Facilitating the Information Exchange Between Parents and Personnel at Preschools by Gathering Quantitative Data

Markus Johansson

February 12, 2014
Master’s Thesis in
Interaction Technology and Design,
30 ECTS credits
Supervisor at TFE: Karin Fahlquist
Examiner: Håkan Gulliksson

UMEÅ UNIVERSITY
Department of Applied Physics and Electronics
SE-901 87 UMEÅ
SWEDEN
Abstract

The information exchange between parents and personnel at preschools is held informally and mainly when the child is departed from the preschool. Interviews with parents and personnel at preschools were made to find out what this exchange consists of, what factors affect it, and if there are parts that may be improved by making them digital. Through these interviews, the information need was extracted and analyzed, and factors affecting the information exchange were identified. Parts of these findings where compiled into a software idea as an extension to the software for preschools provided by Tempus Information Systems AB, where this master’s thesis was conducted.

Requirements for the software were gathered and prioritized. Prototypes were made, tested, and evaluated leading to the development of a web application. The application supports inputting chosen parts of the information need in order to make it accessible for parents. It is intended to be used by the personnel and to run on a tablet mounted on the wall, helping their everyday tasks, as well as being a service to parents of smaller children. This information could then be retrieved by the parents when the child is departed from the Tempus Touch software at the preschool, thus freeing the information exchange to qualitative matters about the child’s well-being. It could also be accessible through the Tempus web or mobile application while at home.
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Chapter 1

Introduction

The information exchange between parents and personnel at preschools usually takes place when the children are being left or picked up. Parents of smaller children, up to about three years of age, are more concerned than parents of older children about how they have slept, how well they have eaten, and the diaper content. Furthermore, these children have limited communicative ability to inform about this. The information exchange is complicated by certain factors such as availability of time for parents and personnel, and the children’s cooperation.

The goal of this master’s thesis is to find out what the information exchange between parents and personnel at preschool consists of, what the topics are, which factors affect it, and which parts of it that might be improved by making it digital. The purpose is to make a software implementation that facilitates this exchange by making analog systems and memorized information digitally accessible.

1.1 Tempus Information Systems AB

This master’s thesis was conducted at Tempus Information Systems AB (hereinafter Tempus). Tempus has a product, also called Tempus (hereinafter Tempus software), aimed at preschools to enable parents to schedule their children’s weeks in advance and to report the actual attendance every day; children are logged in and out of the system when arriving at and departing from the preschool. The scheduling and absence is reported by the parents either through touch screens at the preschool, the web site or through a mobile application. The Tempus software also provides personnel planning and other administrative tools.

1.2 Paper outline

Chapter 2. Problem Description
Describes the goals, the purpose, and the various methods and tools used throughout this master’s thesis work.

Chapter 3. In-Depth Study of Interview Methods
Contains the in-depth study of survey methods used as a starting point for the consecutive work.

Chapter 4. Accomplishment
Describes the various steps in the work, including results and analysis that are needed in them.
Chapter 5. Results
Focuses on the results of the steps taken in Chapter 4.

Chapter 6. System Description
Describes the final application and its parts in detail.

Chapter 7. Discussion
Discusses some of the results and the decisions taken throughout this master’s thesis work.

Chapter 8. Conclusions
Contains concluding thoughts and future work.

Chapter 9. Acknowledgments
Acknowledges people supporting this master’s thesis work.

1.3 Glossary
This section contains a small glossary of words that may need further explanation. Some words are used with a broader definition in this master’s thesis and are therefore described. Other words are listed with their Swedish counterparts [12] as a help for a Swedish reader.

enrolled inskriven

double-blind denoting a test or trial, especially of a drug, in which any information which may influence the behavior of the tester or the subject is withheld until after the test

municipality kommune

parent used in this master’s thesis for any caretaker responsible for the child’s well-being

parental leave (of absence) föräldraledighet

premises [premsız] område

preschool head förskolechef

rapport [raˈpɔː] a close and harmonious relationship in which the people or groups concerned understand each other’s feelings or ideas and communicate well

reception inskolning

reception period inskolningsperiod

substitute (teacher) (lärar)vikarie

1.4 Fictitious names
In examples and schematic illustrations there are fictitious names used. The children are named alphabetically after the Swedish spelling alphabet and their last names are common Swedish last names, sharing the same initial letter. A fictitious preschool with the departments “The Birch,” “The Oak,” and “The Pine” are used in examples. All resemblances of real persons or preschools are coincidental.
Chapter 2

Problem Description

Much of the information exchange between parents and personnel is done informally when the children are arriving at or departing from the preschool. There are factors affecting this exchange; for instance: 

a) there are other children being left or picked up at the same time, 
b) the personnel is busy with other activities or attending other children, 
c) the parents are in a hurry, 
d) the child may be reluctant, and 
e) the personnel at hand may not be the one who has the information the parent wants.

At departure, the information may be difficult for the parent to gather. Later, at home, the parent may have the need to know why its child is behaving in a certain way—perhaps due to not eating, sleeping, or pooping. Because it is not digital, the information is not accessible from home.

For parents, these everyday issues are important aspects of the care taking of their children, who lack the communicative ability to share this information.

2.1 Goals

The goals that were identified for this master’s thesis are:

– Find out what the information exchange between parents and personnel at preschool consists of, what the topics are, which factors affect it, and which parts of it that might be improved by making it digital.

– Make an in-depth literature study on survey methods and select appropriate method asking the parents and personnel.

– Prepare and carry out interviews with parents and personnel at preschools with and without the Tempus software.

– Summarize a list of information need found in the interviews.

– Make prototypes from a selection of the information needs and prioritized requirements.

– Evaluate the prototypes using heuristics and walkthroughs.

– Test the prototypes on usability experts and real users.

2.2 Purpose

The purpose for this master’s thesis is to facilitate the information exchange between parents and personnel. This will be achieved by making information accessible by digitalizing analog systems and memorized information.
2.3 Methods

A user-centered concept and product development cycle was used as template for the design process throughout this master’s thesis work. To ask parents and personnel about their information need, an in-depth literature study of survey methods was carried out (Chapter 3) to gather knowledge of the available methods in the field and to choose an appropriate method. The MoSCoW prioritization method was used to prioritize the requirements. Prototyping was used to try ideas and test them on users. A cognitive walkthrough was carried out on the low-fidelity prototype. Usability heuristic was carried out on the high-fidelity prototype. Google Web Toolkit (GWT) was used to make the high-fidelity prototype.

2.3.1 Design process

The design process used throughout the work was developed by Nokia. \[20\] It is a user-centered concept and product development cycle (Fig. 2.1) that consists of two main parts: the concept creation and the concept evaluation. The starting point for entering this design process is the contextual data gathering.

The first part describes the workflow of the concept creation with data analysis, scenario and task building, and the first designs. This part can be reiterated if necessary. The second part consists of prototype tests, design iterations, and simulation tests. These steps are reiterated and made more refined as the concept evolves to a final design. \[20\]

![Figure 2.1: The user-centered concept and product development cycle. \[20\]](image)

2.3.2 MoSCoW prioritization method

A straightforward and easy way of prioritizing the requirements is to use the MoSCoW prioritization method, in which requirements are categorized on the basis of their priority. The name of the method comes from the initial letters in the categories, with o’s inserted for pronunciation. The categories are: \[20\]

**Must** Requirements that must be in the final solution in order for it to be considered successful.
2.3. Methods

**Should** Requirements that are of high priority and should be included if possible.

**Could** Requirements that are desirable but not necessary—they are included if time and resources permit.

**Won’t** Requirements that stakeholders have agreed will not be implemented in a given release, but may be considered for the future. This category is also known as *Would*.

### 2.3.3 Prototyping

In the field of user interface design, a prototype can span from a simple paper-based storyboard to fully functional software. A prototype lets stakeholders interact with an envisioned product and gain experience of using it in real-world contexts. It is also useful for exploring imagined uses. It is recommended that prototyping should always precede any writing of code.

A prototype is an important aspect of the design process. The designer is encouraged to reflect on the design while building the prototype. The prototype supports the designer in choosing between alternatives. A prototype can be of low or high fidelity. [20]

**Low-fidelity prototype**

A low-fidelity prototype uses materials that are very different from the final product; paper, cardboard, wood, and adhesive tape are common. Appealing characteristics of a low-fidelity prototype are that they are simple, cheap, and quick to produce. These characteristics are also valid when it comes to modifying and exploring alternative designs and ideas. Some of the disadvantages are limited error checking, limited usefulness for usability tests, and navigational limitations (Table 2.1a). [20]

**High-fidelity prototype**

In contrast to low-fidelity prototypes, high-fidelity prototypes uses material that are expected to be in the final product. In user interface design, a high-fidelity prototype is a software, but usually not written in the final software’s language.

Some of the advantages of high-fidelity prototypes include that they have complete functionality, are fully interactive, and have the look and feel of the final product. However, low-fidelity prototypes should be used more because of the inherent problems with high-fidelity prototyping: a) they take too long to build, b) testers are inclined to comment on superficial aspects rather than content, c) developers are unwilling to change something they have been crafted for hours, d) the expectations are too high on software prototypes, and e) a simple bug in a high-fidelity prototype can bring the testing to a halt (Table 2.1b). [20]

### 2.3.4 Cognitive walkthrough

In a cognitive walkthrough, a task is *walked through* while notes of problematic usability features are taken. Each step in the human–computer dialog is being checked to see if the users’s goals and memory for actions can be assumed to lead to the next correct action being taken. The questions typically asked for each step in a task are:

- Will the correct action be sufficiently evident to the user?—Will the user know what to do to achieve the task?

- Will the user notice that the correct action is available?—Can users see the button or menu item that they should use for the next action? Is it apparent when it is needed?
### Table 2.1: Advantages and disadvantages of prototyping

#### (a) Low-fidelity prototype

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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<tr>
<td>+ Lower development costs.</td>
<td>– Limited error checking.</td>
</tr>
<tr>
<td>+ Evaluate multiple design concepts.</td>
<td>– Poor detailed specification to code to.</td>
</tr>
<tr>
<td>+ Useful communication devices.</td>
<td>– Facilitator-driven.</td>
</tr>
<tr>
<td>+ Address screen layout issues.</td>
<td>– Limited utility after requirements established.</td>
</tr>
<tr>
<td>+ Useful for identifying market requirements.</td>
<td></td>
</tr>
<tr>
<td>+ Proof-of-concept.</td>
<td>– Limited usefulness for usability tests.</td>
</tr>
<tr>
<td></td>
<td>– Navigational and flow limitations.</td>
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#### (b) High-fidelity prototype

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Complete functionality</td>
<td>– More expensive to develop.</td>
</tr>
<tr>
<td>+ Fully interactive.</td>
<td>– Time-consuming to create.</td>
</tr>
<tr>
<td>+ User-driven.</td>
<td>– Inefficient for proof-of-concept designs.</td>
</tr>
<tr>
<td>+ Clearly defines navigational scheme.</td>
<td>– Not effective for requirements gathering.</td>
</tr>
<tr>
<td>+ Use for exploration and test.</td>
<td></td>
</tr>
<tr>
<td>+ Look and feel of final product.</td>
<td></td>
</tr>
<tr>
<td>+ Serves as a living specification.</td>
<td></td>
</tr>
<tr>
<td>+ Marketing and sales tool.</td>
<td></td>
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2.3. Methods

− Will the user associate and interpret the response from the action correctly?—Will users know from the feedback that they have made a correct or incorrect choice of action?

This list is summarized in other words by Preece et al. [20]:

“Will users know what to do, see how to do it, and understand from feedback whether the action was correct or not?”

2.3.5 Usability heuristics

Jakob Nielsen’s *Usability Heuristics for User Interface Design* is a method of evaluation the usability by heuristics. Heuristics are in computing science a proceeding to a solution by trial and error, or by rules that are only loosely defined. The evaluation is carried out by looking at an interface from a set of rules, heuristics, to find usability problems. This can be done by one or more evaluators, unexperienced or experts.

The Nielsen heuristics are the following: [18]

**Visibility of system status** The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

**Match between system and the real world** The system should speak the users’ language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

**User control and freedom** Users often choose system functions by mistake and will need a clearly marked “emergency exit” to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

**Consistency and standards** Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

**Error prevention** Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

**Recognition rather than recall** Minimize the user’s memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

**Flexibility and efficiency of use** Accelerators—unseen by the novice user—may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

**Aesthetic and minimalist design** Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

**Help users recognize, diagnose, and recover from errors** Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
Help and documentation  Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user’s task, list concrete steps to be carried out, and not be too large.

2.3.6 Google Web Toolkit

At Tempus, Google Web Toolkit (GWT) is used in many products and systems. It was therefore preferable to make the final application in that framework, using related techniques and software patterns.

GWT is a toolkit that allows developers to write code entirely in Java, and GWT compiles the client part of the code to JavaScript. The GWT framework has built-in support for Asynchronous Remote Procedure Call, history management, UI abstraction, internationalization and cross-browser portability.

Since GWT projects are written in Java, they need to be compiled. There are two modes in which the GWT applications can run: development and production modes. The former runs in a Java Virtual Machine and does compilation on the fly and provides debugging, but is slower to use. The latter requires full compilation, but in return yields faster performance. Since GWT has cross-browser portability and internationalization, each of these permutations needs to be compiled, increasing the compilation time considerably. These permutations can be limited until the final production mode compilation. GWT projects are preferably handled with Eclipse IDE and the GWT plugin.  

UI Binder

UI Binder in GWT allows for writing the interface in XML instead of in programatically injecting elements in code. This allows for separation of behavior and user interface construction. According to the GWT Project, UI Binder helps productivity and maintenance because the user interface can be made from scratch and easily copied from templates. User interface designers may be more comfortable with writing XML code than Java code. In addition, UI Binder performs compile-time checking of cross-references from Java source to XML and the other way around.

Touch Events

Since GWT 2.2.0, released in February 2011, touch events have been integrated in the framework. There are however no built-in widgets that support it out of the box; for instance, buttons, menus, or checkboxes. Touch-aware widgets can either be activated manually (Listing 2.1), or by using a library such as Mobile GWT. The need to support touch events explicitly comes from the mobile browser behavior of waiting 300 ms to see if the user wanted to do another action, such as to double tap instead. It also enables the browser to emulate hover state, which a pointer-less interface does not have.

Model-view-presenter

The Model-view-presenter (MVP) is an interface design pattern that separates the presentation logic. The model contains the data, but has no knowledge of how it is being used. The view takes care of displaying data and sending user events to the presenter. The presenter has the key role in MVP and contains the application logic. It retrieves data from the model and sends formatted data to the view. In contrast to its predecessor, Model-view-controller (MVC), where the model updates the view, the model in MVP has no knowledge of the view (Fig. 2.2).
Listing 2.1: Touch events added programmatically in the application.

```java
button.sinkEvents(Events.TOUCHEVENTS);
button.addHandler(new TouchStartHandler() {
    @Override
    public void onTouchStart(TouchStartEvent event) {
        // code here
    }
}, TouchStartEvent.getType());
```

![Diagram](a) The Model View Presenter
![Diagram](b) The Model View Controller

Figure 2.2: Comparison of two related software patterns

In gwt, the view consists of two main interfaces: one for the presenter, and one for the view itself. The former specifies what the presenter must implement, and the latter what the view must implement. The view implementation can be exchanged for another implementation, for instance to a view for mobile, tablet or desktop, as long as it implements the interface. The view talks to the presenter through the interface, and usually sends user events for the presenter to respond to. The presenter talks to the view through its interface and usually interacts with its components, preferable unwitting of its inner structure. \[11\]

2.3.7 Media queries

Media queries is a css technique popularly used in responsive web design to adapt the interface to various screen sizes. This is done by using \texttt{min-width} or \texttt{max-width} and other media features in a media query. \[16\]

The \texttt{width} and \texttt{height} attributes in css support limitations by \texttt{min-} and \texttt{max-} prefixes which can be used to ensure a certain size when scaling down the user interface. The \texttt{font-size} attribute does not support these prefixes, so an absolute size, or a larger relative size, can be set using media queries instead (Listing 2.2).
Listing 2.2: Example of `min-height` and media queries in CSS

```css
body {
  font-size: 20px;
}

button {
  height: 3em; // relative height
  min-height: 44px; // minimum height
}

caption {
  font-size: 0.5em; // 50% the size
}

@media (max-width: 767px) { // small tablet
  body {
    font-size: 18px;
  }
}

@media (max-width: 480px) { // smaller tablet or big phone
  body {
    font-size: 14px;
  }
  caption {
    font-size: 9px; // fixed size. 0.5em (14*0.5=7px) too small.
  }
}
```

Listing 2.3: Sample Sass syntax with mixin, variables, functions, and nested selectors

```css
@mixin rounded($radius) { // custom mixin
  -webkit-border-radius: $radius;
  -moz-border-radius: $radius;
  border-radius: $radius;
}

$color: #fc3; // color variable

nav {
  background: $color;
  a { // nested selector nav a
    background: darken($color, 10%); // built-in color function
    @include rounded(0.5em); // calling custom mixin
  }
}
```
2.3. Methods

2.3.8 Sass

Sass is a stylesheet preprocessor that outputs standard stylesheets (CSS). Another popular preprocessor is Less. Some of the prime advantages of using a CSS preprocessor instead of writing plain CSS is the ability to use variables, nesting of selectors, mixins, and custom or built-in functions, such as color functions to blend colors, or to make them more transparent (Listing 2.3). [23]

The use of a stylesheet preprocessor in conjunction with a CSS reloader in the web browser makes testing stylesheets easy and fast; since no full page reload is required, the state of the page is preserved when the CSS is reloaded.
Chapter 3

In-Depth Study of Interview Methods

This chapter presents the in-depth study with different methods of asking the users, as well as variants and approaches within those methods. The in-depth study was made as a starting point for the interviews held with personnel and parents, in order to find a suitable method for this master’s thesis.

3.1 Introduction

An effective way of finding out what people want, what they do, what they like, and what they don’t like, is to ask them. Interviews and questionnaires are well-known techniques in social science research and human-computer interaction. Questionnaires and interviews can be used in evaluation as well as in requirements activity.\[2, 20\]

The design of an inquiry concerns the things that should be taken into account and remembered when carrying out a research project. There are many models, the following is the one Robson proposes:\[22\]

– Purpose(s). What is the study trying to achieve? Why is it being done? Are you seeking to describe something, or to explain or understand something? Are you trying to assess the effectiveness of something? Is it in response to some problem or issue for which solutions are sought? Is it hoped to change something as a result of the study?

– Theory. What theory will guide or inform your study? How will you understand the findings? What conceptual framework links the phenomena you are studying?

– Research questions. To what questions is the research geared to providing answers? What do you need to know to achieve the purpose(s) of the study? What is it feasible to ask given the time and resource that you have available?

– Methods. What specific techniques (e.g. semi-structured interviews, participant observation) will be used to collect data? How will the data be analyzed? How do you show that the data are trustworthy?

– Sampling strategy. From whom will you seek data? Where and when? How do you balance the need to be selective with the need to collect all the data required?

These aspects are related to each other: the purposes and theory are the basis of the research question, from which the methods and sampling strategies are formed. In fixed design, this
should be done upfront, whereas in flexible design, these aspects are reevaluated repeatedly. In a good framework these aspects are harmonizing well (Fig. 3.1).

If the answers from a research question are not relevant to the purposes of the study, then something has to change—most likely the research question. If the research questions do not link to the theory, it is unlikely that the study will give answers of value—the theory needs developing or the research questions need changing. If the methods and/or sampling strategy are not providing answers to the research questions something has to change—more data has to be collected, sampling has to be extended, or modify the research question.  

![Figure 3.1: Framework for research design](image-url)

### 3.2 Preparation

To carry out an inquiry, Robson  makes a list of a variety of things to pay attention to: deciding on focus, developing the research questions, choosing a research strategy, selecting the method(s), arranging the practicalities, collecting the data, preparing for analysis, and reporting what you have found. These items will be described in the following sections.

#### 3.2.1 Deciding on the focus

According to Robson, deciding on the focus is either straightforward or problematic. The former case is especially true if it has already been decided upon. In the latter case there is an open field involved.

To find the focus, the researcher has to identify what information he wants to gather. Until this step is fulfilled, further planning is impossible. If the researcher is deciding for himself, then the decision is driven by personal interests and concerns.

#### 3.2.2 Developing the research questions

The research questions are the ones that the researcher wants answers to. It is important to know the area on which the research focuses. The number of research questions can be around three to ten, depending on resources and the questions themselves; in small-scale studies there are usually less than six.  

Good research questions according to Punch are:  

- *Clear*. They are easily understood, and are unambiguous;
- *Specific*. Their concepts are at a specific enough level to connect to data indicators;
3.2. Preparation

– **Answerable.** We can see what data are required to answer them, and how the data will be obtained;

– **Interconnected.** They are related to each other in some meaningful way, rather than being unconnected; and

– **Substantively relevant.** They are interesting and worthwhile questions for the investment of research effort.

Inadequate research questions fail to satisfy one ore more of these criteria, often due to being unclear and not specific enough. [21]

3.2.3 Choosing a research strategy

There are two design strategies: fixed, and flexible. A fixed design strategy requires a rigid pre-specification before the data collection stage. If this is not feasible, then this approach is not suitable. Data is generally in the form of numbers, therefore this strategy is also referred to as a **quantitative**. For fixed design there are two broad traditions:

**Experimental strategy** “...[T]he researcher actively and deliberately introduces some form of change in the situation, circumstances or experience of participants with a view to producing a resultant change in their behaviour.” [22]

**Non-experimental strategy** “The overall approach is the same as in the experimental strategy but the researcher does not attempt to change the situation, circumstances or experience of the participants.” [22]

A flexible design strategy evolves during data collection. Data is generally in the form of words, therefore this strategy is commonly referred to as a **qualitative** strategy. Flexible designs stem from very different traditions than fixed designs. There are three of these that are of interest in “real world studies”:

**Case study** “Development of detailed, intensive knowledge about a single ‘case’, or of a small number of related ‘cases’.” [22]

**Ethnographic study** “Seeks to capture, interpret and explain how a group, organization or community live, experience and make sense of their lives and their world.” [22]

**Grounded theory study** “The central aim is to generate theory from data collected during the study.” The grounded theory study is “[p]articularly useful in new, applied areas where there is a lack of theory and concepts to describe and explain what is going on. Data collection, analysis and theory development and testing are interspersed throughout the study.” [22]

A flexible design can contain quantitative data whereas a fixed design rarely contains qualitative data. [22]

3.2.4 Selecting the method

What method is selected depends on what kind of information is sought, from whom, and under what circumstances. There are various methods: to find out what people do in public, **direct observation** is used; to find out what people do in private, **interviews** or **questionnaires** are used; to find out what people feel and/or believe **attitudes scales** can be used as well as interviews and questionnaires; and to determine people’s abilities, or measure their intelligence or personality, **standardized tests** are used. [22]
3.2.5 Arranging the practicalities

It is important to initiate contact with people from whom necessary permission is required. It may also be needed at various levels in an organization. An outline with purposes and conditions of the study should be prepared and then discussed with “gatekeepers,” such as managers and head-teachers. The outline should be discussed in the same manner with likely participants. The researcher should be prepared to modify the study as a result of these discussions. [22]

3.2.6 Collecting the data

The central part of an inquiry is the collection of data, which depends of the method chosen: direct observation, interviews, questionnaires, and standardized tests. All methods have strengths and weaknesses. The selection of method should be driven by the research questions, moderated by what is feasible in terms of time and other resources, and by skills and expertise. Some studies use one method, and others use multiple methods. It is often possible to allocate a small share of resources to a complementary method, for instance an unstructured interview session at the end of an experiment.

It is important to choose an adequate method that the researcher feels comfortable with and has the skills and personality characteristics for. The method should be acceptable in the setting involved, and it should not raise ethical concerns. [22]

3.2.7 Preparing for analysis

Analysis of the data is important, because the raw data do not speak for themselves. In flexible design, it is important to start the analysis as the data are being collected. The analysis of qualitative data is mostly done by the researcher himself.

In fixed designs, the analysis is traditionally made when all the data are collected. To analyze quantitative data, computerized analysis is the obvious choice. There are nevertheless a vast number of approaches and softwares to use, so it is advisable to seek help from someone familiar with the area, and this should be done in the design phase. [22]

3.2.8 Reporting what you have found

Reporting is an essential part of the enquiry process and the appropriate format for the report depends on the nature and purpose of the enquiry; many types of reports can be used. According to Robson, [22] real world enquiries call for professional standards of reporting and presentation.

3.3 Sample size

The sample size for a flexible design is difficult to specify in advance. The general idea is to continue until “saturation” is reached, that is when further data collection seems not to add to what has already been learned. The sample size is correlated to: the scope of the study—the broader the scope, the longer it takes; the nature of the topic—if it is obvious and clear, fewer respondents are needed; the quality of the data; the study design; and the research method—semi-structured interviews producing a small amount of data imply more respondents. For ethnographic and grounded theory studies, approximately thirty to fifty interviews are a “rule of thumb.” [22]

For fixed design, there are limits on the number of participants needed for statistical tests and procedures. There are praxis of fifteen participants per variable in non-experimental relational designs. If the survey seeks to generalize the findings to the population from which
the sample is drawn, then homogeneity is of importance. If pilot work shows considerable heterogeneity, then a larger sample is needed. The sample size for the 95% confidence level is depending on population size, homogeneity, and sampling error tolerated (Table 3.1). For a polar item (yes/no question), the 50/50 split indicates a heterogenous sample, and the 80/20 split indicates a homogenous. \[22, 7\]

Table 3.1: Completed samples needed for various population sizes and characteristics at three levels of precision. (Excerpt from Dillman \[7\])

<table>
<thead>
<tr>
<th>Population size</th>
<th>±10% sampling error</th>
<th>±5% sampling error</th>
<th>±3% sampling error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50/50 split</td>
<td>80/20 split</td>
<td>50/50 split</td>
</tr>
<tr>
<td>100</td>
<td>49</td>
<td>38</td>
<td>80</td>
</tr>
<tr>
<td>200</td>
<td>65</td>
<td>47</td>
<td>132</td>
</tr>
<tr>
<td>400</td>
<td>78</td>
<td>53</td>
<td>196</td>
</tr>
<tr>
<td>800</td>
<td>86</td>
<td>57</td>
<td>260</td>
</tr>
<tr>
<td>1,000</td>
<td>88</td>
<td>58</td>
<td>278</td>
</tr>
<tr>
<td>2,000</td>
<td>92</td>
<td>60</td>
<td>322</td>
</tr>
<tr>
<td>4,000</td>
<td>94</td>
<td>61</td>
<td>351</td>
</tr>
<tr>
<td>8,000</td>
<td>95</td>
<td>61</td>
<td>367</td>
</tr>
<tr>
<td>20,000</td>
<td>96</td>
<td>61</td>
<td>377</td>
</tr>
<tr>
<td>100,000</td>
<td>96</td>
<td>61</td>
<td>383</td>
</tr>
<tr>
<td>1,000,000</td>
<td>96</td>
<td>61</td>
<td>384</td>
</tr>
<tr>
<td>1,000,000,000</td>
<td>96</td>
<td>61</td>
<td>384</td>
</tr>
</tbody>
</table>

3.4 Questionnaire

Most surveys involve the use of a questionnaire, which is administered in three ways: \[22, 7\]

**Self-completion** Respondents fill in the answers themselves. This could be by post, email, or web forms.

**Face-to-face interview** An interviewer asks the questions in the presence of the respondent. The interviewer completes the questionnaire.

**Telephone interview** The interviewer asks the questions over telephone and also records the responses.

Self-completion survey questionnaires can be administered on group basis, for example filled in simultaneously by everybody present in the room. \[22\] Depending on method of data collection chosen, the format and appearance of the questionnaire varies (Table 3.2)

3.4.1 Designing a questionnaire

The survey questions should be designed to help achieve to goals of the research, and answer the research questions. Robson \[22\] presents a model of how the research question belongs to the general survey process (Fig. 3.2). There is emphasis on the researcher’s task of connecting research questions to survey questions. The respondent’s task is to understand the question,
Table 3.2: Comparison of approaches to survey data collection

<table>
<thead>
<tr>
<th>Aspect of survey</th>
<th>Self-completion questionnaire</th>
<th>Face-to-face interviews</th>
<th>Telephone interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resource factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>Low</td>
<td>High</td>
<td>Low/medium</td>
</tr>
<tr>
<td>Length of data collection period</td>
<td>Long</td>
<td>Medium/long</td>
<td>Short</td>
</tr>
<tr>
<td>Distribution of sample</td>
<td>May be wide</td>
<td>Must be clustered</td>
<td>May be wide</td>
</tr>
<tr>
<td><strong>Questionnaire issues</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of questionnaire</td>
<td>Short</td>
<td>May be long</td>
<td>Medium</td>
</tr>
<tr>
<td>Complexity of questionnaire</td>
<td>Must be simple</td>
<td>May be complex</td>
<td>May be complex</td>
</tr>
<tr>
<td>Complexity of questions</td>
<td>Simple to moderate</td>
<td>May be complex</td>
<td>Short and simple</td>
</tr>
<tr>
<td>Control of question order</td>
<td>Poor</td>
<td>Very good</td>
<td>Very good</td>
</tr>
<tr>
<td>Use of open-ended questions</td>
<td>Poor</td>
<td>Good</td>
<td>Fair</td>
</tr>
<tr>
<td>Use of visual aids</td>
<td>Good</td>
<td>Very good</td>
<td>Not usually possible</td>
</tr>
<tr>
<td>Use of personal/family records</td>
<td><strong>Very good</strong></td>
<td>Good</td>
<td>Fair</td>
</tr>
<tr>
<td>Rapport</td>
<td>Fair</td>
<td><strong>Very good</strong></td>
<td>Good</td>
</tr>
<tr>
<td>Sensitive topics</td>
<td><strong>Good</strong></td>
<td>Fair</td>
<td>Fair/good</td>
</tr>
<tr>
<td><strong>Data-quality issues</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sampling frame bias</td>
<td>Usually low</td>
<td>Low</td>
<td>Low*</td>
</tr>
<tr>
<td>Response rate</td>
<td>Difficult to get high</td>
<td>Medium/</td>
<td>Medium/high</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Very high</strong></td>
<td></td>
</tr>
<tr>
<td>Response bias</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Control of response situation</td>
<td>Poor</td>
<td>Good</td>
<td>Fair</td>
</tr>
<tr>
<td>Quality of record response</td>
<td>Poor</td>
<td>Good</td>
<td>Fair</td>
</tr>
</tbody>
</table>

Advantageous values are typeset in boldface.

*a with Random digit dialing*
The purpose of the model is to design a questionnaire that gives a valid measure of the research question, makes the respondent cooperative, and brings accurate information. It is important to bear in mind that a research question is not suitable as a survey question.

When writing the survey information letter that presents the survey, it is a good idea to underline that respondents are being asked for advice or to assist, as it gives a sense of reward. Topics of high importance to the recipient are more likely to be returned than those of low importance. If the questionnaire is made to look short and easy to fill out, the response rates improve. A questionnaire should not take longer than half an hour to fill out, which means about 40–50 questions.

Web questionnaires

An increasingly popular method is to use electronic survey methods, such as email or web forms, which reduce the time required for survey implementation from weeks to days, or even hours. These methods also reduce the correspondence between sample size and survey costs.

If the result of a web questionnaire is compared to the result of a telephone interview or a face-to-face interview, then it can be constructed to prevent the respondents from reading questions in advance, corresponding to the constraints of those interviews. Conversely, if the questionnaire is compared to a self-completion questionnaire, then it is advisable not to make such prevention, as a self-completion questionnaire has no such constraints.

A disadvantage of web forms is the visual representation that depends on technical factors such as monitor size and capabilities, operation system, personal preferences, fonts etc. A paper questionnaire has the same esthetics as the designer intended.

Designing the questions for a web form is essentially the same as for a paper survey, but there are aspects to take into consideration when designing a web questionnaire. The welcome screen should be motivational, emphasize ease of responding, and show instructions. Paper questionnaires normally contain a letter that explains the reason for the study and encourages to continue. This should also be the case in a web questionnaire. The questions should be presented in a conventional format, similar to that of a paper questionnaire and
the first question should be interesting to most respondents, easily answered, and fully visible on the welcome screen. The use of drop-down menus should be used sparingly, as it hides information from the respondent. In a paper questionnaire, increasing the response area for open-ended questions results in more words and broader answers. This relation is not as strong in web questionnaires. Respondents tend, however, to write more on the web than on paper. [7]

Questions

When construction scalar questions, it is important to use equal numbers of positive and negative categories; for example, strongly agree, somewhat agree, somewhat disagree, strongly disagree. A neutral category should be placed in the middle of the scale. The distinction between undecided and neutral can made clearer by placing the undecided category at the end of the scale (Table 3.3). Bias can be avoided by using equal comparison, that is not to put words with value connotations in the categories. [7]

3.4.2 Data collection

The use of different modes for data collection often produces different result. Respondents of a self-completion questionnaire may rate an item differently than if they were asked in a personal interview. A typical example of this is when respondents are asked to rate their health: when asked in a personal interview, they rate their health better than when asked in a self-completion survey.

The result of different survey modes are sometimes incompatible and little can be done to change that. It is therefore preferable not to mix modes in order to compare them; but it may not always be possible. A reason is that questions are constructed differently. For telephone interviews, the “don’t know” option is rarely given, but recorded when the interviewee responds it. In self-completion questionnaires, the option must either be offered explicitly or not at all. There are techniques to reduce these difficulties. [7]

3.4.3 Issues

The length of the questionnaire, and therefore the time taken to complete it, can be large in face-to-face interviews (Table 3.2). Furthermore, the complexity has to be kept to a minimum when using a self-completion questionnaire. There is also a loss of control regarding the order of the questions—respondents can answer in any order, which may effect the outcome. Low response rate is a serious and common issue for self-completion questionnaires.

Even though surveys rely heavily on closed questions, some open-ended questions can be used in face-to-face interviews; in telephone interviews they are less common. When using a
3.5 Interviews

An interview is a flexible and adoptable method of retrieving information. Face-to-face interviews allow following up interesting responses and investigating underlying motives in a way that postal and other self-administered questionnaires cannot. The face-to-face interview might be helped by non-verbal cues to understand the responses. In qualitative research, interviewing is one of the most commonly used methods of data collection. [22]

A disadvantage is that biases are difficult to rule out. Interviewing is time-consuming. Robson [22] says that an interview shorter than half an hour is unlikely to be valuable, whereas if it is much longer than an hour, it is going to put unreasonable demands on the interviewee as well as making it hard to make them participate. Weiss [24] says survey studies try to keep interviews to an hour or less, whereas qualitative interviews can run as long as eight hours.

3.5.1 Interviewing as a method

In qualitative interview research there is an emphasis on interviewing as a method.

“A method is a set of rules, which can be used in a mechanical way to realize a given aim. The mechanical element is important: a method shall not presuppose judgment, artistic or other creative abilities.” [9]

This view of interviewing as a method is not shared by Kvale and Brinkmann, [15] who think of interviewing as a craft rather than a method. According to them, interviewing is based on the practical skills and personal judgments of the interviewer. The skills are learned by practicing and the quality of interviewing is judged by the strength and value of the knowledge produced.

A survey interview may fulfill this definition of method. Its result should be reproducible by other interviewers; the interviewer follows standard rules with a minimum of personal judgment and poses the questions in a fixed order with fixed wording.

In a qualitative research interview, the questions do not mechanically follow rules and the result very much depends on the interviewer’s skills, knowledge of the subject, and the personal judgment in the posing of questions. To become a proficient interviewer takes extensive training, whereas it only takes hours to learn the basics of a survey interview.

Kvale and Brinkmann [15] conclude that it is undoubtedly not a legitimate scientific method to produce knowledge through the personal interactions between the interviewer and the interviewee.

3.5.2 Structured, semi-structured, and unstructured interviews

There are many types of interviews, a commonly used topology separates them in structured, semi-structured and unstructured interviews. At one end, a highly structured interview is the survey interview based on a questionnaire with fixed questions in a specific order where responses usually are selected from a narrow range of alternatives. At the other end is the “depth interview,” where the interview has broad topics and minimal prompting from the interviewer. [22] [24]
Structured interviews A structured interview typically has predetermined questions usually in pre-set order and fixed wording. The use of mainly open-response questions is the only essential difference from an interview-based survey questionnaire. [22]

Semi-structured interviews A semi-structured interview also has predetermined questions but the order can be changed upon the interviewer’s perception. Explanations can be given and the wording can be changed. Questions can be omitted if inappropriate with a particular interviewee. Semi-structured interviews are usually the only data source for a qualitative study, and usually carried out at an appointed time, at a given location, aside from everyday events. Semi-structured in-depth interviews are very common in qualitative research and are carried out with individuals or groups. They are usually only carried out once. [6, 22]

Unstructured interviews An unstructured interview has a general area of interest, but the interviewer may allow the conversation to expand within this area. Unstructured interviews can be completely informal. An interview cannot be completely unstructured; some are relatively unstructured and are equivalent to guided conversations. Unstructured interviews are typically carried out together with observations. [6, 22]

The naming convention differs, depending on the focus. The term unstructured interviewing and free interviewing focus on the questions, which are unstructured and formed as the interview progresses. Qualitative interviewing, as opposed to quantitative, intensive interviewing and in-depth interviewing emphasize their concern for detail and completeness in accounts, and depth interviewing tries to focus on the psychological underpinnings of beliefs or opinions. [24]

3.5.3 Qualitative and quantitative interviews

An interview can be quantitative or qualitative. A quantitative interview is typically a structured or semi-structured interview, whose aim is to generate facts and figures related to an issue based on predefined hypothesis and formal instruments. The standardization of questions and responses allows for comparison among subgroups. Quantitative studies are those who aim to report how many respondents are in particular categories or relationships between categories. [3, 24]

In a quantitative interview, questions and their order are strictly the same for every respondent. This leads to the result being small fragments of the respondents’ views. To obtain more from the respondents than to choose among fixed categories or answer shortly to open-ended items, the requirement that all questions should be asked in the same way to all of them should be removed. [24]

Interviews that sacrifice uniformity of questioning to obtain more development of information are qualitative interviews. They typically rely on a sample significantly smaller than that of a survey interview. A qualitative study aim to generate a theory as it progresses, and it requires the researcher to be involved in the process being studied. The result of a qualitative study cannot be categorized or counted to the same extent as a quantitative one and therefore the analysis will be supported more by quotations and case descriptions than tables or statistical measures. [3, 24]

Kvale and Brinkmann [15] describe qualitative research interviews:

“The qualitative research interview attempts to understand the world from the subjects’ points of view, to unfold the meaning of their experiences, to uncover their lived world prior to scientific explanations.” [15]

Semi-structured and unstructured interviews are sometimes referred to as qualitative research interviews. King [14] proposes guidelines for when to use them:
1. Where a study focuses on the meaning of a particular phenomena to the participants.

2. Where individual perceptions of processes within a social unit—such as a work-group, department or whole organization—are to be studied prospectively, using a series of interviews.

3. Where individual historical accounts are required of how particular phenomenon developed; for instance, a new shift system.

4. Where exploratory work is required before a quantitative study can be carried out; for example, researchers examining the impact of new technology on social relationships in a workplace might use qualitative interviews to identify the range of different types of experience with a subsequent quantitative study should address.

5. Where a quantitative study has been carried out, and qualitative data are required to validate particular measures or to clarify and illustrate the meaning of the findings; for instance, people with high, medium and low scores on a new measures of stress at work might be interviewed to see whether their experience concur with the ratings on the measure.

If the goal is statistical analysis, then a quantitative study is preferable; for instance, a comparison of some specific aspect of different groups, or to make statistical analysis to identify linkages among phenomena—especially those unknown to the respondents.

Quantitative items can be used in qualitative interviews and numerical data can be produced from qualitative studies; albeit time-consuming and cumbersome with lots of missing data. [24]

3.5.4 Conducting an interview

When conducting an interview, it is important to give the whole attention to the respondent and to let the respondent—not the interviewer—do the talking. There should be no “competing on the floor” or intrusion from the interviewer. The questions should be put in a straightforward, clear, and non-threatening way. Cues that lead the respondent in a particular way should be eliminated. [15, 22, 24]

Robson [22] suggests the following interview sequence:

1. Introduction. The interviewer introduces himself, explains the purpose, assures of confidentiality, and asks for permission to take notes and to record—if applicable.

2. Warm-up. Easy, non-threatening questions to settle down.

3. Main body of interview. The central part of the interview, where the important questions are posed. “Risky” questions should be at the end, so that, if the interviewee refuses to continue, less information is lost.

4. Cool-off. Corresponding to the “warm-up”; a few uncomplicated questions to relieve any tension that might have built up.

5. Closure. “Thank you and goodbye.” When the notebook is put away and the recorder stopped, the interviewee may come out with a lot of interesting material. The interviewer could reopen the notebook, start the recorder, or forget about it. It is important to be consistent and note how it is being dealt with.
3.5.5 Questions

Any question is satisfactory if it steers the respondent to material needed by the study. In research interviews, there are mainly three kinds of questions used: closed (or fixed-alternative), open and scale items. Closed questions require the interviewee to choose from two or more fixed alternatives. Open questions have no restrictions on the content or form of the response, apart from the subject area. Scale items require a response in the form of degree of agreement or disagreement.

Commonly used in interviews are open questions, whose advantages are that they: a) are flexible, b) allow you to go into more depth or clear up any misunderstandings, c) enable testing of the limits of a respondent’s knowledge, d) encourage co-operation and rapport, e) allow you to make a truer assessment of what the respondent really believes, and f) can produce unexpected or unanticipated answers.

Disadvantages of open questions are the possibility of loss of control by the interviewer and that they are more difficult to analyze than closed questions.

Questions should be complete, short, and simple, so that the interviewee can understand and remember the whole question and answer it completely. Double-barreled questions should be broken down to simpler ones. It is not difficult to write unbiased questions—it is more difficult not to lead the interviewee by the manner in which the question is asked, or in the way the responses are received. Neutrality is important; try to avoid appearing to share or welcome their views.

Posing questions

When posing questions, it is essential not to affect the respondents’ report by showing anticipations in the questions. Sometimes it is adequate though, if it helps the respondents provide a full report by demonstrating understanding, for example to address the respondents’ feelings.

Weiss talks about transitions between questions. If there is a coherent flow between them, the respondents feel as if the questions are continuations of their own associations. But, when the next question is abruptly different, the respondents need to reorient themselves. The respondents are, as Weiss puts it, flustered, which is acceptable up to three times. If the respondents are flustered more than that, they will begin to answer questions briefly and then wait for the next one. In circumstances where there is initial resistance—if the respondents are not sure whether they want to be interviewed—then even a single flustering can lead to stiff and sparse responses.

An example of a phrasing transitions that can prepare the respondent for reorientation is a phrase like: “Okay. Now there is another issue I wanted to ask you about. It is…” Possibly accompanied by affirmative nodding.

Retrieving answers

Probes are ways to get the interviewee to expand into an area of interest when the interviewer intuitively feels that there are more to get. The use of probes can be difficult for a novice interviewer. An apparent probe is a phrase such as: “Anything more?” or “Could you go over that again?” A probe can also be used if the answer has been in general terms: “What is your own personal view on this?” Other subtle probes are: a period of silence, an inquiring glance, feedback such as “mhmhm…” or repeating back all or part of what has just been said.

Prompts are used to suggest a range or a set of possible answers to the interviewee. The list of expected possibilities could be read by the interviewer or shown on a prompt card. Prompts must be used consistently with all interviewees and, when applicable, all interviewers.
3.6 Bias

It is crucial in any experiment to protect against experimenter effects, that is, effects not due to the experimental treatment itself, but the experimenters' unwitting acting. In quantitative studies, such as studies of drug effectiveness, double-blind procedures are commonplace to lessen experimenter effects; the experimenter himself does not know which group is the experimental group and which is the control group.

In qualitative interview studies, double-blinds are not an available option. It is important to be aware of how prone to the experimenter effects the qualitative interview study is. The investigator is present in every phase of the study: selection, interview, analysis, and reporting. It is important to select adequate samples; conduct interviews whose aim is to learn rather than to demonstrate; perform dispassionate, responsible, and careful analysis; and to be faithful to the findings in the representations.

Weiss [24] says that a “random sample is always an unbiased representation of the population from which it is drawn.” An accidental sample—a sample being drawn from that part of the population which is close to hand—is mostly used in practice. It is important to ensure that it contains adequate range on critically important dimensions. That might be to find instances in settings that are supportive of an idea, and instances in settings that are not.

Biased interviewing may be the result of how the interviewer and the study is presented to the respondents, by the questions asked, and how responses are treated. One way to protect against bias is to establish a research partnership so that the respondent gives a full and accurate report.

Particularly prone to the introduction of bias are the interpretation and reporting of the material. It is easy to pick out comments supporting the investigator’s view and suppressing comments that oppose it.

The remedy against the introduction of bias, according to Weiss: [24]

“Our only defense against this happening is to discipline ourselves to deal fully and fairly with all the evidence and to report everything we’ve learned about an issue, absolutely everything, including cases that don’t fit our theories as well as cases that do.”
Chapter 4

Accomplishment

This chapter presents how the work in this master’s thesis was conducted. It covers the main stages of the work: a) the preparation and conduction of the interviews, b) the analysis of interview data and requirements gathering, c) the idea generation, and d) the low-fidelity and high-fidelity prototypes. The main sections are chronologically presented, but the user tests and design iterations are sometimes presented in one section even though they were separated by design iterations. Issues found in user tests are presented with updates to reflect the final design.

4.1 Preparation for interviews

As a guide for structuring the inquiry, Robson’s suggestion for preparation was used. The headlines in the following sections derive from that list (Section 3.2).

4.1.1 Deciding on the focus

The focus was given as a preliminary to the master’s thesis work: to see if there is any information, that parents and personnel exchange, that could benefit from being computerized and added to the Tempus software. It was also given that the stakeholders—the parents and personnel—should be asked about their needs.

4.1.2 Developing the research questions

The research questions developed as a basis for the survey were:

1. What information about each child is exchanged between parents and personnel?

2. What factors influence this information exchange?

3. Is there information that could benefit from being computerized and added to the Tempus software?

4.1.3 Choosing a research strategy

The aim was to understand the information exchange between parents and personnel at preschools—not to measure, categorize, or interrelate that exchange—therefore a qualitative study was chosen as a research strategy for this inquiry. Nielsen puts it in a straightforward way, “Once you’ve seen a problem in real life, you know it’s there. You don’t need to measure it.” [19] The design of the study evolved during the data collection period.
4.1.4 Selecting the method(s)

Interviews were selected as the method of finding out what the information need was. It was considered better to talk to both parents and personnel, to ask them questions in person, instead of sending an anonymous self-completion questionnaire or to make observations or listen to actual conversations.

The methods for the interviews of both groups were conducted in similar manners. First, pilot studies were carried out to see if the questions were valid. These pilot studies were decided to be semi-structured with many open-ended questions in order to be able to unfold interesting areas. Then, more structured, but still semi-structured, interviews were selected with a supporting questionnaire that contained undisclosed options to make probable and reoccurring answers easy to fill in during the interviews; more listening, and less writing. In some questions, the options were disclosed and the interviewee should select one.

4.1.5 Arranging the practicalities

A letter for the preschool heads, or other persons in charge, were prepared before meeting with them. The letter was a formal introduction of the exam work, the study and its purpose, how the interviews were going to be conducted, and how long it would take. At the end it was stressed that it was a general survey about communication between parents and personnel, that no preschools would be mentioned, and that the data would be treated confidentially. Finally, it contained contact information.

It was decided to visit the preschools personally instead of phoning or mailing them in advance. Personal contact was considered important, talking about children and how they are being taken care of can be a sensitive topic. The anticipation was that the personnel would let them be interviewed right away, or that an appointment would be made a day or two later.

When talking to parents and personnel it was not considered necessary to have a formal letter of consent. The participation would be voluntary and short oral presentation of the study would be held. For the personnel, the letter for the preschool heads would be brought in case the personnel would request one.

For parents, it was decided to approach them outside the preschool premises and the anticipation was that they would let them be interviewed right away. In case a parent did not want to answer the questions right away, he or she would be offered to fill in a web questionnaire. For this, a letter similar to that for the preschool heads was prepared, but less formal. The letter contained a shortened URL to the survey and emphasis on the importance to fill in the questionnaire. At the end the parent was thanked in advance.

4.1.6 Collecting the data

In the interviews with the personnel, an informal and relaxed way of talking was desirable, and hence they were usually approached directly, without the detour past the preschool head’s office. It felt natural to hold the interviews at the workplace of the personnel. On the whole, more or less half of the interviews were held right away. A quarter were held after appointments with the personnel, and the remaining quarter were held after talking to the preschool head.

In the interviews with parents, an equally informal way of talking was desirable, preferable without prior announcement or appointments, and therefore the approach to talk to them outside the gates of the preschool premises was chosen. The author did not feel comfortable to conduct the interviews in neither their home, their workplace, the Tempus office, nor a public café. The decision to prompt them outside the preschool premises was also made so that they hopefully would have the preschool mindset activated since they were just leaving or entering the preschool.
4.1.7 Preparing for analysis

As soon as possible after an interview with the personnel, the notes were rewritten and clarified. For the parent questionnaires, the same procedure was done, but sometimes hours later, due to way in which they were conducted. These questionnaires usually contained less notes, since they were elaborated in a pilot study and continuously adapted and contained many checkboxes for anticipated answers. On open questions, these prepared checkboxes were not disclosed.

4.2 Interviews

In total, twenty-four interviews with parents and personnel were held at, and around, different preschools in the municipality of Umeå, Sweden (Table 4.1). The personnel were interviewed in their work place—at the preschool. The parents were usually interviewed outside the preschool premises, but occasionally in other locations, such as in the street or in a park. Interviews were held in conjunction to preschools from the city center, suburbs, and villages in order to spread the sample—the needs may be different in different environment. The sample included both personnel and parents related to preschools with and without Tempus software.

The purpose of the study was to find information needs that parents and personnel have regarding the children. It is a qualitative study and it is not generalizable on the population, that is, it is not possible to say that a certain percentage of parents in Sweden have a certain need. Nor is it possible to make conclusions that interviewees answering one question in a certain way would answer another question in a certain way.

The interviews within the groups were not held in comparable ways: questions were not asked in the same order due to the focus on letting the interviewee talk freely. Interviewees may not recall answers to open-ended questions at the time of the interview, but could perhaps recall it another time, or in another setting. It is important to take into account that the purpose is to find information need, not to quantify that need or draw statistical measures from it.

<table>
<thead>
<tr>
<th></th>
<th>Pilot study</th>
<th>Study</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parents</td>
<td>5</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>Personnel</td>
<td>3</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>16</td>
<td>24</td>
</tr>
</tbody>
</table>

4.2.1 Interviews with parents

A questionnaire with mainly open-ended questions was designed and tested in a pilot study with five parents in a semi-structured interview. The aim of the pilot study was to get an overview of the field and to see if there were topics that needed to be added to the final questionnaire. The parents for this pilot study were found outside the preschool premises. The questions for the parents in the pilot study were:

- What is the age of your preschool child?
- Tell me about when you are leaving the child.
– Tell me about when you are picking up the child.
– When you pick up your child, what information do you want from the personnel about your child’s day?
– What factors influence the information exchange when picking up the child?
– Other thoughts about the information exchange between you and the personnel?

After the pilot study, the questionnaire was adapted to include more questions and to become somewhat more structured, albeit still semi-structured. More refinements were made when a question revealed a deep area, or when there where discoveries of potentially important areas. It was for instance indicated that parents looking for work, studying, or on parental leave with a small child, while an older child attended preschool, might be in less of a hurry.

After analyzing the result of the pilot study, the most noteworthy additional questions were: a) sex, b) occupation, c) whether they where on parental leave or not, d) how they get to and from the preschool, e) whether the child is cooperating or not while leaving or picking up, f) who is leaving and picking up the children, and g) in what area the preschool is situated. The final questionnaire is in Appendix A.1.

4.2.2 Interviews with personnel

In the same manner as the interviews with parents, a pilot study was first carried out with three personnel in order to get an overview and to see if there were topics missing that needed to be added to the final questionnaire. No appointments were made beforehand, the preschools were visited in an anticipated calm period before lunch. The interviews were semi-structured with many open-ended questions. The questions for the personnel were:

– What information do the parents want?—How do they get it?
– How do you experience the communication with the parents when they pick up their child?
– What information do you want from the parents?
– What do you wish you could speak with the parents about?
– Does it occur that parents contact you after they have picked up their children, in order to complete information?
– Other topics you want to talk about?

The result was analyzed and the questionnaire was adapted to include refined questions and missing topics. The most noteworthy additional questions were: a) sex, b) whether Tempus software is used, c) how Tempus software is functioning (when applicable), d) the age of the children in the department, e) how many children there are in the department, f) what difficult topics there are to talk about with the parents, and g) what questions the personnel want from the parents. The final questionnaire is in Appendix A.2.

The interviews were then made at the preschool. The main approach was to visit the preschools and talk to the personnel without prior announcements. A short presentation of the interviewer, the university program, and the study and its purpose was made. The personnel would then either make the interview right away, make an appointment, or direct to the preschool head. The latter was the case when the personnel in question felt insecure of policies or were inexperienced. In the talks to the preschool head, the aforementioned presentation was held and a formal letter describing it was handed over. The preschool heads were positive to and genuinely interested in the study. If the study was approved, which it
always was, the preschool head would talk to the affected personnel and return by phone or email some days later.

It was always emphasized that the survey itself was not about sensitive information or about exposing any preschool’s internal doings.

4.3 Analysis of interview data

The purpose of the study was to find the information need, not to find percentages of how many parents has a certain information need. The study was consequently done as a qualitative study, from which the result is not generalizable on the population, since the sample is not randomized, it is not large enough, and the interviews were not held in the same way.

The information need was extracted, listed, and put into two main categories based on who wanted the information; parents or personnel. The information need was then further grouped regarding the type of answer each question requires. The groups were then given names corresponding to the type of answer or as a summary of the content. This was merely done as a categorization aid and no formal method was used. The result is presented in no particular order with no consideration for importance. Each group is further presented and analyzed in following sections.

First, the information needs from the parents’ point of view:

**Quantitative questions**
- Whether the child has slept or not
- Whether the child has eaten or not
- Whether the child has pooped or not

**Qualitative questions**
- How the child’s day has been
- Whether anything in particular has occurred

**General questions**
- What activities they have done
- What food was served

And second, the information needs from the personnel’s point of view:

**Practical needs**
- The child needs more diapers
- The child needs more spare clothes
- The child needs other seasonal clothes

**Emotional needs**
- If the child has slept bad
- If the child had a good breakfast
- If something happened in the family
4.3.1 The quantitative group

The quantitative group contains quantitative questions in a polar form (yes/no question), here containing the interrogative “whether.” Some, or all, of these answers are usually kept on whiteboards or similar writing facilities at the preschool. If the answer is positive, then it can be clarified with a quantitative measure in duration or volume. If the answer is further developed, then it contains qualitative measures, such as “how well,” or “what consistency.”

Sleep times and diaper changes are usually recorded, and in some preschools the meal is recorded. Sleep times are written in start and stop times, or estimated to time with a resolution of no more than five minutes.

Diaper changes are generally marked with an “X” in a list, sometimes in a time column for the morning and the afternoon, and a column may contain many marks. The time for diaper change is coarsely estimated, there is no need for accurately specifying it. The column helps the personnel to see if a child has not been changed for a long time. If the diaper contained poop, the mark is often a “B,” corresponding to the Swedish word’s initial letter. A dry diaper is sometimes marked by text, for instance “dry.”

The lunch is sometimes recorded, and in those cases it is quite common to put a happy or sad emoticon, or to write a short text: “well,” “little,” or similar. If it is not recorded, it is usually kept in memory by present personnel and passed along if necessary.

4.3.2 The qualitative group

The qualitative group, here containing interrogatives such as “how,” have answers that are usually memorized by the personnel and may be subjective observations and the answers are descriptive. The question “whether anything in particular has occurred” is indeed quantitative, but the mandatory supplementary question for a positive answer is nevertheless qualitative and cannot be measured quantitatively. Parents usually expect that the day has been good and without issues if they are not told otherwise by the personnel.

4.3.3 The general group

The general group is also a qualitative group, but it contains questions that are the same for all children, or a group of them, and is usually planned. In this list they contain the interrogative “what.” These answers are usually found on a bulletin board in the hallway.

4.3.4 The practical group

The request group contains requests from the personnel. If diapers are provided by the parents—which is the case in many Swedish municipalities—then when they are beginning to run out of them, the personnel commonly puts a sticker on the child’s shelf as a reminder. These stickers can be very creative and are usually laminated paper. The stickers are put on the shelves in advance so there is typically no hurry if the parents forget this a day or two.

The need for spare clothes or seasonal clothes are sometimes communicated with similar stickers, general notes, orally, or a combination of these. The preschool may lend clothes temporarily, so there is generally no hurry if the request is forgotten a day or two in this case either.

4.3.5 The emotional group

The emotional group contains information that the personnel would like to have from the parents in the morning, that are of concern for how the child’s day may evolve. If the personnel are informed whether the child has slept bad or not eaten breakfast or if something happened in the family, they can take actions accordingly: a child that slept bad may need
more calm activities; a child that did not have a good breakfast may need a snack; and a child who experienced something with family, relatives, or friends, may need special attention. These matters affects the day and it is of importance for the personnel to know about them.

4.3.6 Affecting factors

Factors affecting the information exchange were found to be:

- The parents’ available time
- The personnel’s available time
- The cooperation of the child
- The amount of parents picking up children at the same time

The first two items refers to stress or lack thereof. There was generally less time available when leaving the child than when picking it up. Some parents leaving their child have work to attend and might be in a hurry. Parents on parental leave are usually less stressed and stated more often that they have plenty of time. The personnel have less time available when they are changing activities or when the children are having a snack or lunch. When picking up a child, the parent might be in a hurry to go to another preschool to pick another child up.

The third item is whether the child is willing to be left or picked up. Younger children are usually less willing of being left, whereas some older children are less willing of being picked up. It is individual and may vary from day to day.

Regarding the fourth item, it is usually a factor for parents on parental leave with a newborn, while an older child attends preschool. In some municipalities, such as Umeå, the older child can attend 15 hours a week; five hours a day, three days a week, at a times determined by the preschool, for instance from Tuesdays to Thursdays between 8:30 AM and 1:30 PM.

4.3.7 Other findings

Most parents were satisfied with the information exchange; a common response was that the parents were confident that the personnel will inform them if anything in particular has occurred. It was clear from both parents and personnel that parents of younger children, up to three years old, were more concerned about the caring needs for their children. First-time parents were also more concerned about the caring needs and were more interested in knowing details of how the day has been as well as telling the personnel how the night and morning have been when leaving their children, or telling the personnel about habits and behavior of their child.

For the personnel, the relationship with the parents were of utter importance, they want parents to be involved and show interest in the daily activities. A good relationship helps in understanding the child, and is important if there are serious matter to discuss, for example if a child has been involved in a fight or if there are parenting issues. The personnel in general wanted parents to be active in the preschool activities: to read weekly or monthly newsletters and to ask what they have done today and what they will do tomorrow—to show interest.

The interviews showed that the children are important, the personnel want to get to know them and are genuinely interested in their activities and interests outside of the preschool.
Chapter 4. Accomplishment

4.4 Requirements

It was decided to digitalize the quantitative group (Section 4.3.1). This group contains information which is often already registered at preschools; the need is already there. The group is also more easily quantified than other groups regarding the child’s well-being: for instance, it takes many words to describe how a child’s day has been. Regarding whether anything in particular has occurred, it either receives a negative response or takes many words to describe, followed by feedback and responses—that is something that is better held orally.

The digitalization will be an input system that facilitates for personnel to keep track of three quantitative things: sleep times, meals, and diapers changes. It will replace analog whiteboards or similar systems. The ambition is that it will help parents to retrieve this information, and that it will help the personnel in their everyday work.

4.4.1 Prerequisites

In discussion with Tempus, some prerequisites were agreed upon. The prototype should:

– Have a clear interface and be nonintrusive; the product will be used sporadically.

– Be of similar or better convenience compared to current analog solutions, such as whiteboards. It has to offer something that those solutions do not, in order to be compelling.

– Show system status clearly at a glance and at a distance, for instance which children are sleeping.

– Use touch-based interface for use on tablets; keyboard and mouse were not considered.

– Be able to run on low-cost, low-performing tablets.

– The product is supposed to be used mounted on the wall, in analogy to current whiteboards. It is a separate system that is suppose to have exclusive use on the device. Preschools may have tablets for other uses, but an occupied tablet can not show system status at a glance for the personnel, that is as a dedicated whiteboard can.

4.4.2 Use cases

Use cases were developed as a method of gathering requirements and structuring the design process and ideas.

According to Cockburn, use cases are fully adequate requirements that should not be needed to be converted to other forms of behavioral requirements. Use cases accurately detail what the system must do, but they don’t detail external interfaces, data formats, business rules, and complex formulae.

A number of use cases were written for this prototype. For brevity, some similar use cases are omitted in this report. During the tests these use cases were revised and new use cases were added to meet the new requirements.
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<thead>
<tr>
<th>Use case name</th>
<th><strong>Register that a child begun sleeping</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>A user supervising the children at “nap time,” wants to register when a child begun sleeping</td>
</tr>
<tr>
<td>Standard flow</td>
<td>1. The user finds the child in the list and taps on its sleep cell.</td>
</tr>
<tr>
<td></td>
<td>2. Application shows options to change the time and to start the timer.</td>
</tr>
<tr>
<td></td>
<td>3. If some time has passed since the child begun sleeping, the user sets the time back to appropriate time.</td>
</tr>
<tr>
<td></td>
<td>4. The user starts the timer.</td>
</tr>
<tr>
<td></td>
<td>5. Application starts the timer and displays the current time the child has slept.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use case name</th>
<th><strong>Register that a many children begun sleeping</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>A user supervising the children at “nap time,” wants to register when the children begun sleeping</td>
</tr>
<tr>
<td>Standard flow</td>
<td>1. The user selects the batch mode for sleep input.</td>
</tr>
<tr>
<td></td>
<td>2. The user finds the child in the list.</td>
</tr>
<tr>
<td></td>
<td>3. If some time has passed since the child begun sleeping, the user sets the time back to appropriate time.</td>
</tr>
<tr>
<td></td>
<td>4. The user starts the timer for that child.</td>
</tr>
<tr>
<td></td>
<td>5. Application starts the timer and displays the current time the child has slept.</td>
</tr>
<tr>
<td></td>
<td>6. The user continues with the other children.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use case name</th>
<th><strong>Register meals for many children</strong></th>
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</thead>
<tbody>
<tr>
<td>Description</td>
<td>A user supervising the children at meal wants to register how well they have eaten</td>
</tr>
<tr>
<td>Standard flow</td>
<td>1. The user selects the batch mode for food input.</td>
</tr>
<tr>
<td></td>
<td>2. Application shows options to change the amount of food eaten for all children.</td>
</tr>
<tr>
<td></td>
<td>3. The user finds the child in the list.</td>
</tr>
<tr>
<td></td>
<td>4. The user chooses the appropriate amount.</td>
</tr>
<tr>
<td></td>
<td>5. The user continues with the other children.</td>
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<table>
<thead>
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<th>Use case name</th>
<th><strong>Register diaper change</strong></th>
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<tbody>
<tr>
<td>Description</td>
<td>A user changed the diaper a child’s diaper</td>
</tr>
<tr>
<td>Standard flow</td>
<td>1. The user finds the child in the list and taps on its diaper cell.</td>
</tr>
<tr>
<td></td>
<td>2. Application shows options to select the type of diaper content.</td>
</tr>
<tr>
<td></td>
<td>4. The user chooses the appropriate content.</td>
</tr>
<tr>
<td></td>
<td>5. Application dismisses the options and shows the content in the child’s diaper cell.</td>
</tr>
</tbody>
</table>
4.4.3 MoSCoW prioritization

A list of requirements gathered by the interview analysis, prerequisites, and use cases was compiled as a starting point. The requirements were then prioritized by the author and an employee from Tempus using the MoSCoW method (Section 2.3.2).

The prototype must:
- Display the children of the preschool class.
- Register three types of diaper changes: dry, wet, and poop.
- Display diaper changes visually.
- Have a timer that can be started and stopped when a child is sleeping.
- Indicate that a child is sleeping, that its timer is running.
- Display the time a child has slept.
- Register the meal intake amount during lunch, relative to the child’s normal intake: less, normal, and more.
- Display the meal intake amount visually.

The prototype should:
- Display only the present children of the preschool class.
- Update the list of present children whenever that status changes from Tempus Touch.
- Display the time a child has slept, while still sleeping.
- Present gathered information when a child is logged out from Tempus Touch at the preschool.
- The presentation of gathered information should support Swedish and English, as Tempus software today does.

The prototype could:
- Include additional quality indication of a poop diaper, that is, if the content is very hard or very loose.
- A timer restraining the sleep time for children with such restraints.
- Allow for many sleep periods per day.
- Include support for snacks and breakfasts in addition to lunch.
- Support altering the sleep timers in cases where they are set quite some time after the event occurred.
- Support updates of implemented information from other prototype units affecting the same children.
- Include a personnel-activated indicator for parents when they run out of diapers.
- Recover from a reboot and load previous state.
The prototype won’t:

- Be able to run on a mobile telephone or similar small-screened touch-based device.
- Include support for dinner and evening snack, for night preschools.
- Include support for sleeping a night, for night preschools.

4.5 Concept creation

In order to make a system that both displays information and makes input easy using relatively large touch targets, a layout similar to what already exists at preschools was used as a starting point.

The Tempus Touch system uses a layout where the children are laid out in a grid (Fig. 4.1), where the color conveys information about their status: present, absent, and not scheduled. The Tempus Touch system indicates ambiguous states as well; for instance, if a child is not scheduled but present, or if the child according to the schedule should have departed but have not. These states are indicated with striped colors. This works well for an overview where the colors attract attention.

In this application, the whiteboards at the preschools were used as a mental model. A table layout was chosen to represent the data; it is often used in similar systems at the preschools. An advantage of a table layout, if symbols are aligned in a column, is that it makes finding instances containing a certain symbol faster thanks to the Gestalt law of proximity. [10] This was tested very briefly by making paper drawings and letting a test person point at the all instances containing a given symbol as fast as possible, and to summarize the amount of instances containing a given symbol in the layout (Fig. 4.2).

![Figure 4.1: A schematic outline of the grid layout in Tempus Touch](image)

4.6 Paper prototype

Paper prototypes were used to sketch and test ideas early. By sketching a paper prototype, ideas can be visualized and reveal design problems early in the project. Other design decisions...
Figure 4.2: Differences between a grid layout (left) and a table layout (right). A table layout was found to make finding instances containing a symbol faster.

can therefore be made easier. The coarse interface lets test users concentrate on the task, rather than visual details. [20]

A draft for the prototype consisted of a table with buttons in every cell (Fig. 4.4a). It was immediately revised to remove the visual buttons, which made the design look cluttered (Fig. 4.4b). The goal of having a clear interface and to show system status at a glance could not be fulfilled with the first draft.

A paper prototype was sketched and tested (Section 4.6.1) and the revised prototype was evaluated with Cognitive walkthrough.

4.6.1 User tests

The paper prototype was tested on three testers, whereof two usability experts from Tempus and one non-expert. The tests were made at the Tempus office on a desk with a paper for each screen and smaller pieces of paper added on top when the interface changed, for instance icons, texts, and dialogs (Fig. 4.3).

The testers were asked to perform simple tasks from the use cases (Section 4.4.2) as well as to interpret system status. After each test an iteration of the interface was performed. The result from tests is presented here with possible solutions as well as updates to reflect later revisions in the paper prototype, in the high-fidelity prototype, or the final application.

- The testers correctly tapped the empty cell when asked to do appropriate action. Some cells where pre-filled, which might have helped affordance.

- The first time, one tester tapped the child’s name instead. The child’s overview came up as well as options to add sleep, food, and diaper.

Update: These option have since been removed, but were considered a novice way of input.
– It was discussed to provide a better batch mode for starting many sleep timers as well as food and diaper input. This is a possible use case at preschools, and they were added to use cases section.

– When tapping on a cell, the hand obscured the popover dialog that was display below the cell.
  
  Solution: Change the popover dialog position from being below the cell (Fig. 4.5a) to being to the left of it (Fig. 4.5b).

– Users wanted a visible clock to relate to especially when starting or stopping timers.
  
  Solution: Add a clock to the prototype (Fig. 4.5b).

– When changing the time for starting or stopping the timer, the length in minutes was requested.
  
  Solution: Display the time in the sleep cell itself, as if the child was already sleeping.
  
  Update: Later versions display a dotted circle around the time to emphasize that it is a transient state, not the final “sleeping” state.

– The diaper input showed dry, wet, and poop diapers. More options were shown when the latter was selected: quantity and quality. This lead to confusion and the users tapped around to see if the first two also had more options. It was requested to display all options at once.
  
  Solution: The options were made visible and the optional quantity for poop diaper was removed. As a result, the dialog could be dismissed following a select, instead of requiring a select and a confirmation—one tap less! The final diaper input shows: dry, hard poop, loose poop, poop, and wet diaper (Fig. 4.7c).
Figure 4.4: Changes in the initial idea

(a) Initial draft. Visible buttons add to clutter.

(b) Revision. The use of non-visual buttons improves display of system status.

Figure 4.5: Paper prototypes

(a) Initial paper prototype. Here with a timer popover dialog visible below it.

(b) Revision. A clock has been added. Icons on the category headers. Food amount icons have more abstraction. Here with a timer popover dialog visible to the left of it.
Diaper changes were displayed as an icon. One tester was reasoning whether the system state should show the time instead. The rationale being that personnel probably are more interested in knowing when the diaper change was done, than to know what the diaper contained.

Solution: Change to display time.

Update: A solution with both paradigms was chosen. The diaper icon is displayed when added and for twenty minutes. A user can during this time also tap the icon and change the content. After that time, the hour of the diaper change is displayed instead.

4.6.2 Cognitive walkthrough

A cognitive walkthrough (Section 2.3.4) was made by the author personally. The use cases (Section 4.4.2) were used to write the tasks that were evaluated. In the following list, the tasks are typeset in boldface and the discussion from the cognitive walkthrough below each of them. Possible solutions are written after each task and, in applicable cases, an update paragraph has been added to reflect changes in later versions.

- Identify which children are currently sleeping.
  
  In the paper prototype, a time in the sleep column indicates the time a child has slept. If the child is currently sleeping it is identified with a ring around the time. It is not immediately clear what the time means.

  Solution: This could be more clearly indicated by text labels: “sleeping” and “has slept.” A high-fidelity prototype could use color or animation to enhance the sleeping effect.

- Identify for how long users children slept, currently sleeping or not.

  Remark: Same discussion and solution as the previous task.

- Start the timer for a child that has begun sleeping.

  The users need to tap the sleep cell in order for a popover dialog to display. This is not clear, since it is not a button. The draft for the first prototype contained a button in each cell, but they were quickly removed in a revision to remove clutter and make the design more minimalistic. The popover dialog itself is clear. If the timer is started, the popover dialog is removed and the cell is filled with a counting time and a circle around it.

- Stop the timer for a child that has woken up.

  The same as above, but the circle around the time to be stopped has some affordance to it, and the time is also counting. The task is to stop the time, and thus the user wants to interact with the time displayed. The popover dialog works in a similar way as the start timer dialog.

- Lunch has finished and the amount of food for a child should be entered.

  It is not clear that the user should tap the empty cell in order for a popover dialog to display. The popover dialog is clear. If an amount is entered, the popover dialog is removed and the cell is filled with an icon indicating the amount.

  Solution: Display a tapping finger on the cells when lunch has started and for a certain time to indicate that a values is missing.
– Identify for which children the lunch has not been entered.

Given that lunch has been entered in at least one other child’s cell, this is clear: an empty field equals not filled in. In conjunction with other meal cells being filled in, an empty cell is even more clearly empty. If no meal cell is filled in, they are all empty, and it is not clear to distinguish between entered lunch or not. If the users makes the right action, the popover dialog is clear. It can be difficult to decide between the different amounts: nothing, little, normal, and a lot. This is a subjective assessment made from the personnel.

Remark: If the solution for the previous task has been implemented, then the user can scan for the tapping finger.

Update: Later versions allow for registering multiple meals per day, for example breakfast, lunch, snack, and fruit. The result is that the recently entered meal may be other than the current. For example, breakfast may be recently entered, even though it is just after lunch.

– Enter a diaper change for a child.

The same result as other cells here: an empty cell has little affordance—it is not a button. But if other diaper cells are filled in, it is more clear to tap the specific child’s cell in order for a popover dialog to display. Similar to the meal cell, the diaper cell has an icon indicating last entered item.

Update: Later versions display the last entered item and after a certain time, display the hour which the diaper change was made. The cells are never empty.

– Get an overview of how a child’s day has been, regarding food, sleep and diaper changes.

The user is expected to tap on the child’s name. This is not sufficiently evident. It is not evident where to tap. If the users makes the right choice it is evident what happened, a fullscreen view is displayed and the way out is clearly marked “Done.”

Solution: An information button or an “i” icon could be added.

Update: No such button has been added. It was considered clutter.

In summary, if all cells are empty, it is not clear how to make input to the system; but the popover dialogs made interaction clear.

4.7 High-fidelity prototype

A high-fidelity software prototype was developed as a web application intended to run on a tablet attached to the wall. Some of the advantages of high-fidelity prototypes are that they are fully interactive and user-driven, but a disadvantage is that they are time-consuming to create. The high-fidelity prototype was tested on users and evaluated heuristically. It was written in GWT in Java with layout made in HTML/XML. The CSS markup was made using the Sass CSS preprocessor and CSS techniques, such as media queries. Graphics were made in Adobe Illustrator and exported as scalable vector graphics (SVG) to support scaling and displays with high pixel density.

4.7.1 CSS

In this application, the colors (Section 4.7.4) were defined in Sass and then other color variables were set to use these color definitions, either directly or by using a Sass color function to change the colors appearance; for instance, to make them brighter. The CSS
4.7. High-fidelity prototype

markup then used these color variables. Since the colors and the markup are separated, it is easy to develop other color themes. A higher contrast theme and a dark theme was developed. The higher contrast theme overrides the grayscale and has more contrast in it. It also adds a simple markup for coloring every other row in the list. The dark theme overrides the grayscale by inverting it and darkening the colors a bit. The dark theme could be used in a dark environment where the screen should not be lit up to much, for instance a night-time childcare.

Media queries were used to support different tablet dimensions; it even scales down to mobile phone screen sizes, but it is not the intended use. All measures in css were made using the font-relative unit em, which is “the computed value of the ‘font-size’ property of the element on which it is used.” To scale down the user interface, media queries were used to set the font-size on the body element.

A newer font-relative unit is the rem unit, which is “the computed value of ‘font-size’ on the root element.” It is more predictable since a unit of for example 2rem is the same in the whole document, whereas a unit of 2em depends on the font-size of the element on which it is used. For compatibility reasons, rem units were not used, even though the intended browsers support it.

4.7.2 Input device

For this application, a touch-based interface was a requirement, chosen mainly for the resemblance between a tablet and the small whiteboards and slates commonly used at preschools. It is important to consider the different characteristics of a touch-based and a pointer-based device. Computers, such as a desktop or a laptop typically use a mouse for input. Mobile devices and tablets mainly use the human finger for input. Certainly, laptops may use a trackpad, but it is used to steer the mouse pointer. And conversely, a mobile device may use a stylus, but it is used as a finger, not to steer a pointer. There are also laptops with touch screens as well. Nielsen and Budiu make a comparison between these input methods (Table 4.2). The conclusion drawn is that mouse and fingers each have their strengths and that it is important when designing for a given platform to emphasize their strengths and alleviate their weaknesses.

The dimensions from the Nielsen–Budiu comparison that are advantageous for the prototype are: no homing time; suitable for mobile; direct engagement with screen and “fun” to use; and ease of learning.

The disadvantage of low precision is overcome by using larger targets. The prerequisites state that the system should be fast and that the usage is sporadically, which probably conveys even larger targets.

4.7.3 Touch target size

When designing for use with the finger, it is important to make the target size big enough. The target size needs to be no smaller than 7–10 mm for a finger tip to be able to touch it. Touch keyboards on mobile phone may have narrower keys than that, due to screen size and the requirement to fit a standard keyboard layout, but may also compensate for this by predicting the intended key. When a user has typed hello world, then the letter d would be considered highly probable by the software, so its target size is made bigger. So if the users taps between the adjacent keys d and f, or even partially inside the visible area of the f, then it actually hits the d.

In the environment and uses of this application, where the users are standing up and using the system sporadically, larger target sizes were considered better. The aim was to make target sizes of at least 10 mm or larger. The target sizes were measured and were found
Table 4.2: Comparison between mouse and fingers as input device. [19]

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Mouse</th>
<th>Fingers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision</td>
<td><strong>High</strong></td>
<td>Low</td>
</tr>
<tr>
<td>Number of points specified</td>
<td>1</td>
<td>Usually 1; 2–3 with multitouch</td>
</tr>
<tr>
<td>Number of controls</td>
<td>3: left/right button, mouse-up</td>
<td>1</td>
</tr>
<tr>
<td>Has homing time&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Signal states</td>
<td>Hover, mouse-down, mouse-up</td>
<td>Finger-down, finger up</td>
</tr>
<tr>
<td>Accelerated movements&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Suitable for use with big desktop monitors (30-inch or more)</td>
<td>Yes, because of acceleration</td>
<td>No, due to arm fatigue</td>
</tr>
<tr>
<td>Visible pointer/cursor</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Suitable for mobile</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Direct engagement with screen and “fun” to use</td>
<td>No; an indirect pointing device</td>
<td>Yes</td>
</tr>
<tr>
<td>Accessibility support</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Ease of learning</td>
<td>Fairly ease</td>
<td>Virtually no learning time</td>
</tr>
</tbody>
</table>

Advantageous values are typeset in boldface.

<sup>a</sup> *Homing time* is the time it takes for the hand to move from one input device to another, for example from the keyboard to the mouse.

<sup>b</sup>*Accelerated movements* are the ability to have nonlinear relationship between the speed the mouse is moving and the corresponding speed of the mouse pointer—if the mouse is moved fast, than the mouse pointer moves even faster and vice versa—this allows for fast access and high precision.
4.7. High-fidelity prototype

to be 14 mm or larger. However, the controls in the experimental *batch modes* have a target sizes of 9 mm at the smallest, because the controls are in put directly in the table view and not in a separate popover dialog with more space. These measures were made on tablet in portrait orientation with a 9.7-inch screen with a resolution of 1024x768 pixels. On an 8-inch tablet with a 800x600 resolution, the smallest target sizes were 8.5 mm, which is well above the limit of 7 mm.

In some occasions, where the available screen real estate was limited, the target size was made larger than it appeared. An example is when browsing the meals in the meal batch mode, where negative margins were used on the arrow elements. The element’s visible height is 44 pixels, but its actual size is 66 pixels, that is 1.5 times taller than it appears (Fig. 4.6).

Another case is the child detail view where a “Done” button is placed at the bottom of the page. The whole area around the button also does the same action as the button itself—closes the view. That way the user can tap the button without looking at that exact area.

![Figure 4.6: The target size made larger than the visual area](image)

4.7.4 Color scheme

A color scheme was made during the css development (Section 2.3.8). Since the system needed to signal events to the user, a stop light metaphor was chosen in conjunction with a blue color for signaling a state at ease. Shades of gray where defined and used for the interface (Table 4.3). The prime colors were also lightened and darkened when appropriate; yellow text on white background needed darkening.

<table>
<thead>
<tr>
<th>Color</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Alert, overdue tasks</td>
</tr>
<tr>
<td>Yellow</td>
<td>Warning, due tasks</td>
</tr>
<tr>
<td>Green</td>
<td>Done tasks</td>
</tr>
<tr>
<td>Blue</td>
<td>Safe, ui, selection</td>
</tr>
<tr>
<td>Grayscale</td>
<td>User interface</td>
</tr>
</tbody>
</table>

4.7.5 The simple mode and the batch modes

The initial application only implemented the *simple mode*. The simple mode displays one view that does not change appearance other than the content of the children’s cells.

During implementation, an idea of using the category headers for specific filtering of the content was explored and implemented as *batch modes* (Fig. 6.4). The batch modes alter the column layout, content, and appearance. These modes were initially not clearly visible, they were considered for experienced users. User tests reveal that it was better to display these
modes, or rather, to display that the simple mode was selected, it was otherwise confusing if a user entered a batch mode.

4.7.6 Popover dialogs

Popover dialogs were used to reveal options when the user taps a cell. In this master’s thesis the term *popover dialog* is used. Apple calls it *popover* and says that a “popover is a transient view that can be revealed when people tap a control or tap in an onscreen area.” In iOS, popover dialogs are available on tablets, whereas on phones, an *action sheet* that emerges from the bottom of the screen is used instead. An action sheet is as wide as the screen, but reveals the originating view underneath it, slightly darkened. Both are dismissed when tapping outside it, but the action sheet also includes a cancel button, something the popover dialog is discouraged to have.

The design of the popover dialogs evolved during the implementation phase as a result of user tests. The position of the popover dialog was originally below the originating object with an arrow pointing upwards. In this position, the content was partially hidden by the finger and hand, therefore the position was changed to the left side of the originating object (Fig. 4.7).

**Popover dialog for sleep time**

A common way to change time, date, and other values on a mobile phone is to use a *picker*, which is a menu that is displayed as a roll that the user needs to scroll to pick the requested value. This is used instead of typing and to prevent errors. A picker needs some kind of precision and when changing a time it is not possible to go back from say 10:10 to 09:50 by scrolling back the minutes only; the hour needs to be set back one tick, and the minutes stepped back from 10 to 50, or even from 10 to 50 which is a longer way.

In this application the use of *step buttons* were considered instead. The benefits after the final iteration was found to be: holding down a button instead of swiping repeatedly; easily stepping the minutes passed 00 and having the hour adjusted accordingly; interacting with one value: time, instead of two values: hour and minutes; and use less screen real estate.

It was considered that it is probable that the users want to set the sleep time back 5–15 minutes on a regular basis, and stepped further back, 30–60 minutes in some occasions. This depends on how the sleep routines are at different preschools.

At first, the time stepper only permitted stepping in five minutes resolution; the first step would round the time to the nearest five minute. The idea was that sleeping times were found to be reported with five minutes resolution. After testing, it was confusing that the time would only step to even five minutes, thus often leaving the actual sleep time set to other values than even five minutes. For example, if the time is 11:37 and the user steps back one step, then the time would be set to 11:35. One step more and the time would display 11:30. The problem was that the actual sleeping time would start at 0s and then step to 2m and in the last example to 7m. Perhaps the user wanted to say that the child has slept for five minutes already, which could lead to frustration.

So, in later revisions the stepping was set to one minute, and when holding down the button it started to step by five minutes.

The first iteration of the time step buttons had the time split into hour and minutes, as on mobile devices. If the minute would pass 00, it would be confusing for the user if the hour was automatically updated (Fig. 4.7a). The fingers also completely hid the time value when tapping the buttons above it. The second iteration used a unified time as the value and placed the steppers on each side of it. Here the labels contain “5m” to emphasize that it steps five minutes; the first iteration lacked this cue. The problem found was that the finger sometimes hid the time value, so in the third revisions the buttons were placed below
the time value. This also made the popover dialog more narrow. In the last revision the step buttons step one minute when tapped, and start with five minutes stepping when held longer, increasing to 10, 60, and 120 minutes when held down for a longer time. The circle around the button gets a thicker stroke in each level.

**Popover dialog for food amount**

The first iteration of the popover dialog for food amount only supported one meal and had three amount types: little, normal, and a lot (Fig. 4.7b). The icons are abstractions of a plate with a circle representing the amount of food. The user had to select the amount and then tap the “Done” button, which was consistent with the other popover dialogs.

After user tests and the addition of more functionality, the final iteration included a label displaying the current meal and two step buttons for changing the meal. An example of meals set by a department could be breakfast, fruit, lunch, and afternoon snack. Between the text label and the step buttons an indicator with dots was added to display the number of choices. The indicator highlights the dot corresponding to the currently chosen meal. The final iteration also included an option for selecting “nothing” and eliminated the need to tap “Done” to be more consistent with the remodeling of the popover dialog for diaper change.
Popover dialog for diaper change

In the first iterations of the paper prototype, the popover dialog for diaper change had three content types: dry, wet, and poop (Fig. 4.7c). Their icons were derived from the common usage on whiteboards at preschools, with the “B” as a round filled circle for contrast. If poop was selected, then a link for extra options was displayed. If that link was invoked, then quality and quantity options were displayed. The quality being loose, normal, and hard. And the quantity being little, normal, and a lot.

This design required a “Done” button to be displayed. User tests showed that the there was confusion with the extra options, so it was removed. Instead the quality was incorporated in the main selection area; the quantity was not considered important. This design change resulted in the removal of the “Done” button, reducing the number of taps by one for common tasks to two taps; the number of taps for loose and hard poop was reduced from five to two taps! The icons were changed so that the dry diaper had a densely dashed circle around it, connoting an empty container or something weak (like a whispering dialog in comics). The wet diaper was made as a drop icon. The use of any icon with an “X” over it lead to connotation of a disabled, forbidden, or deleted icon. The “X” was changed to a check mark.

In the third iteration, the order was changed to have the more common tasks, wet and poop, to the right, close to the originating tap position. Loose and hard poop were grouped with normal poop, and dry placed to the left. This last iteration also removed the “T” from dry diaper and the check mark from the wet diaper. It was also discussed to have the a per-department setting to choose which diaper types to support, adjusting the interface to the use of each preschool.

4.7.7 Heuristic Evaluation

A revision of the high-fidelity prototype was made and then evaluated heuristically by the author using Nielsen’s *Usability Heuristics for User Interface Design*. The evaluation is presented here with the principle typeset in boldface and the corresponding analysis below it. In some cases a solution to a found problem is presented below the analysis. If the design has been changed to solve a problem in later revisions or in the final application, then an update has been added below the analysis.

- **Visibility of system status**
  
  No issues. The system is responsive and always acts on input. There are no invisible actions that the user triggers. The various states of a child’s areas of interaction need some learning, but important states are always readable adjacent to the child’s name.

- **Match between system and the real world**
  
  This is probably OK, but further tests on real users in real environments could reveal otherwise.

- **User control and freedom**
  
  Is it clear that a popover dialog can be dismissed by tapping outside it? Undo is supported for sleep and food, but diaper as of now only be changed to other type, not unset.

  **Solution:** Add a close button or close icon to popover dialog. Add undo for all actions, preferable using a software pattern for undo/redo.

  **Update:** According to the iOS Human Interface Guidelines, it should be avoided to add a dismiss button in popover dialogs.
4.7. High-fidelity prototype

- **Consistency and standards**
  
  No issues. There are no platform interactions in this system, no printing, saving, or file management. The application is its own system, and uses terminology from Tempus software when applicable. The application is consistent within itself.

- **Error prevention**
  
  Input are always made from available choices not text input, thus preventing many possible errors. More actions should be undoable, see *User control and freedom* above.

- **Recognition rather than recall**
  
  Dialogs are all one step and all possible choices are visible. The individual buttons for adding sleep, food, and diaper are not visible buttons, which can lead to trouble for novice users. When a defined meal has started and for one hour after, empty food cell displays an icon depicting a hand with a finger extended to touch the screen.

- **Flexibility and efficiency of use**
  
  Input has been made designed with consideration of the least amount of input and taps possible. Buttons for adding time step five or more minutes when held down a longer time.

  *Solution:* A batch mode for starting timers, adding food amounts, and diaper changes should be added. These actions are sometimes done many children at a time.

  *Update:* Batch modes have been added and are intended for experienced users.

- **Aesthetic and minimalist design** Minimalistic design has been accounted for along the design process. As little information as possible is shown, and relevant or urgent information is emphasized.

  When clicking on a child’s name, an overview of that child is shown. That page contains settings for adjusting whether that child uses diapers, whether it sleeps during the day, and if so, whether there is a sleep limitation set. These settings are rarely changed, the use of diapers and the daytime sleep is changed perhaps once in a lifetime and sleep limit is usually not changed on a daily basis.

  *Solution:* Move the rarely used settings.

  *Update:* Settings have been moved to a separate page in that view.

- **Help users recognize, diagnose, and recover from errors**
  
  There are no actual errors produced by this system, apart from in the login screen, which is not expected to be needed often; login sessions should be remembered. The login screen shows connection problems in addition to standard messages for login-related errors.

  Users are provided with ready-made options to choose from, and are not required to enter options freely. Other more complex parts of the system is entered by an expert in the database when initially set up. This could of course be done within the application in a future version.

  *Update:* If the tablet cannot connect to the server, an error is shown in the header, which is colored red, until it is able to connect. The system is fully useable in the meantime and synchronization is performed when the connection is established.

- **Help and documentation**
  
  No help or documentation is provided. Visual cues are however provided; for instance, a small notification label, called *toast* in Android terminology is displayed when tapping
a disabled sleep cell or diaper cell, informing the user that the particular child is not a sleep child or diaper child respectively.

*Solution:* A help section or introductory section should be added. The system may be used by novice users, for instance substitute teachers.

### 4.7.8 User tests

The application was tested on two usability experts from Tempus and one non-expert. The tests were done in different phases of the application development cycle, which meant that for some users, previous issues had been addressed. The testers were asked to think aloud, although a formal *think-aloud protocol* was not followed.

In general, the users found their way around the interface very well. The given tasks were successfully completed by all testers. The tasks were: start and stop a timer, add food amount for a child and add food amount for a previous meal for another child, and finally to register a diaper change. They all acted correctly on application output, such as notifications that a child needs to be woken or that a diaper change is due.

The testers were asked to give input and feedback while performing the tasks and in a short discussion session afterwards. This feedback is grouped in following sections.

#### Information interpretation

One tester in an early test did not understand what the time displayed in the sleep cell represented. This has been addressed by displaying a label over it with the text “has slept.”

The abstract icons for food amount were not fully understood. One user thought they were radio buttons (in the food batch mode). A suggestion to display the fork and knife was tested but not fully liked by the author due to the added clutter. This has not been addressed.

The diagonal crossing line through a sleep cell was not understood by a tester in an early test. The tester could not figure out why it was not possible to start the timer for a non-sleep child. Even though the crossing line became temporarily wider and red when tapped. The solution was to display a toast, that notified the user why an action could not be done. The toast was visible for a short time and dismissed when the user tapped outside it.

#### Legibility

The dots conveying the number of available meals in the food popover dialog were considered too small. These dots are similar to those displaying page information in mobile devices. This has been addressed by making the dots larger.

#### User interface

The user interface did not clearly convey that the column headers were tappable in order to enter a batch mode. This was made by design to keep the simple mode clutter-free. To leave the batch modes, the user had to tap on the currently active, and visually selected, column header. This was not understood by any of the testers and one tester accidentally entered a batch mode without knowing how to leave it. The solution was to make a more conventional tab bar by adding an “Overview” tab that was initially selected as well as make the column headers more tab-like.

The color mapping of the early user interface was not understood. In the child detail view, a green color was used in check boxes previously present there. The tester misinterpreted the green color to map the graph displaying a finished sleep period. This problem was indirectly addressed by moving the child settings to a separate view. The checkbox appearance and
its green color was redesigned. And a related issue of the using green as selection color was changed to a more conventional blue.

**Expected behavior**

One tester wanted to tap on the graph icons in the child detail view. This is a static view, but the tester wanted to interact with the icons in order to see more information or change their value. This has not been addressed. The graph should either be made interactive, or have less interaction affordance to it.

**Missing information**

If the child is not a sleep child, then it should be displayed in the child detail view in order to clarify why no sleep information was there. The child detail view displayed either the amount of time the child has slept or a text stating that the child has not slept today. Non-sleep children had no text at all.

If a child had multiple sleep sessions, they were not displayed separately, neither in the sleep cell nor in the child detail view; only the total sum and the number of periods are displayed. This has not been addressed.

**Touch-related issues**

The step buttons for changing time or meal were requested to be bigger. They were rather big initially, but the user’s focus is not on the buttons, but on the value they manipulate. This has been addressed by making the step buttons larger.

In later tests on a revision, it was an issue that the toast was not dismissed when tapped. When the user by mistake tapped the wrong sleep cell—that of the child below—the toast partially hid the intended cell, thus making interaction with that cell impossible until it was dismissed either automatically or by tapping outside the toast. This behavior impeded the user from quickly tap the correct cell. This was corrected by making a tap on the toast dismiss itself.
Chapter 5

Results

This chapter presents the results of the work conducted in this master’s thesis. The results have already been covered in Chapter 4 but is more concentrated in this chapter.

5.1 Introduction

First, a recall of the initial goals. The main goal is at the top and the subsequent goals follow in chronological order.

– Find out what the information exchange between parents and personnel at preschool consists of, what the topics are, which factors affect it, and which parts of it that might be improved by making it digital.

– Make an in-depth literature study on survey methods and select appropriate method asking the parents and personnel.

– Prepare and carry out interviews with parents and personnel at preschools with and without the Tempus software.

– Summarize a list of information need found in the interviews.

– Make prototypes from a selection of the information needs and prioritized requirements.

– Evaluate the prototypes using heuristics and walkthroughs.

– Test the prototypes on usability experts and real users.

To reach the goals and to find out what the information exchange consists of, it was decided to ask parents and personnel about their information need. Therefore an in-depth literature study of survey methods was carried out. As a result of the in-depth study, interviewing was chosen as a method. The interviews were made as semi-structured interviews. For the parents, they were more structured and for the personnel, they were less structured with more open-ended questions.

The result from the interviews was compiled and the information need extracted and categorized by the type of answer or response they require. Use cases were produced, and prerequisites and requirements were prioritized using the MoSCoW prioritization method.

A low-fidelity paper prototype was made and tested on usability experts. Revisions based on the tests were made and tested further using cognitive walkthrough. A high-fidelity web application was made and tested on usability experts and evaluated using usability heuristics. The results from these steps are presented more thoroughly in the following sections.
5.2 In-depth study

The in-depth study was conducted initially to get knowledge of various approaches to gather information from people by asking them. The purpose of the in-depth study was to choose an appropriate method to use in this master’s thesis work.

From the in-depth study it was decided to carry out a qualitative survey, since it attempts to understand the world from the subjects’ points of view. There was no intention to compare among subgroups, to report how many respondents are in particular categories, or relationships between them.

The survey was decided to be face-to-face interviews with a semi-structured questionnaire, which allows for changing the order of the questions depending on the interviewer’s perception. It further allows explanations to be given and questions to be omitted if inappropriate with a particular interviewee.

5.3 Interviews

There were two groups to be interviewed: parents and personnel. Interviews were held in the municipality of Umeå, Sweden, at preschools from the city center, suburbs, and villages in order to spread the sample. The sample included both personnel and parents related to preschools with and without Tempus software. In total, twenty-four interviews were held (Table 4.1).

5.3.1 Pilot study

For both groups, a small pilot study was conducted initially. After the pilot studies, the questionnaires were adjusted to correct ambiguous and unclear questions, add new questions, and include anticipated answers in checkboxes to reduce writing during the interviews; the questionnaires were filled in by the author personally. These checkboxes were not disclosed on open-ended questions. The final questionnaires are in Appendix A.1 and Appendix A.2.

5.3.2 Parents

For parents, it was decided to approach them outside the preschool premises after they left their child or before they picked it up. The reason for this was to make sure that the parent was alone; the child would likely be a distracting factor. The parents were generally more relaxed in the afternoon, before picking up their children; in the morning they were probably in a hurry to work.

The parents were usually interviewed outside the preschool premises, but occasionally in other locations, such as in the street or in a park. The interviews usually took between ten and fifteen minutes to complete; one interview took thirty minutes. The questionnaire was filled in by the author and rewritten afterwards or within a few hours. A web questionnaire was made as a backup if an interviewee did not want to participate in a face-to-face interview, but it was never needed.

5.3.3 Personnel

For the personnel, it was decided to approach them at the preschool, their workplace. No prior announcement was made, but it was anticipated that they would either agree on being interviewed right away, make an appointment, or direct to the preschool head. In some occasions it was decided to turn to the preschool head immediately, based on the intuition of the interviewer.
About half of the interviews were held right away. A quarter were held after appointments with the personnel, and the last quarter were held after talking to the preschool head.

The preschool heads were always positive and interested in the survey. They needed to talk to the personnel to inform them, agree on suitable date and time, and return by phone or email some days later.

The interviews were usually held in the staff room and lasted between twenty to forty-five minutes. In one occasion, the interview was held while the children were having the afternoon snack and the author, the interviewee and four children were sitting around a table. It was not optimal, because of the distracting environment.

5.4 Information need

From the interviews, a list of information needs was extracted and analyzed. These needs were then put into groups, which were given names corresponding to the type of answer the needs in it required, or as a summary of the content. This was merely done as a categorization aid and no formal method was used. From these groups, the “quantitative group” was chosen for the digitalization prototype. It contains the following questions:

– Whether the child has slept or not
– Whether the child has eaten or not
– Whether the child has pooped or not

These questions can be answered rather objectively and can easily be quantified in binary yes/no, or specified in minutes or amount where appropriate. Other questions from other groups, such as how the child’s day has been, can not be answered objectively or easily quantified.

5.5 Requirements

From the list of information needs, it was decided to make a prototype from the quantitative group. This group contains information which is often already registered at preschools; the need is already there. This group is also more easily quantified than other groups regarding the child’s well-being; for instance, it takes many words to describe how a child’s day has been and it is a subjective assessment; but whether the child has slept or not is an objective assessment, and is easily measured in minutes.

5.5.1 Prerequisites

In discussion with Tempus, some prerequisites were agreed upon regarding the prototype. It should:

– Have a clear interface and be nonintrusive; the product will be used sporadically.
– Be of similar or better convenience compared to current analog solutions, such as whiteboards. It has to offer something that those solutions do not, in order to be compelling.
– Show system status clearly at a glance and at a distance, for instance which children are sleeping.
– Use touch-based interface for use on tablets; keyboard and mouse were not considered.
– Be able to run on low-cost, low-performing tablets.
The product is supposed to be used mounted on the wall, in analogy to current whiteboards. It is a separate system that is supposed to have exclusive use on the device. Preschools may have tablets for other uses, but an occupied tablet can not show system status at a glance for the personnel, that is as a dedicated whiteboard can.

### 5.5.2 Use cases

The use cases that were put together made it clearer how the product would be used and how a user would interact with it. The use cases were also used in the user tests.

### 5.5.3 MoSCoW prioritization method

A list of requirements gathered by the interview analysis, prerequisites, and use cases was compiled as a starting point. The requirements were then prioritized by the author and an employee from Tempus using the MoSCoW method (Section 2.3.2).

The **prototype must:**

- Display the children of the preschool class.
- Register three types of diaper changes: dry, wet, and poop.
- Display diaper changes visually.
- Have a timer that can be started and stopped when a child is sleeping.
- Indicate that a child is sleeping, that its timer is running.
- Display the time a child has slept.
- Register the meal intake amount during lunch, relative to the child's normal intake: less, normal, and more.
- Display the meal intake amount visually.

The **prototype should:**

- Display only the present children of the preschool class.
- Update the list of present children whenever that status changes from Tempus Touch.
- Display the time a child has slept, while still sleeping.
- Present gathered information when a child is logged out from Tempus Touch at the preschool.
- The presentation of gathered information should support Swedish and English, as Tempus software today does.

The **prototype could:**

- Include additional quality indication of a poop diaper, that is, if the content is very hard or very loose.
- A timer restraining the sleep time for children with such restraints.
- Allow for many sleep periods per day.
5.6. Low-fidelity prototype

- Include support for snacks and breakfasts in addition to lunch.
- Support altering the sleep timers in cases where they are set quite some time after the event occurred.
- Support updates of implemented information from other prototype units affecting the same children.
- Include a personnel-activated indicator for parents when they run out of diapers.
- Recover from a reboot and load previous state.

The prototype won’t:

- Be able to run on a mobile telephone or similar small-screened touch-based device.
- Include support for dinner and evening snack, for night preschools.
- Include support for sleeping a night, for night preschools.

The list is long, but according to the MoSCoW method, the must category must be fulfilled in order for the solution to be considered successful; the should and could are less important in that aspect.

5.6 Low-fidelity prototype

5.6.1 User tests

The paper prototype was tested on three testers, whereof two usability experts from Tempus and one non-expert. The tests were made at the Tempus office on a desk with a paper for each screen and smaller pieces of paper added on top when the interface changed; for instance, icons, texts, and dialogs.

After each test, a redesign iteration was done to address some of the problems found, or to include ideas that were received from the testers.

The test cases were clear and the result was good and lead to interesting discussions in all three tests. Changes were suggested by the testers or by the author in later analysis. All suggestions were considered, but not necessarily taken into account. This was a short test and lacked the all-day runtime that the system should handle.

An important finding was to display the resulting duration when changing start and stop timers. Another important finding was that the popover dialog for diaper change needed to be simplified and diaper changes should be displayed with time instead of icon since it was considered more important to know when the diaper was last changed than what was in it.

5.6.2 Cognitive walkthrough

A cognitive walkthrough was made on the paper prototype by the author personally. The use cases were used as a basis for the test tasks. A result of the cognitive walkthrough was to have clearer labels in the user interface.

5.7 High-fidelity prototype

After the iterations with the low-fidelity prototype, a high-fidelity prototype was built using Google Web Toolkit (gwt) and the Sass CSS preprocessor. This prototype was a web application that should run on a tablet mounted on the wall. A description of the final application is in Chapter 6.
Chapter 5. Results

5.7.1 Usability Heuristics

The high-fidelity prototype was evaluated heuristically by the author using Nielsen’s Usability Heuristics for User Interface Design. [18]

The result was good; some usability problems were found and solutions were produced to address them. An important result from the heuristic evaluation was to move rarely used child settings from the child detail view to a separate settings view.

5.7.2 User tests

The application was tested on two usability experts from Tempus and one non-expert. The tests were done in different phases of the application development cycle, which meant that for some users, previous issues had been addressed. The testers were asked to think aloud, although a formal think-aloud protocol was not followed.

In general, the users found their way around the interface very well. The given tasks were successfully completed by all testers. The tasks were: a) start and stop a timer, b) add food amount for a child and add food amount for a previous meal for another child, and c) to register a diaper change. They all acted correctly on application output, such as notifications that a child needs to be woken or that a diaper change is due. The testers were asked to give input and feedback while performing the tasks and in a short discussion session afterwards.

An important test result was that the initial design of the batch mode was made invisible; the user needed to tap on a column header. This made it unclear how to leave the batch mode (tapping the same column header). A visible column header for the simple mode was added. It was also decided to deactivate the batch modes initially. An other result was to change the coloring of some elements not to have the similarity of color convey some relationship that was not there. A central aspect that was considered in the whole design process was to make the touch buttons big, but the user tests revealed that they would benefit from being even bigger. The touch target sizes were made bigger whenever possible.
Chapter 6

System Description

This chapter presents chosen parts of the final web application. The main view of the application and its parts are defined and described, including icons and popover dialogs. There is also a description of some software solutions and some Java classes.

6.1 The views

The application contains three main views:

- the login view
- the main view
- the child detail view

The login view is trivial and is not presented in more detail here. The other two views are described briefly in the following sections.

6.1.1 The list view

The main view consists largely of a list, where the children of the department are listed alphabetically in rows (Fig. 6.1). Each child has three areas of interaction: sleep, meal, and diaper, which are represented in three cells in each child’s row. If an area of interaction is not applicable for a child, then its cell is rendered disabled with a crossing line. If a user taps a disabled cell, then a small notification label, a toast, appears temporarily to notify the user that the cell is disabled and why. The crossing line shortly becomes red and wider for emphasis. In the upper left corner, the name of the department is displayed. In the upper right corner the current time and weekday are displayed.

6.1.2 The child detail view

The child detail view displays the child’s image and contains graph of the days events regarding the interaction areas: sleep, meals, and diaper changes. The events are also written in plain text. The diaper changes are nevertheless displayed using the icons (Fig. 6.2).

From the child detail view there is a link to the child settings, which contains two checkboxes to set whether the child sleeps during the day and whether the child uses diapers. If the checkbox for sleeping during the day is activated, then a time limit may be set in steps of five minutes.
Figure 6.1: The main list view with a sleep popover dialog visible
6.2. General descriptions

This section contains brief descriptions of the three interaction areas: sleep, meal, and diaper.

6.2.1 Sleep

Sleep is recorded as a start and stop time. If no stop time is set, then the sleep is currently active. A child may have a sleep limit set in even five minutes. It is sometimes requested by parents, that the child does not sleep for more than a certain amount of time. Multiple sleep times are permitted and the sleep widget displays the total time slept that day and how many times if more than one.

6.2.2 Meal

Meals are set on a per-department basis and constitutes of a title, a time, and an internal classification: fruit, snack, or meal. The classifications can be used to make calculations by combining them with the amount the child ate. For instance, if a child has eaten a lot of fruit, but a small amount of meal, then that is less than if a child has eaten a small amount of fruit, but a lot of meal. The classification can also be used to only display snack and meal classes in order to see if a child has eaten well in an overview.

6.2.3 Diaper

A diaper change can be done at any time. If a diaper change has been performed within 20 minutes, then the previous diaper value is replaced instead of adding a new diaper change. There are five diaper content types: dry, wet, poop, hard poop, and loose poop.
6.3 Popover dialogs

Popover dialogs are used to input data. They float above the view and are invoked by tapping the sleep, food, or diaper cells respectively. They are dismissed if the user taps outside.

6.3.1 Sleep popover

The sleep popover displays the current time and two step buttons for changing it. It has a button for starting or stopping the timer depending on the current state (Fig. 6.1). The popover is dismissed when the timer is started or stopped.

6.3.2 Food amount popover

The food amount popover displays the current meal and two step buttons for selecting the previous or next meal. It has a segment widget containing four food amounts: nothing, little, normal, and a lot. If there is a food amount already set for the current meal, that food amount is selected in the segment widget (Fig. 6.3a). Changing value is allowed at any time. The popover is dismissed when an amount has been selected.

6.3.3 Diaper change popover

The diaper change popover displays five diaper contents: dry, loose poop, hard poop, normal poop, and wet (Fig. 6.3b). If a diaper change has recently been made, that content is selected and may be changed by the user. The popover is dismissed when a content has been selected.
6.4 Icons

Icons were designed to be abstract and legible from a distance. The only icon with a specific color is the wet diaper icon, all other icons may easily be inverted in the user interface. The icons were made in Adobe Illustrator and exported as scalable vector graphics (SVG) to support scaling and displays with high pixel density.

6.4.1 Column header icons

The column header icons are displayed in the column header together with a label. In the application they have less contrast than they have here. When a column header is selected, they are rendered white on the blue background.

- flower
  The icon for the overview (or simple mode). The icon is only present when batch modes are active.
- crescent moon
  The icon for sleep times.
- plate and cutlery
  The icon for meals.
- drop
  The icon for diaper changes.

6.4.2 Food amount icons

The food amount icons depict a plate with the amount represented as a disk. To reduce clutter, these icons do not have cutlery. However, the meal icon in the column header includes cutlery to make the connection to a plate stronger.

- empty circle
  The child did not eat anything.
- small disk in circle
  The child ate a little, much less than usual.
- medium disk in circle
  The child ate normal. This is the expected value.
- large disk in circle
  The child ate a lot, much more than usual.

6.4.3 Diaper icons

The diaper icons are distinct from each other, at least when considering the poop icons as a group. The poop icons were designed to be similar at a glance, but to reveal extra information if studied in detail.

- blue drop
  A wet diaper.
- "B" in circle
  A poop diaper. This icon does not convey quality and could be used generically for all poop types.
- "B" in rounded square
  A hard-poop diaper.
- "B" in drop
  A loose-poop diaper.
- dashed circle
  A dry or empty diaper.
6.5 Cells

The main view consists of a table view to present the children. There are four table cells distinguishable: the name cell, the sleep cell, the food cell, and the diaper cell. The cells respond to touch events. The child cell displays a new view when tapped, the others display popover dialogs to enable data input or to change data.

6.5.1 Name cell

The name cell contains an image, the child’s first and last name, and the status text for the interaction areas. The last name is shortened to the initial letter on narrower screens. This is done in advance in Java and activated by media queries in CSS. The status text for the interaction areas are visible only when necessary, and colored according to the severity level. Blue for ongoing actions (sleeping), yellow for actions that are due, and red for actions that are overdue. If the user taps anywhere in the name cell, then the child detail view is displayed.

6.5.2 Sleep cell

The sleep cell displays the status of a child’s sleep. It may display one of the following:

- **crossing line**: When not a sleep child.
- **has slept 50m static time**: When a child has slept during the day. If multiple sleep periods have been registered, the total time is displayed and the number of periods in parenthesis, for example “50m (2)”.
- **10m counting time**: Displays the current sleep time while a child is sleeping. The background is slowly pulsating blue.
- **40m**: As above, but the sleep limit is reached. Awakening is due. The background is static yellow.
- **50m**: As above, but the sleep limit is passed by 10 minutes. Awakening is overdue. The background is rapidly pulsating red/yellow.
- **0s temporary time**: When the sleep popover is visible or when time manipulation is activated in batch mode. Displays the sleep duration based on the time value.

These status elements are activated by media queries in CSS. In order to start or stop a sleep time, the user taps the sleep cell and interacts with the popover dialog that is displayed.

6.5.3 Food cell

The food cell displays the status of a child’s food intake. It may display one of the following:
6.6. Batch modes

To set a food amount, the user taps the food cell and may change the meal by using the arrow buttons, the user then selects an appropriate amount for that child.

6.5.4 Diaper cell

The diaper cell displays the status of a child’s diaper changes. It may display one of the following:

- **crossing line**
  - When not a diaper child.

- **recently diaper icon**
  - When a diaper change has been made within 20 minutes. If tapping this icon, the user may change the value of this diaper change.
  - When a diaper change has been made more than 20 minutes ago.

- **changed at 10 hour**
  - Same as above, but when a diaper change has not yet been done. The hour represents the time the child arrived. It is anticipated that a diaper has recently been changed when a child arrives. The background is static yellow.
  - Same as above, but four hours has passed since the last diaper change. Diaper change is due. The background is rapidly pulsating red/yellow.
  - As above, but five hours has passed since the last diaper change. Background pulsates rapidly. Diaper change is overdue.

6.6 Batch modes

For experienced users, there are three batch modes for the three interaction areas: sleep times, meal, and diaper change. This feature is considered experimental and not activated by default. The activation is done in the database or the temporary debug menu, but should be available for users in the department preferences view, which is not implemented. When activated, the batch modes are accessible through the tab bar, which then also displays the overview mode.

The batch modes were implemented so that experienced users can input data as a batch. Common for all batch modes are that they use all three cells from the interaction areas, that is, the simple-mode cells become invisible when a batch mode is activated.
6.6.1 Sleep batch mode

The batch mode for sleep times consists of three widgets: the sleep widget from the overview mode; a time widget for changing the start or stop time; and an invocation button for starting or stopping the sleep time (Fig. 6.4a).

When a sleep time has been started or stopped, the user may undo that action during a short time. It was found important to be able to undo actions in sleep batch mode, due to the fact that many buttons are placed close to each other, not only within a child’s row, but between the rows.

Children that are not sleep children, do not have these widgets in the corresponding row. The sleep widget has a crossing line and a text label “not a sleep child.”

6.6.2 Meal batch mode

The meal batch mode consists of a global meal selector displayed above the sleep tab (Fig. 6.4b). When entering this batch mode, the currently active meal will be the last one started, or the first one for the day if none has been started yet. The user may change the active meal by tapping the arrow buttons placed below the label.

Each child’s row contains inputs for the active meal with the values: not set, nothing, little, normal, and a lot. The thought behind letting the user choose not set is to provide a way of undoing the action, if it was previously not set. In addition, the not set value is separated from the other values by a space. The user may glance at the rows to find children whose values are not set in order to set them.

6.6.3 Diaper batch mode

The diaper batch mode provides a way of displaying an overview of the diaper changes, not only the last diaper change. The department may have any number of preset diaper periods. A common distribution is to have two columns: morning and afternoon. In this mode, the diaper changes are displayed in the corresponding diaper period (Fig. 6.4c).

The user is supposed to be able to edit diaper changes, or to add new diaper changes in any of the diaper periods. This is not implemented, so the actions taken in this batch modes is in reality the same as the diaper cell in the overview mode.

6.6.4 Graph mode

For experienced users there is also the graph mode, which displays a graph over the three interaction areas (Fig. 6.4d). There is no user input available in the graph mode. Each hour gets its own cell in the graph timeline. Unscheduled hours for a child are grayed out. Labels for hours passed are displayed darker; and future hours are displayed lighter—there is no information in the future. The current time is displayed as a blue vertical line. The three interaction areas are displayed from the top in the same order as they appear horizontally in the cells.

Sleep time is displayed as a rounded bar. A currently ongoing sleep is displayed in blue and has a straight cut where the current timeline is. Passed sleep times are displayed in green, current sleep times due to be stopped, are displayed in yellow, and an overdue sleep time is pulsing between yellow and red. Meals are displayed with the food amount icon and diaper changes are equivalently displayed with the diaper icon.
6.6. Batch modes

(a) Sleep batch mode
(b) Food batch mode
(c) Diaper batch mode
(d) Graph mode

Figure 6.4: Batch mode views and graph view
6.7 Synchronization

No data was saved during the early implementation phase. The base functionality to start
timers and add meals or diaper changes functioned without server storage—as long as the
application was running. Department settings and children data was received from the server
since the first iterations of the application, but initially hard coded. When a basic sql
server was set up, the need to save data to the server emerged. It was decided to use a
synchronization model in which the unsaved local data was sent to the server and new data
was received. No data can be received without a prior save. This model was chosen because
the server implementation did not know what data the client had, so it sent all applicable
children data. The client knows what data it has changed but cannot know whether the
server data is more recent. In order not to have to resolve conflicts in the client, the server
data was defined to be correct and up to date.

In this solution two clients may overwrite data on the server if manipulating the same
data at the same time. New data would not be overwritten. If only one application unit is
used, then there should be no problem. The only data saved from the client should be the
interaction areas and settings in them. From Tempus software other data should be read, such
as presence and schedule. There is no possible conflict between these. The synchronization is
done sporadically and the application runs well even if the network communication is down
for a long time.

6.8 Java widgets and classes

6.8.1 Time

In Java, a Date object represents an accurate time (in milliseconds) on the entire timeline,
whereas in a real-world scenario, it is often useful to represent a time that is valid every day,
without the need for year, month, and day. Seconds are superfluous as well, not to mention
the milliseconds. In this application, “lunch is every day at 11:30” is a useful representation,
not “lunch is at 11:30 AM CET on February 12, 2014 AD” and so on for all days that apply.

This is partially solved in java.sql.Time, which is a time representation with hours,
minutes, and seconds. But for this application, a simple Time class was implemented. The
class only stores hours and minutes, and is used to store for instance meals. It supports
comparison against other Time or Date objects and implements special methods useful for
this application: to round up or down the time to a requested value of even minutes and a
method to add or remove minutes that takes hour into consideration, but not the day. The
class can return a Date object where the date part is set to today.

6.8.2 StepButton

The StepButton extends a normal java Button but activates touch events and sends a
StepEvent every time it is tapped, or repeatedly when pressed with increasing levels of
stepping. It is up to the implementer of a StepButton to check and act upon the different
levels of stepping.

6.8.3 TimeWidget

A TimeWidget displays a time (Time) and has two buttons (StepButton) for changing it.
The TimeWidget implements the GWT interfaces HasValue and HasValueChangeHandlers
with Time as the value.
6.8.4 DurationWidget

A DurationWidget is very similar to a TimeWidget. The difference is that instead of a time it represents a duration in minutes with the value as an integer.

6.8.5 TextSelectWidget

A TextSelectWidget is also similar to the TimeWidget, but has a string as the value and the step buttons are displayed as arrows instead of having a minus or plus sign. Below the current string there are dots indicating the amount of options available. The current dot is highlighted. The value wraps when reached the beginning or the end. It is used to select meal in the popover dialog.

6.8.6 SegmentWidget

The SegmentWidget displays a number of visual choices with icon and text. Only one choice can be selected, much like a radio button in HTML. It implements the GWT interfaces HasValueChangeHandlers and HasValue with an integer as the value that represents the index of the selected button. It is used to select food amount or diaper type.

6.8.7 PopoverDialog

The PopoverDialog extends the GWT PopupPanel and displays a small dialog with an arrow pointing to the invocation area. The popover dialog is dismissed if the user taps outside it.
Chapter 7

Discussion

The interviewing period, at the end of August and the beginning of September was ideal when interviewing parents; the late summer weather was fair and warm and the parents were often walking to the preschool and they were generally in a good mood. The decision to approach them outside the preschool premises was successful and gave expected results.

The parents usually said that they did not have much time for the questions, but when they begun answering them and discussing the topic, they usually showed less stress. There was a regional referendum about healthcare held in the beginning of September and it could have influenced the first reactions the parents had when they were approach by an interviewer with a questionnaire. If they expected an opinion poll of a political referendum, they were perhaps defensive. The result from their answers was probably not affected.

Parents were more interested in talking before picking up their child than after leaving it; in the morning they probably were in a hurry to work. It was far easier to talk to parents on parental leave with a small child, not yet enrolled in preschool, meanwhile the older child was attending preschool. These parents had more time, even though they had their small child with them after leaving the older one at preschool. It was not anticipated that they would bring another older child with them; it was a distracting factor in those occasions.

In contrast to the interviews with the parents, the interviewing period was not ideal for personnel; there were reception periods for new children at preschools, especially in departments with small children, so the personnel were usually busy and occupied with these small children and there were parents around. Even though clearance was made from the preschool head and dates were set, the personnel in a certain case were not receptive and no further interviews were made in that department. The overall result was probably not affected by this.

The work with the application went well, but a deeper investigation of how current analog systems are used would have been an asset. The usage was observed, told, or asked about during the interviews, but not sufficiently to understand the complete workflow.

In the application, the simple mode combines system overview and data input: system overview by watching, and data input by tapping the corresponding cell. For the batch modes, it would likely be better to have two separate modes: one for overview, and one for data input. The approach chosen in this design, to tap the column header in order to reveal a batch mode cannot easily comprise two modes without using switches. As a result, sleep batch mode is a detailed data input mode, meal batch mode is a combination of a detailed overview and a detailed data input mode, and the diaper batch mode is a detailed overview of diaper changes. If a new diaper is added in that mode, the time is set to now anyway. The batch modes were late considerations, and this inconsistency lead to the decision to disable them by default. A redesign coupled with a deeper study of the uses of current analog systems mentioned earlier would be beneficial.
Chapter 8

Conclusions

The master’s thesis resulted in an application that may be used by the personnel at preschools where Tempus software is used. The application takes care of three aspects of the children’s care taking at the preschool: sleep, meals, and diaper changes. The personnel may start and stop sleep timers on applicable children; input the amount of food each child has eaten in any meal predefined by the preschool, such as breakfast, lunch and afternoon snack; and input the content of the diaper changes on applicable children. The application is supposed to run on a tablet mounted on the wall, where the system status can easily be monitored.

The application is a web application written in Java using Google Web Toolkit, which converts the front-end code to JavaScript. It communicates with a server to retrieve and store data in a database using mySQL.

The goal of this master’s thesis was to find out what the information exchange between parents and personnel consists of, what the topics are, which factors affect it, and which parts of it that might be improved by making it digital. The goals have been reached, but more resources should have been allocated to investigate how the current workflow is in the chosen parts, that is the routines for registering sleep times, food amount, and diaper changes. This seems to differ between preschools, but common denominators and customization can compensate for this difference.

No tests on real users were planned due to the time factor, but such tests would be of interest for proof-of-concept of this application. Initial testings revealed that the use for such software may help personnel as well as parents.

8.1 Restrictions

The interviews were qualitative interviews aiming to get knowledge of topics of information exchange. The result is by design not generalizable on a larger population than the sample. The application does not support night-time childcare due to the current restrictions in the time handling when passing midnight. This was also specified in the requirements.

8.2 Limitations

The application does not connect to the Tempus software to retrieve data for departments and children, the data need to be entered in the application’s own database. The database connections is closed after extended idle time and a login request or other actions need to be done twice in order to establish that connection again; the first request fails.
Chapter 8. Conclusions

8.3 Future work

The prototype needs testing on real users in real environments. A more thorough survey of the workflow of sleep, food, and diaper change would be an asset. Tests need to be performed to ensure that the application can run for months without the need to restart. This implies implementation of a daily cleanup of old data.

Security and robustness need to be addressed: the login procedure, session handling, and database implementation are very basic. They were built to show proof-of-concept. A connection with the Tempus software database needs to be implemented on the server to retrieve department and children data as well as actual attendances and schedules. Some parts of the interface need implementation: the batch modes for diaper change and the department settings are the most evident. In the synchronization protocol, the transmission is only optimized when sending data. When retrieving data, it currently retrieves unchanged data as well.

The next features to implement would be the emotional group, which contains information that the personnel would like from the parents in the morning: if the child has slept bad, if the child had a good breakfast, and if something happened in the family. This could be selected by the parent in the morning when the child is checked in at the preschool.

Another feature to investigate is whether there is a need to indicate poop for non-diaper children. The functionality could then be easily implemented by enabling the diaper cells for all children.

To implement full support for night-time childcare, a remodeling of the time handling is required and should take into account that the night-time childcare opening hours are on different days, passing midnight. It is also important to consider that one shift ends in the morning and the next shift starts in the evening the same day. It should be possible to specify time for meals and similar as hours and minutes without specifying date, it is otherwise cumbersome. The key is to consider the opening hours, and relate time to those.
Chapter 9

Acknowledgments

First of all, I would like to thank Andreas Hedström, CEO at Tempus, for offering the opportunity to conduct the master’s thesis at Tempus. I would also like to thank the Tempus staff for answering questions, testing prototypes, and giving invaluable feedback and thoughts.

A big thanks to Karin Fahlquist, my internal supervisor, for the guidance throughout the work and for the great discussions.

I would also like to thank everybody supporting me in any way throughout the work. This includes, but is not limited to, proofreading text, academical guidance, and technical advice.

And finally, a special thanks to the people I have interviewed.
References


Appendix A

Questionnaires

\textit{italics} Text typeset in \textit{italics} denotes comments or an undisclosed alternative

- A circle denotes an alternative for a single choice question
- A square denotes an alternative for a multiple choice question

A.1 Parents

- Sex. \textit{Filled in without asking}
- What is your main occupation?
- Are you on parental leave?
- How many preschool children do you have?
- What are their age?
- How do you normally transport yourself to and from the preschool? \textit{Alternatives usually not necessary to disclose}
  - By foot/bike
  - By car
  - Public transportation
  - Other ...
- In which area is the preschool? \textit{Filled in without asking if known}
  - Among predominantly apartments
  - Among both apartments and single-family detached houses
  - Among predominantly detached houses
- Is Tempus used at the preschool? \textit{Filled in without asking if known}
- Who normally leaves the child or children at the preschool? \textit{Alternatives not disclosed}
  - (The respondent)
  - Other caretaker in the same household
  - Other caretaker in other household
  - Other relative to the children
  - Other ...
– How is your own availability of time normally when leaving at preschool?
   - Plenty of time
   - Somewhat plenty of time
   - Neither plenty or time nor short on time
   - Somewhat short on time
   - Short on time

– How do you experience your child when leaving at preschool?
   - Cooperating
   - Somewhat cooperating
   - Neither cooperating nor reluctant
   - Somewhat reluctant
   - Reluctant

– Who normally picks up the child or children from the preschool? *Alternatives not disclosed.*
   - (The respondent)
   - Other caretaker in the same household
   - Other caretaker in other household
   - Other relative to the children
   - Other . . .

– How is your own availability of time normally when picking up from preschool?
   - Plenty of time
   - Somewhat plenty of time
   - Neither plenty or time nor short on time
   - Somewhat short on time
   - Short on time

– How do you experience your child when picking up from preschool?
   - Cooperating
   - Somewhat cooperating
   - Neither cooperating nor reluctant
   - Somewhat reluctant
   - Reluctant
To what extent do the following factors influence the information exchange between you and the personnel?

- Your own availability of time
- The personnel’s availability of time
- Your child’s cooperating ability
- Many children being picked up at the same time
- What weekday it is

Alternatives for each question:
- Not at all
- A small extent
- To some extent
- Very great extent

Are there other factors that influence the information exchange?

When you pick up your child, what information do you want from the personnel about your child’s day? Alternatives not disclosed

- What activities the did at the preschool
- What my child has done
- What mood the child was in
- If anything happened to the child
- If the child has slept
- If the child has rested
- If the child has pooped
- If the child has eaten
- What the child has eaten
- If they are out on diapers for my child
- If more spare clothes are needed
- Other . . .

Follow-up question for each answer:

- Where do you get the information? Alternatives not disclosed
  - Personnel
  - Board/whiteboard
  - The child’s shelf
  - Digitally
  - Other . . .

How is Tempus functioning? Only asked if Tempus is used

Is there anything in Tempus you miss regarding the communication between parents and personnel? Only asked if Tempus is used

Other thoughts about the information exchange between you and the personnel?
A.2 Personnel

- Sex. *Filled in without asking*
- Is Tempus used at the preschool? *Filled in without asking if known*
- How many children are there in your department?
- What age are the children in your department?
- What information about their children do parents want? *Alternatives not disclosed*
  - What the child has done
  - If anything happened to the child
  - What mood the child was in
  - What activities the did at the preschool
  - If the child has slept
  - If the child has rested
  - If the child has pooped
  - If the child has eaten
  - If they are out on diapers
  - If more spare clothes are needed
  - Other . . .

*Follow-up question for each answer:*

- How is that information saved? *Alternatives not disclosed*
  - Memorized
  - Whiteboard
  - Digitally
  - The child’s shelf
  - Other . . .

- How do you experience the communication with the parents when they pick up their children?
- What information would you like from the parents in the morning?
- What do you find difficult to talk to the parents about regarding the children?
- What would you like the parents to ask you about regarding the children?
- Does it occur that parents contact you after they have picked up their children, in order to complete information?
  - *If yes:*
    - How often, how, and what information?
- How is Tempus functioning? *Only asked if Tempus is used*
- Is there anything in Tempus you miss regarding the communication between parents and personnel? *Only asked if Tempus is used*
- Other thoughts about the information exchange between parents and personnel?