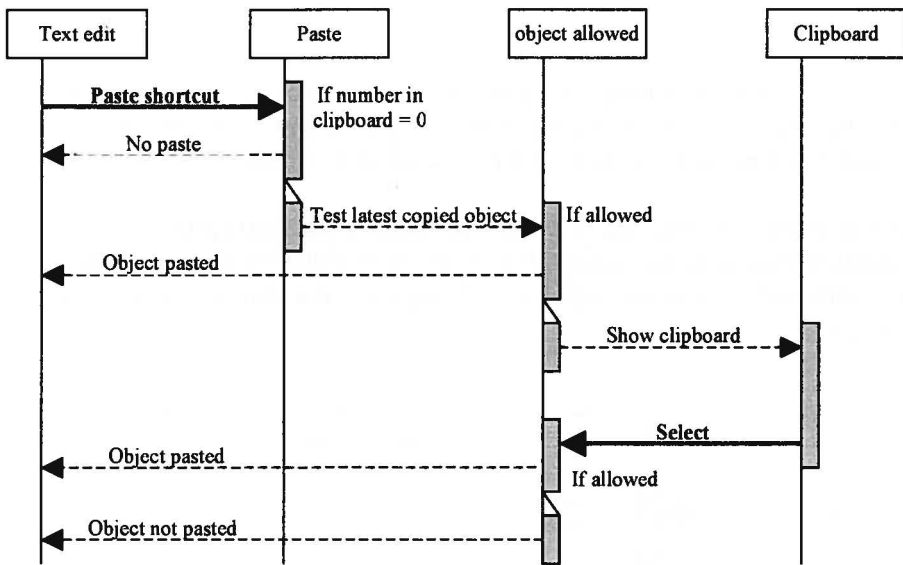


Figure 11 - Sequence diagram of paste with soft-keys

## Paste Shortcut

The shortcut for paste inserts the latest saved string at the current cursor position. If nothing has been copied into the clipboard, nothing will be inserted. If the first object is disabled, the clipboard menu is displayed to let the user choose an enabled object. The command is activated with holding one of the volume buttons pressed and at the same time move the joystick up or down. If the button and the joystick are not released the string will be inserted multiple times. A sequence diagram of the shortcut is visible in Figure 12.



**Figure 12 - Sequence diagram of paste with shortcut**

### ***Object Allowed***

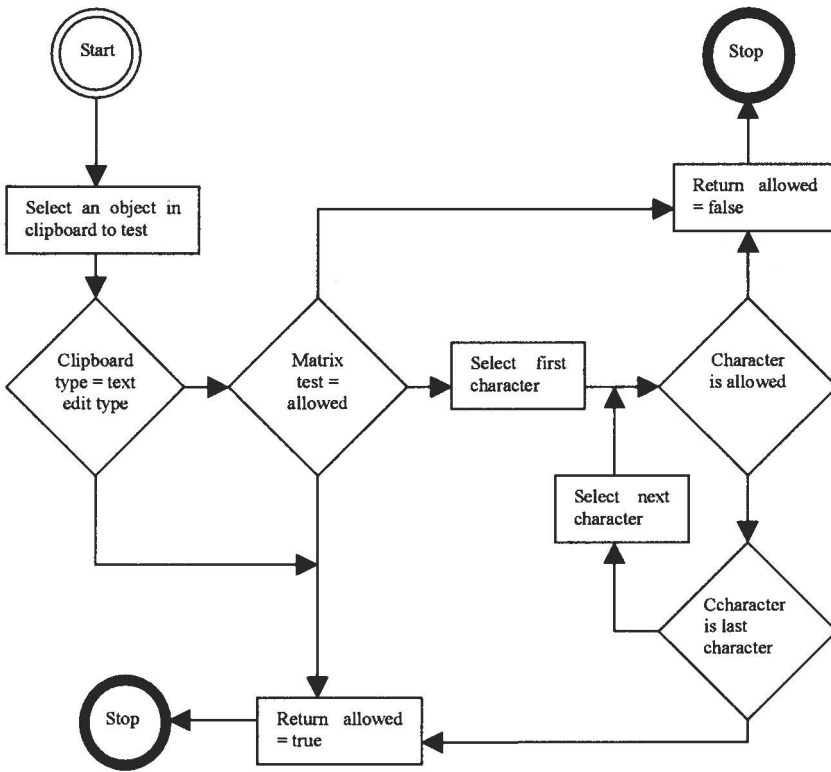
Some objects cannot be inserted in other types of input fields, for example a text message cannot be inserted in a phone number field, but a phone number can, without any problems, be inserted in a text message. It should however, be possible to copy a phone number from the text message and put it in a phone number field.

To speed up the test if an object is allowed, a three level test was developed. The first part of the test is to see if the chosen object is of the same format as the field it is supposed to be pasted in. If the formats match, it is allowed to be pasted without any further testing needed, and the object is enabled in the clipboard menu.

If the formats do not match, the second test checks if it is allowed to paste a special kind of the object into another type of field, i.e. if it is allowed to paste a text object into a phone number field. This test is made with a two dimensional matrix. The two types are used to index the answer from the matrix.

The matrix gives three different answers; *Paste is allowed*, *Paste is not allowed* or *Further testing is needed*. If the answer is *Further testing is needed*, the matrix specifies what kind of test that is.

The third part of the test is a character test. In this test the string will be examined character by character. If all the characters are allowed the string pass the test, but if one of the characters is not allowed, the test is terminated and the result is *Paste is not allowed*. A state diagram of *Object allowed* is in Figure 13.



**Figure 13 - State diagram of object allowed**

## 7.3 Final Evaluation

The implemented copy/paste functionality was tested informally with ten testers. Due to time limits within this thesis, no formal test was carried out. The functionality was favourably received, but some comments about further development were noted:

- When an item has been copied, *Paste* could be visible to get a better flow with the functionality. In most cases, *Copy* is followed by *Paste* and to avoid selecting the option from *More*, *Paste* could be a soft-key function.
- The shortcuts could be altered, since the volume-button is seldom used with text input, and the resemblance between the shortcut for copy and the one for paste might be a bit too close.
- When the shortcut for paste is used, and the latest copied item has the wrong format, the copied item with a right format should be highlighted in the clipboard. This to avoid the need of scrolling.

- Some testers thought *Copy* and *Paste* should be visible in *More*, only when the options are enabled.
- *Mark* is a better soft-key label than *Start*.

The test made during the benchmarking, where the steps to copy from a text message and paste the information into a contact was counted, was carried out for the final prototype as well. Due to the navigation in a Sony Ericsson T610, the score was 16, but only to open a contact, seven steps were needed. With shortcuts, the score was reduced to 11, i.e. the same score as the Panasonic GD87.

## 8 Conclusions

### 8.1 Results

The result of this thesis is a working prototype of *Copy/Paste* with clipboard functionality in a Sony Ericsson T610. During the thesis a number of concepts were generated, evaluated and tested in order to choose the best idea of how to copy information and insert it in another place. The final prototype is a product of continuous evaluation with different usability methods.

The generated concepts were improved during the process, to be more and more competitive, and a usability test was a valuable tool to find positive and negative aspects of the tested concepts. The usability test was carried out with nine participants, and was an important factor when the final concept was chosen.

Two of the concepts were close rated in the usability test. The second concept, apart from the implemented one, was *Fetch*. It was rated higher than *Copy/Paste* by the users and it was quicker to use, but it had a bit longer learning time and there was a risk; the user would not understand it.

To speed up the functionality for the advanced users, shortcuts were included in the copy/paste concept. These reduced the number of commands needed to copy and paste, significantly. Instead of navigating via menus, the commands are reached by pressing one of the volume buttons and moving the joystick at the same time.

Due to the problem with navigation – it takes seven steps to open a contact in a Sony Ericsson T610 – a clipboard was included to store up to five different pieces of information. This reduces the number of iterations when copying several pieces of information from one application to another.

To make the functionality useful, format recognition was added to single out what kind of input that is copied or pasted. Without it, there would be no possibility to copy and paste between different kinds of text modes, e.g. phone number, e-mail address, string or IP-number.

## 8.2 Recommendations of Further Development

Many questions are still not answered and have to be considered before a final version of the product is released. The ones encountered are listed below:

- Further feedback can be offered by making an icon visible in the status bar when something has been copied. A few participants in the usability test had troubles knowing whether they had copied or not and therefore they copied twice. The icon can be visible until something is pasted or a timer could be set to make it disappear after a few seconds. Another way to offer feedback of *Copy* is to show a text box with the text “A copy has been done” for a short period. This method is already used when leaving a text message with the text “Saved in drafts”.
- *Mark & Copy* might be a better menu alternative than just *Copy*. This to avoid conflict with the computer environment, where something has to be marked before the *Copy* command can be chosen.
- A timer might be used on the objects in the clipboard. The reason for this is that the clipboard is showed when it contains more than one object. It is not likely that a user wants to paste something that has been copied days earlier. A second reason is that it takes up space in the memory. If large amounts of data are placed in the clipboard, they might have an impact on the performance of the phone.
- The cursor should get a new look when the user is selecting text. The look changed in the user tests and when this was done none of the testers had any problems to identify that they were in a text selecting mode. The cursor did not change in the implemented product and it caused some hesitation among some of persons, who have tried the implemented version.
- It is necessary to implement a copy function in the browser<sup>6</sup>. In the implemented version it is not possible to copy from a received text message until edit is chosen.
- Instead of highlighting the first object in the clipboard, the first allowed object, due to formats, should be highlighted.
- Automatic error control should be implemented to complement the format recognition, i.e. a phone number field cannot handle spaces or the “-” character. These are however often used when writing a phone number in a text message and should be trimmed when pasted in a phone number field. In the strict format recognition implemented in this thesis a number with these characters would not be allowed to be pasted.

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<sup>6</sup> A browser is used to display different kinds of information, but does not allow editing.



- The shortcut to mark text within Sony Ericsson phones, i.e. T68i, T610, has been used when the user wants to edit the marked text. Within this thesis it has been changed and the shortcut is now locked to the copy option. It is however only a small change needed to show a *More*-menu with the options *Cancel*, *Text format* and the other possible options, which have to do with editing the marked text.
- Only show *Copy* and *Paste* when they are possible to choose in the menu. This is to reduce the number of options in the menu. Some special text edit modes such as code memory only has two options and by adding a *More*-menu, the simplicity is lost.
- A change in the platform to allow multitasking would make copy/paste much faster to use. This should also make *Fetch* possible to implement.
- Implement *Fetch* as a complement to *Copy/Paste*, as the option *Insert text* in the *Insert object* menu.



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# Glossary

Application	A program which keeps a certain functionality working, different applications within a mobile phone, e.g. calling, messages, calendar or phonebook.
Back-key	A key on the keyboard with a reversal array, when pressed the phone enters to the previous state.
Brainstorming Session	A meeting with the purpose of coming up with new ideas for a certain matter.
Browser	A browser is used to display different kinds of information, but does not allow editing.
Cursor	A symbol indicating the current position in a text.
GIF	Graphics Interchange Format. GIFs are pictures stored in the .gif format.
GOMS	An evaluation method described in section 2.2.2, the abbreviation stands for goals, operations, methods and selection rules.
Heuristics	Recognized usability principles
Highlight	The color of the text and the background are inverted, to make a part of a text stand out.
KLM	An analytic evaluation method further described in section 2.2.3., the abbreviation stands for the keystroke level model.
More-menu	A menu of options visible as a soft-key function, <i>More</i> , whenever input is available; in the text message application it consists of options like add symbol, input method, insert item etc.
Persona	A hypothetical user archetype that represents the needs and goals of several users. Personas are <i>not</i> average users.
Picture Message	MMS, Multimedia Messaging Service, a message that can withhold one or more pictures/photos, sounds and text.
Platform	A software/hardware foundation upon which a generation of mobile phones is based.

Scenario	A concise textual description of a persona using the design in a realistic context of use to achieve a goal
Soft-key	A key which is able to change functionality, the present value is visible at the bottom of the display
Storyboard	A combination of scenarios and user interface sketches.
Struct	A data type used in
Task	A human activity that will achieve a goal.
Text Message	SMS, Short Message Service, a message of maximum 160 characters.
UCD	User-Centered Design, a method aiming for ease of use with products
User interface	The aspects of the system that the user comes in contact with.

# Appendix

## Appendix A – Counted Keystrokes

Scenario A										
Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Concept 6	Concept 7	Concept 8	Concept 9	Concept 10	Concept 11
back	back	more	more	back	long back	more	more	more	more	back
back	back	databoard	recent	back	notes	Fetch	fetch	fetch	set pastemark	back
sms	sms	latest data	mark	sms	mark	application	application	data board	back	sms
inbox	inbox	mark	copy	inbox	copy	Sms	sms	latest data	back	inbox
choose message	choose message	copy	more	choose message	long back	inbox	inbox	mark	sms	choose message
mark	mark		recent	mark	message	choose message	choose message	copy	inbox	mark
copy	copy		paste	copy	paste	mark	mark		choose message	copy to recent
back	back			more		copy	copy		mark	
back	back			switch					copy to pastemark	
back	back			choose appl.						
e-mail	e-mail			paste						
draft	draft									
choose message	choose message									
continue	continue									
edit&send	edit&send									
paste	paste									
16	16	5	7	11	7	8	8	6	9	7

Scenario B										
Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Concept 6	Concept 7	Concept 8	Concept 9	Concept 10	Concept 11
mark name	mark name	mark name	mark name	mark name	mark name	long back	mark name	mark name	mark name	mark name
copy	copy	copy	copy	copy	copy	phonebook	copy to clipboard	copy to clipboard	copy	copy
long back	mark address	long back	long back	long back	long back	add contact	mark address	long back	long back	long back
phonebook	copy	phonebook	phonebook	phonebook	phonebook	name	copy to clipboard	phonebook	phonebook	phonebook
add contact	long back	add contact	add contact	add contact	add contact	more	long back	add contact	add contact	add contact
name	phonebook	name	name	name	name	fetch	phonebook	name	name	name
more	add contact	more	more	more	more	application	add contact	more	more	more
paste	name	paste	paste	paste	paste	Sms	name	paste	paste	paste
yes	more	yes	yes	yes	yes	Inbox	more	yes	yes	yes
save	clipboard	address	address	address	address	choose	clipboard	address	address	address
long back	choose number 1	more	more	more	long back	Mark	choose number 1	more	more	save
message	yes	databoard	recent appl.	switch	message	Copy	yes	databoard	pastemark	long back
sms	address	latest	mark	choose appl.	mark	Yes	address	latest	save	message
inbox	more	address	copy	mark	copy	address	more	mark address	long back	sms
choose message	clipboard	copy	more	copy	long back	More	clipboard	copy	message	inbox
mark address	choose number 2		recent appl.	more	phonebook	Fetch	choose number 2		sms	choose
copy			more	switch	more	application			inbox	mark
long back			paste	choose appl.	paste	Sms			choose	copy to recent
phonebook				more		inbox			mark	
edit contact				paste		choose			copy to pastemark	
address						Mark				
more						Copy				
paste										
23	16	15	18	20	18	22	16	15	20	18

Scenario C										
Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Concept 6	Concept 7	Concept 8	Concept 9	Concept 10	Concept 11
mark	mark	mark	mark	mark	mark	fetch	mark	mark	mark	mark
copy	copy	copy	copy	copy	copy	application	copy to clipboard	copy to clipboard	copy	copy
more	more	more	more	more	more	sms	more	more	more	more
paste	paste	paste	paste	paste	paste	draft	fetch	fetch	paste	paste
						choose	clipboard	clipboard		
						mark	choose	choose		
						copy				
4	4	4	4	4	4	8	6	6	4	4

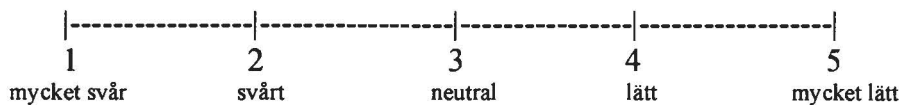


## Appendix B – Task Evaluation Form and Results

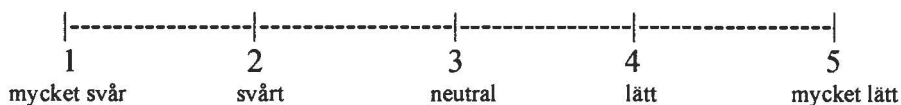
### Uppgiftsbedömning

*På en skala från 1 till 5 – bedöm hur lätt denna uppgift var (1=svår och 5=lätt)*

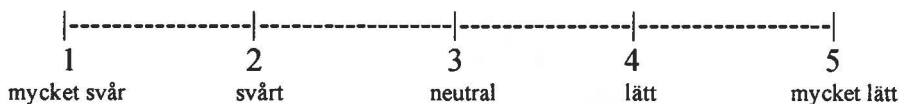
1.



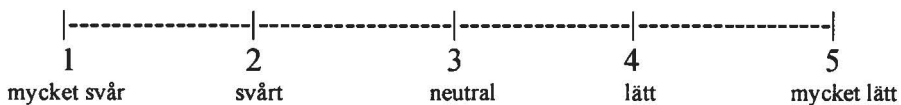
2.



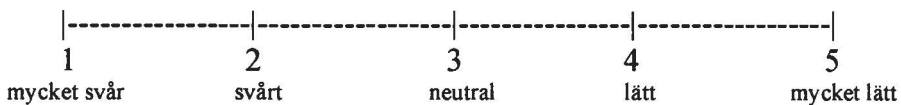
3.



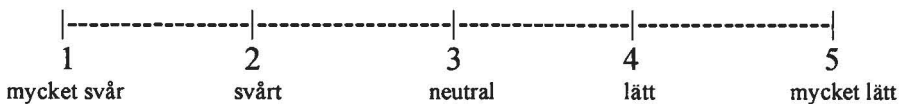
4.



5.



6.



- |   |                                  |            |
|---|----------------------------------|------------|
| 1 | Copy/Paste                       | Scenario 1 |
| 2 | Copy/Paste                       | Scenario 2 |
| 3 | Copy/Paste/Clipboard/Latest Data | Scenario 1 |
| 4 | Copy/Paste/Clipboard/Latest Data | Scenario 2 |
| 5 | Fetch                            | Scenario 1 |
| 6 | Fetch                            | Scenario 2 |

Colors depending on the order the test was made

First tested concept      Second tested concept      Third tested concept

### Task evaluation

Task	Tester									Sum for each scenario
	1	2	3	4	5	6	7	8	9	
1	2	3	4	3	4	4	2	3	4	29
2	3	3	3	4	2	4	2	3	5	29
3	3	2	4	2	5	3	3	4	4	30
4	4	2	2	5	4	4	2	4	5	32
5	5	4	5	5	4	5	2	4	5	39
6	5	3	3	5	3	3	2	1	5	30
Sum	22	17	21	24	22	23	13	19	28	

## Appendix C – Participant Questionnaire and Results

### Utvärdering av Copy/Paste i en mobiltelefon

**Kön**                      Kvinna    Man

**Åldersgrupp**    -19    20-25    26-30    31-35    36-40    41-50    50-

#### 1. Hur upplevde du möjligheten att kopiera text i en mobiltelefon?

Dålig      1              2              3              4              5      Mycket bra

#### 2. Har du använt denna funktion tidigare?

Ja              Nej

Om ja,  
var? \_\_\_\_\_

#### 3. Vilket koncept tyckte du bäst om? Vänligen rangordna alternativen med nummer ett som det bästa.

Copy and paste  
Copy and paste med clipboard  
Fetch

Kommentar: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

#### 4. Tyckte du att något av koncepten följde din intuitiva känsla, d.v.s. var något extra lätt att använda?

Ja              Nej

Om ja, vilket? \_\_\_\_\_

Ange din grad av instämmande till de tio frågorna nedan. Markera en av rutorna bredvid påståendet med ett kryss. Tänk inte för länge på varje fråga, det är din första reaktion på påståendet som du ska ange. Om du inte vet hur du ska svara, markera '3'.

	Instämmer inte alls			Instämmer helt	
4. Jag skulle använda kopieringsfunktionen ofta om en sådan fanns i min telefon.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
5. Jag kan tänka mig att använda båda händerna för att markera text (t.ex. med hjälp av volymknappen och joysticken).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
6. Jag kommer att komma ihåg hur jag kopierar och klistrar in om en månad.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
7. Jag kommer att komma ihåg hur jag ska använda <i>Fetch</i> om en månad.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
8. Om det fanns en <i>Clipboard</i> i min telefon skulle jag använda den ofta.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
9. Om det fanns kortkommandon för att kunna markera text i min telefon skulle jag använda dessa ofta.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
10. Jag behärskar <i>Fetch</i> .	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
11. Jag behärskar <i>Copy/Paste</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
12. Jag behärskar <i>Clipboard</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5
13. Jag behärskar <i>Latest data</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1	2	3	4	5

**14. Hade du velat ha mer hjälp med något under testningen?**

Ja      Nej

**Om ja, med vad?** \_\_\_\_\_

---

---

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**15. Hur skulle du vilja markera text i en mobiltelefon?**

---

---

---

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**16. Hur ofta skickar du sms?**

Varje dag      Varje vecka      Sällan      Aldrig

**17. Har du använt någon av följande funktioner?**

MMS    EMS    E-post i mobilen

**18. Hur ofta använder du en dator?**

Varje dag      Varje vecka      Sällan      Aldrig

**19. Har du använt kopiera och klistra in (copy and paste) på datorn?**

Ja      Nej

**Om ja, hur använder du dessa funktioner?**

Ctrl-c, ctrl-v      Högerklicka med musen      ”Drag and drop”

Via redigera-menyn      Verktögsfältsknappar

**Tack för din medverkan!**

# Evaluation of Usability Testing

Question	Tester											
	1	2	3	4	5	6	7	8	9	Sum		
1	5	4 Yes, P800	4	5	4	4	2	4	5	37	4,1	
2	No	No	No	No	No	No	No	No	No			
3 - C/P	3	2	3	3	3	3	2	3	3	25	3	
3- Clipb.	2	3	2	1	1	2	3	2	1	17	2	
3- Fetch	1	1	1	2	2 latest data	1	1	1	1	11	1	
4	Fetch	Fetch	Fetch	C/P		Fetch	Fetch	Fetch	Fetch			
Obs 4	4	5	2	4	2	2	5	2	2	28	3,1	Use Both hands
5	1	3	4	2	2	3	5	4	4	28	3,1	
6	3	4	4	5	5	3	3	4	5	36	4,0	C/P month Fetch month
7	5	3	5	5	5	4	4	4	5	40	4,4	Use clipboard Use short cut
8	4	3	4	5	3	2	3	2	2	28	3,1	Control Fetch Control C/P
9	4	4	2	4	2	2	4	3	2	27	3,0	Control Fetch Control C/P
10	5	4	2	5	3	4	3	3	4	33	3,7	Control Fetch Control C/P
11	3	3	2	5	2	4	2	3	4	28	3,1	Control Clipboard Control Latest Data
12	3	3	2	5	4	4	2	3	4	30	3,3	
13	3	3	2	3	5	2	2	1	3	24	2,7	
Sum 4-12	35	35	29	43	33	30	33	29	35	302	33,6	
14	No Every day	No Every week	No Every week	No Every week	No Every week	No Every week	No Every week	No Every week	No Every week			
16		MMS, E- mail	MMS, E- mail									
17	Every day	Every day	Every day	Every day	Every day	Every day	Every day	Every day	MMS Every day			
18												
19	Yes, 3	Yes, 5	Yes,3	Yes,3	Yes,5	Yes,1	Yes,2	Yes,3	Yes,2			

15.

Tester #1: Doubleclick the joystick at a word, as a complement.

Tester #2: Mark with the joystick.

Tester #4: Press *Mark* and use the joystick.

Tester #5: Good as it was.

Tester #6: Good as it was.

Tester #8: Direct via a *More* menu. The functionality worked fine by me.

Tester #9: With the joystick.

Statistics over the  
participants in the  
test.

Men	7
Women	2
Age 20-25	1
Age 26-30	7
Age 31-35	1

# Appendix D – Usability Test Scenario Walkthrough

The typical way to solve scenario number one with the three different concepts are shown below. Between the screenshots is information on what buttons to press to get to next screen. Four different buttons are used. *Back* is used to navigate to previous state. The joystick is used for navigation. It is only shown in these scenarios when selecting text. It is also used to move the cursor and to navigate in the menus. The last two buttons are the soft-keys. These have different functions depending on the current application. The functions are shown at the bottom of the screen.

## Copy / paste

	Back		Back		Yes
	Back		Back		Select
	Select		Read		More
	Select		Mark		Joystick



Copy



Back



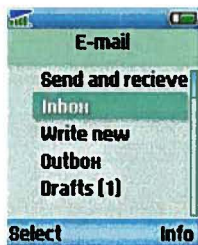
Back



Back



Select



Select



Select



Edit



More

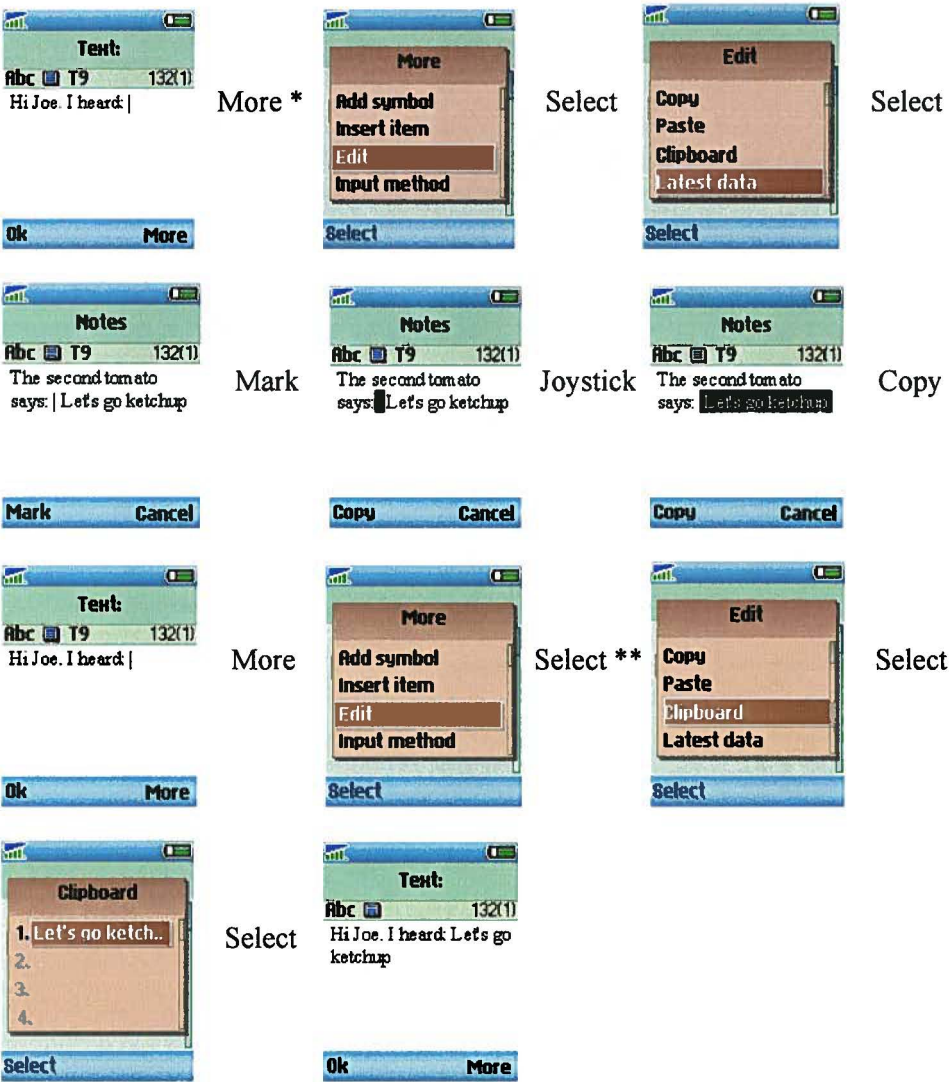


Select





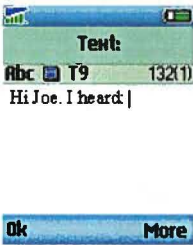
*Copy / Paste / Clipboard / Latest data*



\* This concept is built on the Copy / paste and the back button could also be used to solve scenario as in Copy / paste.

\*\* Paste could also be chosen which would lead directly to the last screen instead of going via the clipboard.

Fetch



More



Select



Select



Select



Select



Select



Mark



Joystick



Fetch

