

Developing a horse nutrition analysis application

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<p>Optimized horse nutrition is in a key role when considering performance. Finnish climate is unfavorable for horses and has lead to feeding concentrated feeds and other supplements which are not ideal for horses. The optimization of nutrition can only be achieved by calculating the intake and comparing it to the official recommendations.</p> <p>The objective of this thesis was to design and implement a web application for horse nutrition analysis using Microsoft Silverlight. The study focused on clarifying the fundamentals of horse nutrition; the core features of Silverlight; the functional requirements for the application; and the design principles and the choices made before and during the implementation phase.</p> <p>The first version of the application was published as a beta-version to the target group. The testers were asked to fill in a survey and the application was developed further using the survey results as requirements.</p> <p>Based on the evaluation of the survey results and the number of daily users, the study concludes that there is clearly a need for this kind of application and also room for further development.</p>	
Keywords Silverlight, horse nutrition, software development	

Terms and Abbreviations

C#	Programming language developed by Microsoft
CLR	Common Language Runtime
MTT	Maa- ja elintarviketalouden tutkimuskeskus
MVVM	Model-View-ViewModel
.NET	Microsoft .NET Framework
UI	User interface
VB.NET	Visual Basic .NET
XAML	Extensible Application Markup Language
XAP	Compressed output file containing Silverlight application
XML	Extensible Markup Language

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1 Introduction

Balanced horse nutrition is an issue in a country like Finland where it's not possible to graze around the year. Horses' digestive tract is adapted to digest feed with high fiber content. A demand to maximize growth and performance has led to feeding grains, concentrated feeds and all sorts of supplements which are not ideal for horses. For example feeding several vitaminized feeds may lead to excessive intake or even poisoning.

It is vital that feeding is planned based on the recommendations. Deficiencies have an effect on performance, digestion, blood circulation, fertility and musculature. Malnutrition on foals is particularly harmful, because it may lead to growth disorders. Growth disorders are impossible to undo later on and they are often realized much later, usually when the training starts.

There were approximately 75 000 horses in Finland in 2011 (Hippos). According to a survey, there is a need for equine nutrition calculators and especially for ones which calculate the need for minerals and vitamins (Paavilainen & Tauren 2009, 23).

The topic was chosen because there is definitely a gap for a free horse nutrition analysis application. There is one application on the market but it has a lot of other features than analysing the intake and most importantly, it's not free.

1.1 Scope

This thesis focuses on designing and implementing a Silverlight web application to calculate the horse's intake of the diet and to analyze the diet based on the recommended nutritional values provided by Maa- ja elintarviketalouden tutkimuskeskus (MTT). The application compares the intake and the recommendations and points out possible deficiencies and excess.

The thesis contains also a kvalitative research conducted as a survey. Survey research is a good way to gather opinions of the target group. Survey questions are planned in a way that the results are measurable.

The application is published to beta testers along with the survey. The survey contains questions of users' previous experiences of horse nutrition calculations, usability issues and features. The application is developed further using the survey results as requirements.

The thesis will not question the recommended nutritional values provided by MTT.

1.2 Plan

The background of the thesis can be split in two areas, horse nutrition and Silverlight as an application framework. The background is discussed more throughly in chapter two. Development chapter focuses on explaining the technical implementation of the application as well as explaining choices made before or during the development process. Survey for beta testers and survey results chapters will explain how and when the survey was conducted and graphically describe the results of the survey.

Improvements made based on the survey results are discussed in the chapter six.

2 Theoretical background

This chapter will focus on describing the background of the development process by introducing the two main concepts of this thesis: horse nutrition and Silverlight as an application framework.

The main source of the horse nutrition chapter is Ruokinnalla Tuloksiin 4 book. It was chosen as the source because it's used in educational institutions in Finland and it contains Finnish nutritional recommendations.

2.1 Horse nutrition

The only way to evaluate the accuracy of horse nutrition is to calculate the intake of energy, protein, vitamins and minerals. (Lillkvist 2007, 246.) Miracles aren't going to happen no matter how perfect the horse's nutrition is but on the other hand, poor nutrition will definitely have major consequences. (Lillkvist 2007, 246.) This chapter focuses on the fundamentals of horse nutrition.

2.1.1 Energy

Energy demand is probably the easiest area in horse nutrition. If the energy intake is on a sufficient level, the horse is in a moderate body condition. Also the quality and form of energy is an issue when considering the energy intake of a racehorse. In addition to muscle work, energy is also used in growth, gestation, milk production and supporting all bodily functions. (Lillkvist 2007, 70.)

Energy is presented in MJ (mega joule) in Finland. Some other countries use different units such as DE (digestible energy) which is used in USA, UK and Germany and NE (net energy) which is used in France. The usage of different units makes it difficult to compare the recommendations. (Lillkvist 2007, 70.)

The amount of energy which is required for sustaining life is mostly based on weight. The heavier the horse, the more it requires energy. Race and disposition also have an

effect in the energy requirements. Calm horses typically have slow metabolism and thus require less energy. Climate and especially cold weather also increase the need of energy. (Lillkvist 2007, 70-71.)

Low muscle work doesn't increase the energy demand that much but as the exercise level rises up to moderate to heavy the need clearly increases. Studies have pointed out that a 500 kg horse uses 3,5 MJ / hours while walking. It's gained from a little less than a kilogram of hay. Slow-paced trot triples the usage and brisk trot increases usage eight to nine times. When it comes to racehorses or horses with heavy exercise routines, the need can be up to 130 MJ. Meeting this need requires 8 kg of hay and 6 kg of concentrated feeds. Feeding this amount of concentrated feeds may lead to issues in degradation of carbohydrates. (Lillkvist 2007, 72.)

Feeding excessive amounts of energy is quite common issue. The consequences are hyperactivity and gaining weight. The need and the intake should always be in balance to avoid harmful consequences. Obesity puts a burden on internal organs, bones and lowers fertility. Obesity is especially dangerous for foals when bone development isn't as fast as gaining weight. Excessive energy leads to excessive amount of carbohydrates. These carbohydrates are stored to organ system, mostly as glycogen to muscles. Glycogen is released to blood circulation as energy source when horse gets exercise. If the energy consumption isn't at the same level with the amount of released glycogen, it will transform into lactate. Lactate is stored in muscles and causes muscular pain and stiffness. In the worst case it may lead to equine exertional rhabdomyolysis, also known as tying up, azoturia or Monday morning disease. (Lillkvist 2007, 77-78.)

Inadequate energy intake leads to weight loss. First consequence of weight loss is performance degradation. Prolonged weight loss will cause disorders in gestation, blood circulation and digestion. Weight loss isn't necessarily caused by too low energy intake but it's more likely caused by low appetite especially during competition season. Low appetite is caused by stress, either physical or mental. It is important to slightly over feed the horse off-season so the weight loss isn't as severe during stressful times. (Lillkvist 2007, 75-76.)

2.1.2 Protein

Proteins have a very essential part in bodily functions. Proteins are needed in the formations of cells and to construct tissue. Excessive proteins are transformed into energy but it also puts a strain on kidneys and can lead to allergic reactions. Protein is constructed of amino acids and there are 20-30 different amino acids. The most important amino acid is lysine. Lysine is needed in the formation of protein. Horse's digestion can't use all protein, only the digestible protein, which defines the quality of the protein. (Lillkvist 2007, 22-25.)

2.1.3 Minerals

Minerals have a significant impact on several bodily functions. Minerals are used in bone structure, blood cells, muscle contraction, nerve cells and maintaining acid-base balance. Minerals can be divided in two main categories, micro minerals and macro minerals. Micro minerals are typically presented in milligrams (mg) whereas macro minerals are typically presented in grams (g). (Lillkvist 2007, 114.)

Macro minerals contain seven different minerals which are calcium (Ca), chloride (Cl), magnesium (Mg), phosphorus (P), sodium (Na), sulfur (S) and potassium (K). (Lillkvist 2007, 114.)

Micro minerals contain cobalt (Co), copper (Cu), iron (Fe), manganese (Mg), selenium (Se) and zinc (Zn). (Lillkvist 2007, 126.)

Minerals are rather difficult part in the nutrition. It's not only a matter of volume, but also the rations in comparison to each other and most of the minerals have an effect in the absorption of other minerals. Excessive amount of one mineral can lead to serious health issues, since it can affect other minerals as well. Some of the minerals are also very poisonous when they are overfed. Most poisonous minerals are selenium, cobalt and copper. (Lillkvist 2007, 140.)

The most common flaw in horse's mineral intake is excessive amount of phosphorus which leads to loss in calcium concentration in bones. The amount of phosphorus and the correlation between phosphorus and calcium are typically correct in hay. The imbalance is caused by concentrated feeds. (Lillkvist 2007, 140.)

2.1.4 Vitamins

Vitamins are essential for metabolism. Even though horses have the ability to produce some vitamins themselves, still most of the vitamins need to be obtained from feeds. Too low amounts of vitamins will lead to deficiencies and too high amounts of vitamins will lead to disorders. Deficiencies are mainly caused by three reasons. First reason is clearly too low amount of vitamins. Secondly, stress or illness may affect absorption of vitamins. Also diseases can rapidly increase the need of vitamins. (Lillkvist 2007, 90.)

Vitamins are effective in small amount and thus the required amounts are reported in milligrams. For some vitamins the unit is IU (international unit). (Lillkvist 2007, 90.)

Vitamins are divided into two categories based on solubility: fat soluble vitamins and water soluble vitamins. The main difference between these two categories is that fat soluble vitamins can be stored into body fat for two to three months. This means that it's not necessary to feed these vitamins on a daily basis. Fat soluble vitamins are A-, D-, E- and K-vitamins. Water soluble vitamins are B1-, B2-, B3-, B6-, B12- and C-vitamins. Water soluble vitamins are produced in colon, so there the need of the vitamins is rather easy to fulfill. (Lillkvist 2007, 90.)

The recommended values of vitamins differ a lot from country to country. The recommended values should always be used as a guideline and not as a strict rule. It's also important to remember that the soil and climate affect the requirements. Regardless of the country, the need for vitamins is clearly increased in special situations. Thus for example racehorses, broodmares and foals have higher requirements for vitamins than backyard horses. (Lillkvist 2007, 91.)

2.1.5 Nutritional recommendations

The nutritional recommendations used in the application are published by MTT (attachment 1). As MTT hasn't published recommendations for all nutrients, the recommendations for salt (Na), lysine, B1-, B2-, B6-, B12-vitamins are from Ruokinnalla Tuloksiin 4 –book.

For salt the recommended values vary from 25 g to 50 g (Lillkvist 2007, 121). For lysine the recommendation is 35 (Lillkvist 2007, 23). For B1-vitamin and B2-vitamin the recommendation is between 20 mg and 70 mg (Lillkvist 2007, 106-107). For B6-vitamin the recommendation is between 20 mg and 60 mg (Lillkvist 2007, 108). For B12-vitamin the recommendation is 0.3 mg (Lillkvist 2007, 109).

2.2 Silverlight application framework

Silverlight was chosen as the technology due to its familiarity to the author. The time resources for the thesis process are limited and thus it felt like a natural choice.

Silverlight is a cross-browser, cross-platform technology and an implementation of .NET Framework. Silverlight application platform is used to create rich internet applications, desktop applications and Windows phone applications. Silverlight uses XAML to create user interfaces and code (C#, VB.NET, JavaScript) for application logic. To be able to run Silverlight applications, a plugin is required. The plugin is free and if it's not installed, user will be automatically prompted to install it. Silverlight runs on Microsoft Internet Explorer, Mozilla Firefox, Apple Safari and Google Chrome browsers. Supported operating systems are Microsoft Windows and Apple Mac OS X. (Microsoft a.)

2.2.1 XAML

XAML is a declarative language which enables creation and initialization of .NET objects in XML. Everything that can be done XAML, can also be done in code.

XAML enables separation of presentation layer and code. All XAML elements map to a .NET type. (Brown 2010, 22.)

```
<Border Grid.Row="0" Grid.ColumnSpan="2" Background="{StaticResource HeaderBackgroundBrush}">
  <StackPanel Orientation="Horizontal" Margin="30,10,30,10" VerticalAlignment="Stretch">
    <Image Source=" ../Images/oatlogo.png" HorizontalAlignment="Center" Height="60" Width="60"/>
    <TextBlock Text="Equus Acana"
      VerticalAlignment="Center"
      FontSize="24" FontWeight="Light" Foreground="White" Margin="20,0,0,0"/>
  </StackPanel>
</Border>
```

Figure 1. Sample XAML code.

2.2.2 Styling controls

A control template is used to specify the visual structure and behaviour of a control. All controls have a basic control template which can be overridden by creating a new control template for a specific control. When a control template is overridden, the control still has the same functionality as before. (Microsoft b.)

Control templates can be created with or without a key. If they are created with a key, they need to be used with that key. If they are created without the key, the style will be applied to all controls of that type. For example a style in which target type is button and which is created without a key will be applied to all buttons in the application. A style was implemented for all buttons in the application (attachment 2).

2.2.3 Data binding

Data binding is a way to connect UI and the actual source of data. Binding supports MVVM pattern since it can be used to separate UI and model. Binding consists of three parts, the source of the data, the binding mode and the target for data. (Brown 2010, 262.)



Figure 2. Binding structure.

(Brown 2010, 262.)

Binding can be set up either at design time or at runtime. In runtime, the binding happens in code behind. It's typically used in event driven applications. In design time, the binding is declared in XAML. (Brown 2010, 262-264.)

```

DateTime currentTime = DateTime.Now;
Binding binding = new Binding("TimeOfDay");
binding.Source = currentTime;
binding.Mode = BindingMode.OneWay;
SampleBindingTb.SetBinding(TextBlock.TextProperty, binding);
  
```

Figure 3. Binding at runtime.

```

<controls:Label Margin="10,0,0,0" Content="{Binding Path=KalkkiFosforiSuhde, Source={StaticResource ViewModel}}"/>
  
```

Figure 4. Binding at design time.

CLR properties don't notify their changes automatically. To be able to notify the target of the property change, a change-notification-handler needs to be created. It handles notifying the target that a change in the source has been made. Target will respond to updates and update accordingly. This can be achieved by implementing the INotifyPropertyChanged interface (attachment 3). (Brown 2010, 267.)

2.2.4 Commanding

Silverlight uses WPF-style commanding. By using commands it's possible to get rid of the code-behind event handler. This is essential while using MVVM pattern, when code-behind should be as clean and neat as possible. Commands make it possible to truly separate the view and the model. (Brown 2010, 32-33.)

```
<Button Margin="10,0"
        Content="Laske analyysi"
        Command="{Binding Path=AnalyseCommand, Source={StaticResource ViewModel}}"/>
```

Figure 5. Command in Button's XAML declaration.

Commands also include a CanExecute method which evaluates with a set of rules if the command can run and then notifies the button accordingly. Commands can be used with all controls inheriting from ButtonBase and with Hyperlink. (Brown 2010, 32-33.)

```
public bool CanExecute(object parameter)
{
    return !string.IsNullOrEmpty(ViewModel.ValittuTyppi) &&
        ViewModel.HeinaMaara > 0;
}
```

Figure 6. CanExecute –method disabling and enabling the button.

2.2.5 Value Converters

In Silverlight it's possible to dynamically convert values while data binding. It can be accomplished by creating a value converter. That is, a custom class implementing IValueConverter. Value converter can be referenced from XAML. A Boolean to visibility -value converter was used in the application (attachment 4). (Brown 2010, 277.)

```
<controls:Label Grid.Row="3" Grid.Column="4" Content="Varsan arvioitu aikuispaino"
                Visibility="{Binding Path=VarsaTyppi, Source={StaticResource ViewModel},
                Converter={StaticResource BooleanToVisibilityConverter}}"/>
```

Figure 7. Value converter used in visibility property.

2.2.6 Model-View-ViewModel

Model-View-ViewModel (MVVM) is the most common design pattern in Silverlight application development. It's a Silverlight / WPF specialization of Presentation Model pattern. MVVM divides the application into three parts: Model, View and ViewModel. In MVVM the view uses binding and commands to communicate with the ViewModel. (Brown 2010, 426-427.)

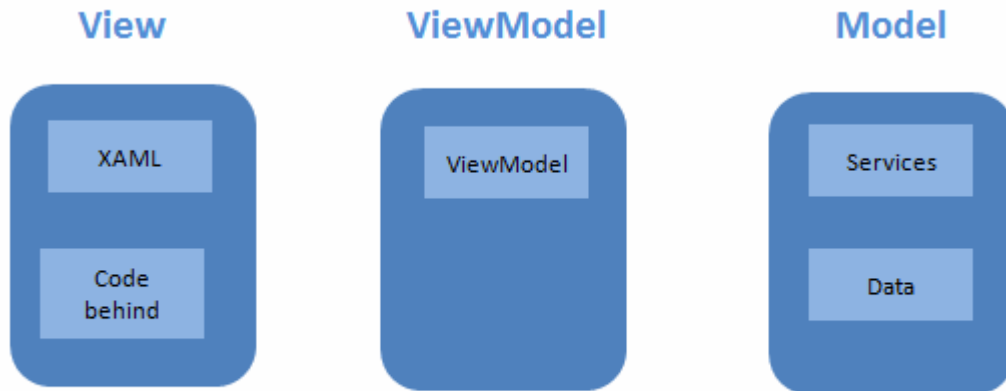


Figure 8. Model-View-ViewModel structure.

(Brown 2010, 427.)

The Model is a model of the application. It contains entities and services. The View is the XAML-file and its code behind. The View is only used to present data and to interact with the user. The ViewModel is an interface between the View and the Model. Bindings are used to access data from the View and commands are used to call methods from the View. The ViewModel knows nothing about the contents of the View.

(Brown 2010, 427.)

```

1 <UserControl x:Class="EquusAcana.MainPage"
2   xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
3   xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
4   xmlns:d="http://schemas.microsoft.com/expression/blend/2008"
5   xmlns:mc="http://schemas.openxmlformats.org/markup-compatibility/2006"
6   xmlns:sdk="clr-namespace:Microsoft.Internal.Pivot.Controls;assembly=System.Windows.Controls.Pivot"
7   xmlns:controls="clr-namespace:System.Windows.Controls;assembly=System.Windows.Controls.Data.Input"
8   xmlns:toolkit="clr-namespace:System.Windows.Controls;assembly=System.Windows.Controls.Toolkit"
9   xmlns:data="clr-namespace:System.Windows.Controls;assembly=System.Windows.Controls.Data"
10  xmlns:vm="clr-namespace:EquusAcana"
11  xmlns:converters="clr-namespace:EquusAcana.Converters"
12  mc:Ignorable="d">
13
14  <UserControl.Resources>
15    <ResourceDictionary>
16      <ResourceDictionary.MergedDictionaries>
17        <ResourceDictionary Source="Styles.xaml"/>
18      </ResourceDictionary.MergedDictionaries>
19    </ResourceDictionary>
20    <vm:MainViewModel x:Key="ViewModel"/>
21    <converters:BooleanToVisibilityConverter x:Key="BooleanToVisibilityConverter"/>
22  </UserControl.Resources>

```

Figure 9. ViewModel locator in XAML.

2.2.7 .xap file

When building a Silverlight application, the application is packaged into a .xap file. .xap file is actually a .zip file and it can be renamed to .zip and extracted like any other .zip file. (Brown 2010, 50.)

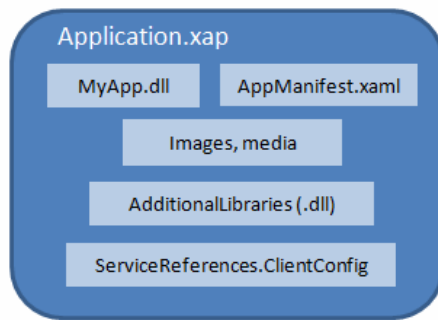


Figure 10. .xap file contents.

(Brown 2010, 50.)

3 Requirements and Design

The focus of this chapter is to introduce the requirements of the application and user interface design principles.

3.1 Requirements in short

The requirements for the application are summarized as user stories as follows:

1. As a user I want to be able to choose a type of the horse
2. As a user I want to choose the exercise level / sub type of the horse
3. As a user I want to add information of hay
4. As a user I want to choose feeds from a list of widely used feeds
5. As a user I want to view selected feeds and amount
6. As a user I want to remove a feed from the list of selected feeds
7. As a user I want to add a non-existing feed by entering values
8. As a user I want to calculate the daily intake based on hay and feeds
9. As a user I want to compare the daily intake to recommendations

3.2 Use cases

Due to the simplicity of the nutrition calculator, the use cases are very simple and self-explanatory:

Use Case: Choosing the type of the horse User stories: 1 & 2	
Actor:	User
Preconditions:	Application is available.
Goal:	The type of horse is defined.
Actions	User chooses the type of the horse.
	User chooses the exercise level or a sub

	type of the horse.
	User chooses the weight of the horse.

Use Case: Entering data from hay analysis	
User story: 3	
Actor:	User
Preconditions:	Application is available.
Goal:	The information of the hay is entered.
Actions	User enters values: ME, digestible protein, dry matter, crude protein, sugar, calcium, phosphorus, magnesium, sodium, copper, zinc and iron.
	User enters the amount of the hay given to the horse daily.

Use Case: Choosing a feed from the list	
User story: 4	
Actor:	User
Preconditions:	Application is available.
Goal:	A feed is chosen and presented in the list of chosen feeds.
Actions	User selects a feed from the list.
	User enters the amount given to the horse daily.
	User presses the Add feed –button.

Use Case: Removing a feed from selected feeds	
User story: 6	
Actor:	User
Preconditions:	Application is available.
Goal:	A feed is removed from the list of feeds.

Actions	User selects a feed from the selected feeds list.
	User presses the “Remove feed” -button.

Use Case: Adding a new feed	
User story: 7	
Actor:	User
Preconditions:	Application is available and user has the values for adding a new feed.
Goal:	A new feed is added to the list of chosen feeds.
Actions	User enters values: MJ, digestible protein, calcium, phosphorus, magnesium, sodium, sugar, lysine, A- vitamin, D- vitamin, E-vitamin, B1- vitamin, B2- vitamin, B6- vitamin, B12-vitamin, C-vitamin, zinc, copper, iron, weight of one liter of feed and amount given to the horse daily.
	User presses the “Add new feed” -button.

Use Case: Calculating intake compared to recommendations	
User story: 8 & 9	
Actor:	User
Preconditions:	Application is available and user has entered the hay.
Goal:	A calculation is made based on the hay and chosen feeds. A result grid is shown with list of feeds, daily intake, recommendation and difference between recommendation and intake.
Actions	User presses the “Calculate”-button.

3.3 Architectural design

The application was implemented using the MVVM pattern. MVVM pattern was chosen because it supports binding and commanding. The implementation of a pattern might take a bit longer while creating the application but it's a lot easier to maintain. In example it would be possible for another person to re-design the UI from scratch without touching the logic. Having a separate ViewModel also makes it possible to do unit tests.

3.4 User interface design

The main principle in the user interface (UI) design was to make it as simplistic as possible. According to usability rules, web sites should be self-evident, obvious and self-explanatory. The user should be able to use it without spending any time thinking how it should be used. (Krug 2006, 11.)

The design was made by using online mock-up tool Mockup Builder (www.mockupbuilder.com) (attachment 5). Mockup Builder tool makes it possible to drag and drop various UI elements to different positions and to find out the best layout. It's a lot faster to use a tool like this than to write the actual XAML-code.

3.5 Data model

Only one class is required in the application. The same class is used for hay, feeds, summed intake, recommendation and difference between intake and recommendation.

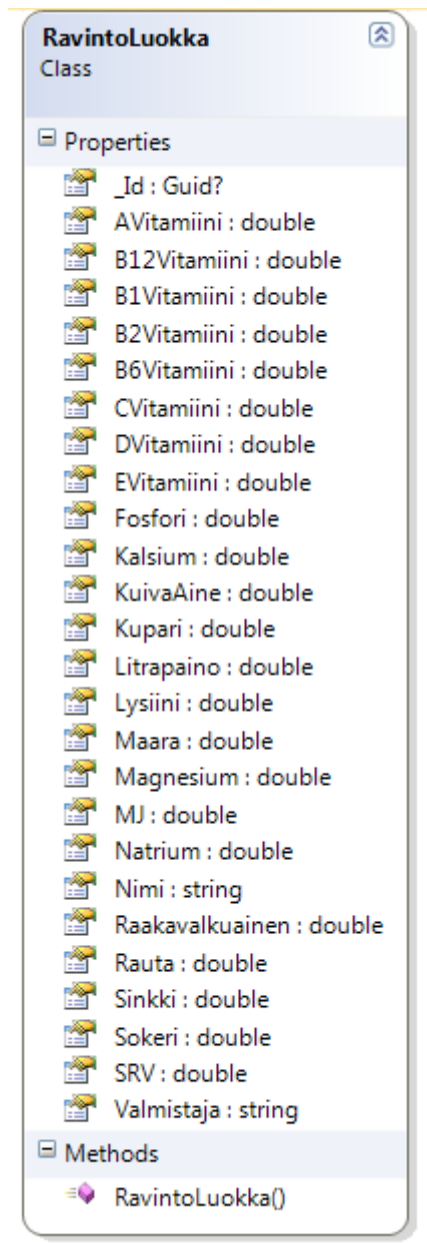


Figure 11. Class diagram.

3.6 Feed products chosen for the application

The most important criteria when choosing the feed suppliers and feeds to the application was whether the supplier has published adequate information of their feeds. Two biggest Finnish feed suppliers, Biofarm & Suomen Rehu, have published very thorough lists of feed contents on their web site and thus they were chosen. Other suppliers with sufficient amount of information of their feeds were Krafft and Marstall. Oat was chosen based on the average information of oat published by MTT.

A lot of big feed suppliers were left out due the lack of information they provide on their web sites. Some suppliers don't have information available on their web site but they have printed it on the packages of the feeds.

4 Application overview

This chapter describes the choices made during the implementation as well as presents the features of the application.

4.1 Implementation and description of the application

The application is a Silverlight 5 application using XML file as a data source (attachment 6). Development was done using Visual Studio 2010 and Silverlight 5 Tools for Visual Studio.

XML file was chosen as the data source because only reading of data is required in the application. The XML-file is read using XDocument (attachment 7). The feeds are ordered in ascending order based on the supplier and name using Linq. An extension method was used to convert the IOrderedEnumerable to ObservableCollection (attachment 8). ObservableCollection was needed to implement the INotifyPropertyChanged.

4.1.1 Choosing type of horse

Recommendations vary based on the type, exercise level and weight of the horse. There are three types of horse types: sport horse, foal and broodmare. For sport horses there are four exercise levels: backyard horse, light exercise, medium exercise and heavy exercise. For broodmares there are two types: with young and nursing mare (1st to 3rd month). For foals there are three types: weanling (6-12 months), 1-3 years in training and 1-3 years not in training. There are three weights: 450 kg, 550 kg and 600 kg. For foals the weight is the predicted adult weight.

The recommendations used in the analysis are chosen based on the information provided of the horse.

Tiedot

Hevosien tiedot

Hevosien tyyppi: Urheiluhevonen

Painoluokka: 450, 550, 600

Levossa
 Kevyt työ
 Kohtalainen työ
 Raskas työ

Figure 12. Choosing the type, exercise level and weight of the horse.

4.1.2 Entering hay information

The application can be used only with an analysis of hay. That is because the levels of ingredients vary based on the time of harvest and soil. After improvements were made based on the survey, there is a possibility to add two different hays. The contents of the hay are calculated based on dry matter.

Values given by the user are validated and if they are not numeric values the field will be set to zero. Negative numbers will also set the value to zero.

Heinä

ME (MJ / kg ka) 9 Magnesium (g / kg ka) 2 kg ka = kg kuiva-ainetta

SRV (g / kg ka) 35 Natrium (g / kg ka) 4

Kuiva-aine (g / kg) 650 Kupari (mg / kg ka) 0

Raakavalkuainen (g / kg ka) 110 Sinkki (mg / kg ka) 0

Sokeri (g / kg ka) 135 Rauta (mg / kg ka) 0

Kalsium (g / kg ka) 4

Fosfori (g / kg ka) 2

Määrä (kg) 10

ME (MJ / kg ka) 0 Magnesium (g / kg ka) 0

SRV (g / kg ka) 0 Natrium (g / kg ka) 0

Kuiva-aine (g / kg) 0 Kupari (mg / kg ka) 0

Raakavalkuainen (g / kg ka) 0 Sinkki (mg / kg ka) 0

Sokeri (g / kg ka) 0 Rauta (mg / kg ka) 0

Kalsium (g / kg ka) 0

Fosfori (g / kg ka) 0

Määrä (kg) 0

Figure 13. Adding hay.

4.1.3 Choosing feeds

The feeds can be selected from the list of feeds or the user can add a new, non-existing one. To be able to add a new feed, the user must have the detailed list of ingredients of the feed. If the user doesn't provide a supplier or a name, the name will be set to "Own feed". The same feed can't be added to the list twice. Added feeds can be removed from the list.

Väkirehut

Krafft Pluss Energi
Krafft Pluss Protein
Krafft Rider
Marstall Champion
Marstall Cornmysli
Marstall Freizeit
Marstall Haferfrei
Marstall Isi-Robustmysli
Marstall Senior Plus
Marstall Sinfonie
Marstall Western
Racing Action Vimin
Racing A-D-E Vimin
Racing BE Vimin
Racing Builder Mix
Racing C-100 Vimin
Racing Cool Mix
Racing Greenline

Määrä (litraa) 0

Lisää rehu

Valitut rehut (kg)

Black Horse Sportpower 0,70 kg
Kaura keskiarvo (450g-540g/litra MTT) 0,50 kg
Black Horse Kivennäinen 0,06 kg
Marstall Haferfrei 0,53 kg

Poista rehu

Figure 14. Adding a feed from existing feeds / removing a feed from the list.

Lisää väkirehu

Valmistaja: Nimi:

MJ / kg A-vitamiini (ky/kg) Sinkki (mg/kg)

Sulava raakavalkuainen (%) D-vitamiini (ky/kg) Kupari (mg/kg)

Kalsium (%) E-vitamiini (mg/kg) Rauta (mg/kg)

Fosfori (%) B1-vitamiini (mg/kg) Litrapaino (g)

Magnesium (%) B2-vitamiini (mg/kg)

Natrium (%) B6-vitamiini (mg/kg)

Sokeri (%) B12-vitamiini (mg/kg)

Lysiini (%) C-vitamiini (mg/kg)

Määrä (litraa) Lisää väkirehu

Figure 15. Adding a non-existing feed.

4.1.4 Creating the analysis

The recommendations used in the analysis are described in chapter 2.1.5.

The analysis can be calculated when the user has changed the value of amount of hay greater than zero. The user doesn't have to add any feeds, because feeds are not always used in nutrition.

The results of analysis present the ratio of phosphorus and calcium, the recommendation for that ration, dry matter percentage of horse's weight and the recommendation for that percentage.

The results were originally in one grid but after the improvements based on survey were made the results were divided into two grids. The first grid presents energy, protein, sugar and minerals and the second grid presents vitamins. The summed intake has a different row color, blue. The recommendations also has a different row color, green. The last row calculates the difference between the intake and the recommendations.

There is also a possibility to print the results. The print includes only the results. The user is guided to choose landscape printing, because it's not possible to force it. Scaling the results to fit on a portrait page made it very difficult to read the print.

Tulokset

Kalsium/fosfori -suhde 1,9 / 1
 Normi 1,4-2 / 1
 Kuiva-aine % painosta 1,3%
 Normi 1.5%-2.5%

Rehu	Määrä (kg)	ME	SRV g	Sokeri g	Lysiini	Kalsium g	Fosfori g	Magnesium g	Natrium g	Rauta mg	Kupari mg	Sinkki mg
Heinä	10,0	63,0	245,0	910,0	37,0	28,0	14,0	0,00	0,00	0,00	0,00	0,00
Black Horse Sportpower	0,7	9,1	63,7	0,0	3,5	5,4	3,1	2,10	2,80	108,50	18,90	81,90
Kaura keskiarvo (450g-540g/litra MTT)	0,5	5,8	47,0	9,0	2,7	0,4	2,0	0,65	0,10	26,00	2,00	20,50
Black Horse Kivennäinen	0,1	0,7	1,8	0,0	0,2	4,7	1,1	0,55	0,77	41,25	11,00	48,13
Marshall Haferfrei	0,5	6,6	37,8	0,0	1,7	3,2	1,6	1,00	1,68	67,73	15,75	110,25
Yhteensä	0,0	85,1	395,3	919,0	45,2	41,6	21,8	4,30	5,35	243,48	47,65	260,78
Suositus	0,0	70,2	400,0	0,0	35,0	22,0	16,0	8,00	25,00	500,00	60,00	500,00
Ero suositusarvoihin	0,0	14,9	-4,7	0,0	10,2	19,6	5,8	-3,70	-19,65	-256,53	-12,35	-239,23

Vitamiinit

Rehu	A ky	D ky	E mg	B1 mg	B2 mg	B6 mg	B12 mg
Heinä	21 000,0	3 500,0	280,0	14,0	70,0	35,0	0,0
Black Horse Sportpower	5 600,0	1 120,0	161,0	10,5	4,9	2,8	0,0
Kaura keskiarvo (450g-540g/litra MTT)	0,0	0,0	12,0	3,0	1,0	1,0	0,0
Black Horse Kivennäinen	3 410,0	550,0	220,0	8,8	2,2	1,1	0,0
Marshall Haferfrei	9 712,5	425,3	183,8	9,7	2,3	7,0	0,0
Yhteensä	39 722,5	5 595,3	856,8	46,0	80,4	46,9	0,0
Suositus	40 000,0	4 000,0	450,0	40,0	50,0	20,0	0,3
Ero suositusarvoihin	-277,5	1 595,3	406,8	6,0	30,4	26,9	-0,3

Suosituksissa käytetty maksimiarvoja

Tulosta
Valitse tulostuksessa vaakatulostus

Figure 16. Results of analysis.

4.2 Testing

All functions were tested using black box testing. All the features were tested immediately as they were finished. Before the application was published to beta testers, the application was tested against the existing nutritional calculator, Hopti (www.hevostietokeskus.fi). The beta version of the application was tested by two persons and they were given a test case:

The type of horse: Sporthorse
The exercise level: Medium
Weight: 550 kg

Hay analysis:
ME 9,4 MJ/kg ka
SRV 79 g/kg ka
Kuiva-aine 800 g/kg
Raakavalkuainen 120 g/kg ka
Sokeri 110 g/kg ka
Kalsium 3 g/kg ka
Fosfori 2 g/kg ka
Magnesium 1,2 g/kg ka
Natrium 0,2 g/kg ka
Kupari 5 mg/kg ka
Sinkki 30 mg/kg ka
Rauta 150 mg/kg ka

Other feeds:
2 l Racing Progress
1 l oats (450 g /l)
1 dl Black Horse kivennäinen

Figure 17. Test case given to two beta testers.

The testers gave feedback orally. Some bugs were reported by beta testers as they tested the application. The bugs weren't reported through the survey, and thus they are not documented. All bugs were immediately fixed as they were found and a new version of the application was deployed.

There are precautionary measures to handle unexpected user behaviour and input. The measures are the following:

Case	Handled	Pass
User enters non-numeric values.	Values are checked and set to 0 if value is non-numeric.	Yes
User enters negative values.	Values are checked and set to 0 if value is negative.	Yes
User doesn't choose the type of the horse.	The type of the horse is preselected as well as the exercise level and weight. If the user	Yes

	changes the type, the subtypes are also preselected.	
User doesn't enter amount of hay.	The Calculate-button is disabled.	Yes
User enters a new feed and leaves the supplier and name empty.	The feed will be given a name "Own feed".	Yes
User doesn't enter values of calcium and phosphorus of hay.	The calcium phosphorus ratio is presented as NaN/1.	Yes
User selects a feed from the list and sets the amount to 0.	The feed is not added to the list of selected feeds.	Yes
User selects a feed from the list which is already in the selected feeds lists and adds it.	The feed is not added to the list of selected feeds.	Yes

4.3 Deployment of the application

Web servers are typically configured to know only a limited set of file extensions. Silverlight uses two file extensions, which web servers typically aren't familiar with. These are .xaml for XAML files and .xap for the packaging format. MIME types for these extensions need to be added in order to the server to recognize the file types. IIS7, which is included in Windows Server 2008, is configured so that it recognizes both .xaml and .xap files. (Sneath 2008.)

Due to the little experience in configuring servers, Windows Server 2008 was chosen as a server to host the application. Deployment process itself is very simple, the .xap – file was just moved to the web server. As the data source of feeds is a XML-file, the file was placed on the same level with the .xap file.

5 Survey for beta testers

The purpose of the survey was to evaluate the user experience of nutrition calculator usage. The results of the survey were used as requirements while developing the application further. The questions were formed in way that the results would be measurable and also to give enough space for ideas (attachment 9).

The survey was open for ten days, 31.10.-9.11.2012.

Creation of the survey as well as collecting data were done using online survey tool Survey Monkey (www.surveymonkey.com). The link for the nutrition calculator was given out with the link to the survey.

The beta testers for the nutrition calculator were found through social network and the most popular equine discussion forum, Hevostalli.net. Hevostalli.net has over 96 000 unique users per week (Oindex). As the thesis was conducted without a sponsor, Hevostalli.net was chosen as a way to find testers because it reaches a lot of people with quite small effort. There were no limitations in choosing the beta testers since the nutrition calculator is designed for everyone interested in horse nutrition.

6 Beta application survey results

Only a small percentage of people using the calculator answered to the survey. During the test period 20 respondents answered the survey. The website was accessed 368 times, which means 5,4 % answered the survey. The questions weren't obligatory but the respondents answered all the questions.

The results have been described using graphs and descriptions.

6.1 Silverlight

55 % of the respondents didn't have Silverlight installed on their computer when they tested the application. The question had a comment "if you didn't get prompted to install Silverlight, you had it installed" to make it easy for the respondents to know if they had it installed or not.

6.2 Previous experience of nutrition calculations

A small majority of respondents had done a nutritional calculation for their horse.

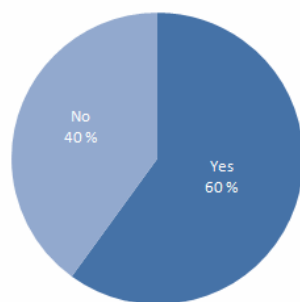


Figure 18. Testers' previous experience of nutritional calculations.

Out of those who said yes, most of the respondents had used Hopti, a nutritional analysis tool developed by Hevostietokeskus. The difference between those who had used Hopti and done it by themselves wasn't that essential.

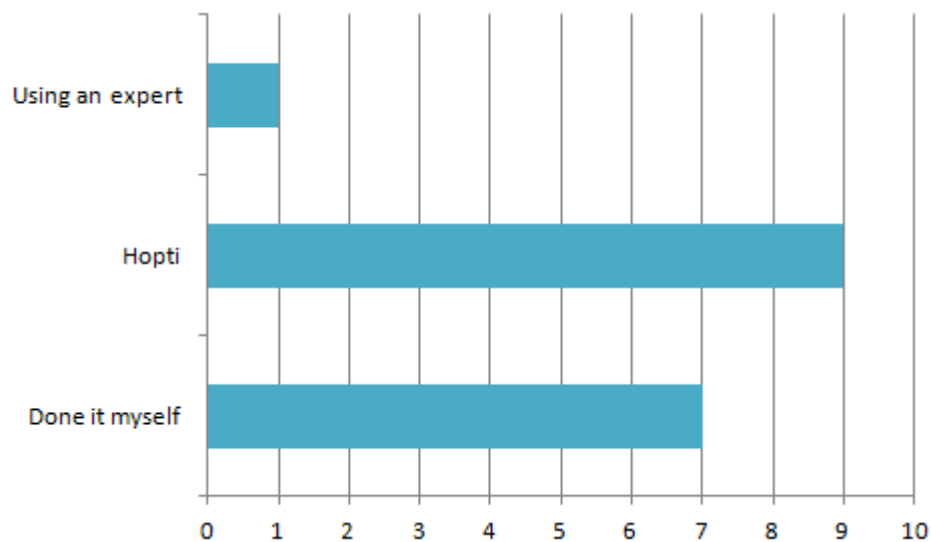


Figure 19. Usage of nutritional calculators.

6.3 Reliability

75 % respondents felt that the nutritional calculator was reliable. 15 % thought it wasn't. Due to the small amount of respondents, 15 % only means three people. The reasons of not relying on the results of the calculator weren't specified.

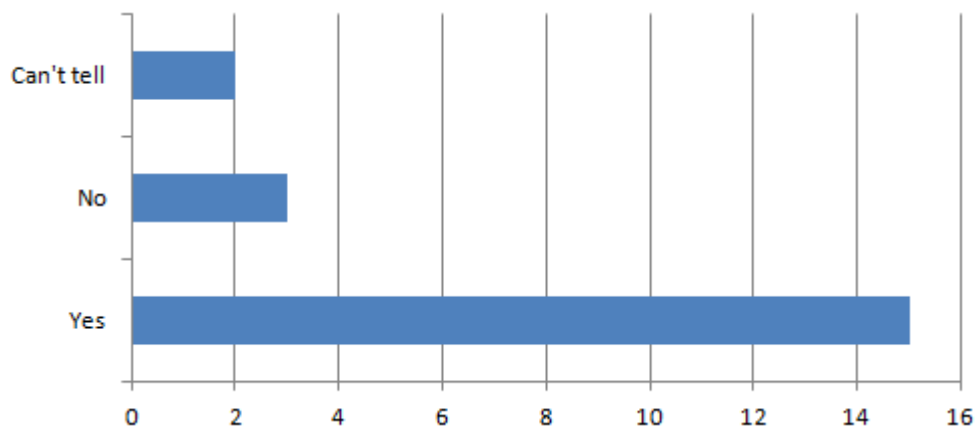


Figure 20. Reliability of nutritional calculator.

Since 15 % of respondents didn't consider calculator as reliable, it is obvious that they wouldn't recommend it to others. 80 % would recommend the calculator to others. 5 % weren't able to tell. The answers regarding recommending the calculator to others are very similar as in the previous question.

The same pattern continues in the following questions, as 80 % of the respondents would use the calculator again, 10 % wouldn't and 10 % weren't able to tell.

80 % of the respondents were familiar with the terms used in the calculator, 20 % weren't.

6.4 Usability of the beta application

In questions regarding usability the respondents were asked to evaluate the question in the range of 1-5 (1 being weak and 5 being excellent). The general UI design got an average of 3,85.

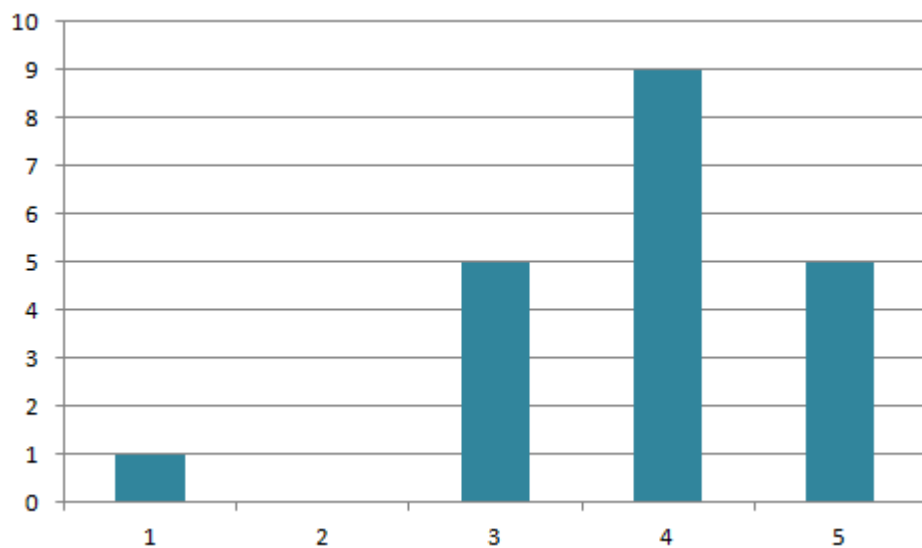


Figure 21. Evaluation of user interface.

In ease of use, the average was 3,4.

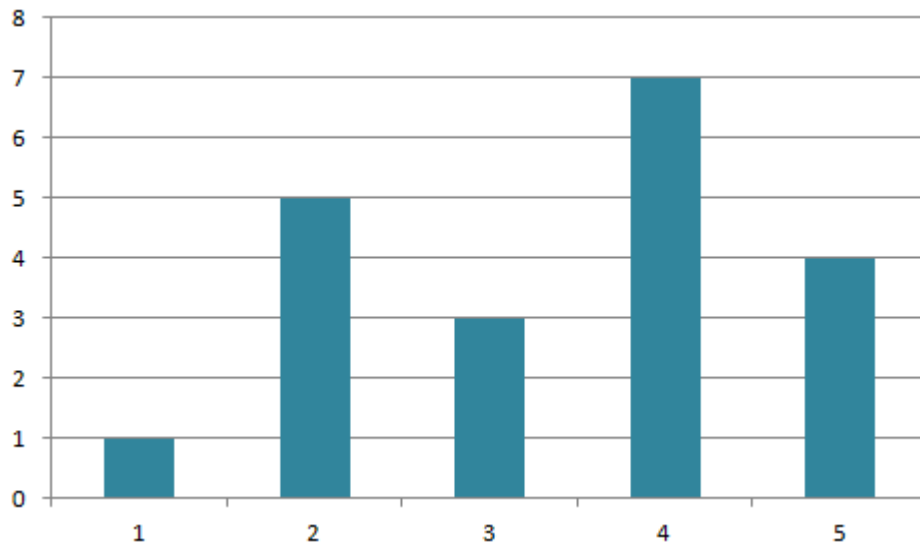


Figure 22. Ease of use.

Average for ease of adding a new feed was 3,25.

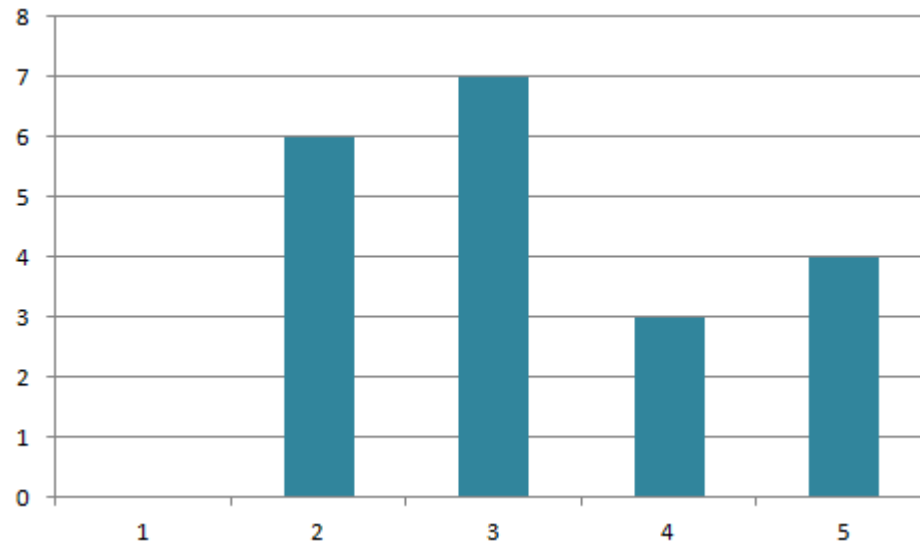


Figure 23. Ease of adding a non-existing feed.

Ease of reading the result of the analysis got an average grade of 3,4.

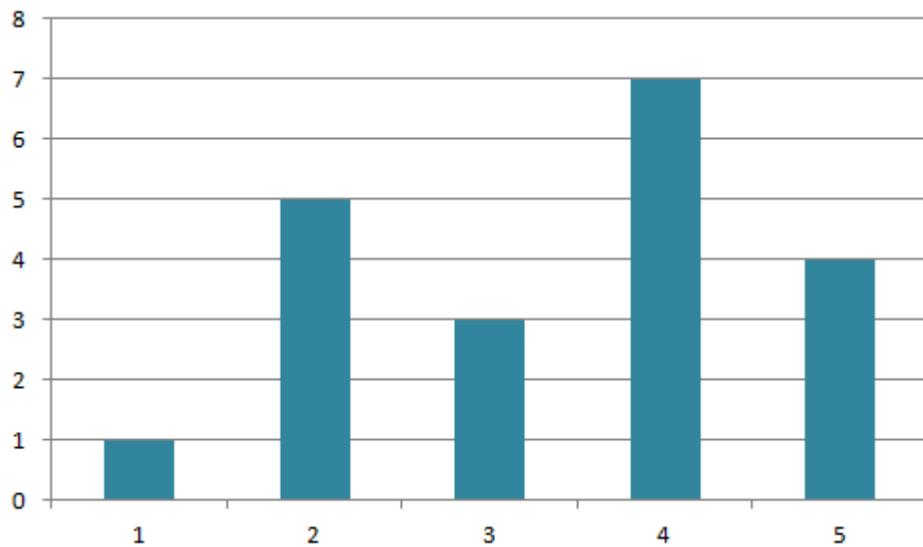


Figure 24. Ease of reading the analysis result.

6.5 Feeds in nutritional calculator

40 % of respondents were able to find all the feeds they are using in their horse's nutrition. 55 % were able to find some and 5 % weren't able to find any.

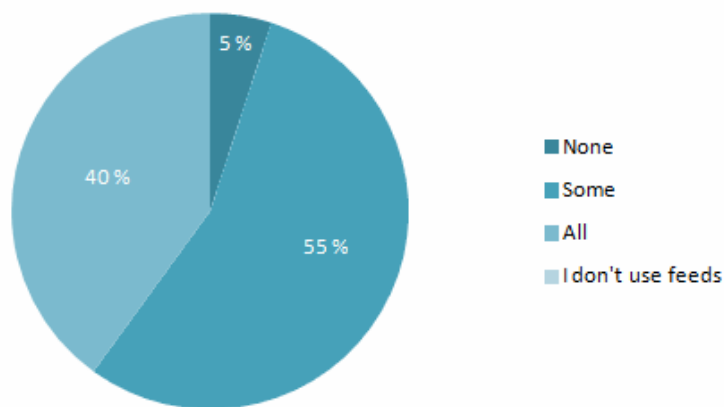


Figure 25. Feeds in calculator.

There was also an open question where respondents were able to name the suppliers whose feeds should be included in the list of feeds. Five respondents gave an answer to this. Suppliers were different oats (1), Dynavena (1), Foran Equine Products (1), Havens (1) and Krafft (2).

6.6 Open questions

There was one open question in the survey regarding missing / additional features to the calculator. The last question was also an open question, where the respondents were asked to give feedback on anything they could think of. The answers from these two questions are combined to a list as follows:

- Larger scale for weight (starting from 250 kg)
- Potassium is missing from analysis
- Calcium, salt and wheat bran missing from feeds
- Should be possible to choose “average hay” without analysis
- Printing
- Carrots and soy grain missing from feeds
- Choosing type of hay
- Instructions how to use
- Sources should be visible in the application
- Possibility to add more than one type of hay
- Results are impossible to read
- There should be instructions to balance the nutrition
- Silverlight is not suitable for this kind of application
- Horse’s age and physical condition should be included
- “Add feed button” needed to be pressed twice
- When adding a new feed, some of the units are in % and some in mg, it’s confusing
- Result grid shouldn’t be scrollable
- Results should be able to save in PDF-form
- There should be some information available of the application (background, purpose)

7 Improvements based on survey

Due to the restriction of time, not all suggested improvements were implemented. Below is a table describing feature, whether it was implemented or not and reason for not implementing it. The features related to “missing feeds” are not described here, but discussed later.

Feature	Implemented / fixed	Reason
Larger scale for weight (starting from 250 kg)	No	Official recommendations exist only for horses from 450 kg to 600 kg.
Potassium is missing from analysis	No	There aren't recommendations for Potassium.
Should be possible to choose “average hay” without analysis	No	Analysis will not be reliable without hay analysis, because the deviation in hays depending on the soil and time of harvest.
Printing	Yes	
Choosing type of hay	No	Type of hay doesn't have any effect on the analysis.
Instructions how to use	Partly	An introduction was added to the application, but no detailed instructions were implemented.
Sources should be visible in the application	Partly	A description of application and the background was added and it states clearly that recommendations are provided by MTT.
Possibility to add more than one type of hay	Yes	
Results are impossible to read	Yes	
There should be instructions to balance the nutrition	No	The author has no qualification of doing so.

Silverlight is not suitable for this kind of application	No	This is discussed thoroughly in chapter “Further Development”.
Horse’s age and physical condition should be included	No	Age and physical condition have effect on the diet of the horse, but there are no recommendations which would take these factors into account.
“Add feed button” needed to be pressed twice	Yes	
When adding a new feed, some of the units are in % and some in mg, it’s confusing	No	This follows the same routine that feed suppliers use.
Result grid shouldn’t be scrollable	Yes	
Results should be able to save in PDF-form	No	Lack of support for creating PDF’s in Silverlight.
There should be some information available of the application (background, purpose)	Yes	

The missing feeds were not added in the second implementation phase due to lack of time resources. Since not all feed supplier provide enough information of feeds on their web site, it’s going to take a lot more time to get the detailed lists of ingredients.

8 Summary

The starting point of thesis was to develop a horse nutrition analysis using Silverlight an application framework. The topic proposal was accepted in September and the thesis was carried out during autumn 2012.

The basic knowledge of horse nutrition and calculations related to that were already familiar to me. Silverlight as a technology choice was also very familiar and it made the implementation of the application very smooth.

In less than one month the web site has been accessed from over 540 different IP addresses. Based on that number it can be acknowledged that there is in fact a need for this kind of application.

Based on the survey results, the usability of the beta application was quite average. There is room for improvements, but with very little experience in usability engineering I am satisfied with the end result. Most importantly, majority of the beta testers found the application as reliable and useful.

The survey results were analyzed and a list of improvements was conducted based on the results. Some of the improvements were not possible to implement, for example having a wider scale of weights due to the fact that the recommendations don't increase linearly. The beta testers wished for several new feeds to the application. Due to the time resources of the thesis project a decision was made not to add any new feeds at this point. All the decisions of implementing / fixing new features or not doing so were reasoned.

8.1 Further development

During the process Silverlight turned out to be a poor choice of technology. It's quite heavy for this kind of application, it doesn't really add any value to the application and it lacks support for Ubuntu. Also the end users of the application might feel uncomfortable of installing the Silverlight plugin and some people might not have the privi-

leges to install the plugin on their computer. For these reasons the application will be published on a different platform in spring 2013. The new platform is not yet decided.

The development will continue also on other levels. There is definitely a need for more choices of feeds. More feeds will be added right after the end of thesis process and the adding will continue as long as there is interest and time to keep this application updated.

8.2 Evaluation

Overall I'm happy with the resulting application of the thesis process. The topic was chosen well, it was interesting and kept my motivation high during the whole process.

The application meets the requirements set in the beginning of the project: it was published to beta testers as planned, a survey was conducted and improvements were made based on the survey results. Based on the survey results, testers considered the application reliable. Reliability is in a key role for this kind of application because otherwise the application is completely useless. The application also raised discussion among the target group and thus showed there is interest in the application.

One key aspect in the design of the application was usability. The survey had several questions on usability and the results pointed out that it was average. In retrospective it's easy to say that it would've been helpful to have a beta tester with knowledge of usability principles. That way I could've received very valuable feedback and suggestions for improvements.

The code was written following good coding principles. The variables and methods are classes are named in a self explanatory way and the methods are short and they only perform one thing. The chosen MVVM architecture makes it rather easy to change the platform when the view and the logic are strictly separated from each other.

I can admit that my schedule for the project was quite ambitious but the schedule was realistic due to the fact that I already had quite good knowledge of the theoretical

background. I was also in a lucky position of having an acquaintance who was very helpful when defining the requirements for the application.

My previous experience of project management is close to nothing. The thesis process taught me a lot of project management and the importance of planning the project carefully and realistically. As I pointed out earlier, I had a tight schedule for the project. By planning the target of the project precisely I was able to divide the project into phases and specific tasks. During the project I had some deviation from the original plan, but only a few days.

Professional growth was gained mainly from project management. Some growth was also gained from deployment of Silverlight applications. Systematic working, time management and writing skills also improved during the project.

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Attachments

Attachment 1. Recommended values

Energy and protein recommendations

Painoluokka	450		550		600	
	MJ/pv	srv, g/pv	MJ/pv	srv, g/pv	MJ/pv	srv, g/pv
Urheilu-hevonen						
Levossa	57,3	320	70,2	400	76	430
Kevyt työ	57,3-66,7	405	70,2-81,9	495	76,0-88,9	540
Kohtalainen työ	66,7-81,9	480	81,9-99,5	585	88,9-108,8	640
Raskas työ	81,9-95,9	640	99,5-117	780	108,8-127,5	850
Kantava tamma, viim. 90 vrk	65,5-71,3	450	80,5-87,5	550	87,4-95,0	600
Imettävä tamma, 1.- 3. imetyskk	95,9	900	117	1100	127,5	1200
Vieroitettu varsa, 6 - 12 kk	52,6	450	64,4	550	70,2	600
1 - 3-vuotias						
Valmennuksessa oleva 1,5-2,5 v.	68,0-74,0	450	84,0-91,0	550	91,0-99,0	600
Ei valmennuksessa oleva	57,3	410	70,2	500	76	545

Mineral recommendations 1

Painoluokka	450			550			600		
	Ca	P	Mg	Ca	P	Mg	Ca	P	Mg
Urheiluhevonen									
Levossa	18	13	7	22	16	8	24	17	9
Kevyt työ	27	16	9	33	20	10	36	22	12
Kohtalainen työ	32	19	10	38	23	13	42	25	14
Raskas työ	36	26	13	44	32	17	48	35	18
Kantava tamma, viimeiset 3 kk	35	23	10	42	28	12	45	30	13
Imettävä tamma, 1.- 3. imetyskk	48	27	11	59	33	14	61	35	15
Vieroitettu varsa, 6 - 12 kk	30	20	5	36	24	5	40	27	7
1 - 3-vuotias									
Ei valmennuksessa oleva	23	15	7	28	18	9	31	20	10
Valmennuksessa oleva (1,5-2 v)	34	22	10	40	27	12	45	30	14

Mineral recommendations 2

Painoluokka: 500 kg

	Joutilas/kevyt työ	Valmennus/työ	Tiine ja imettävä tamma	Vieroitettu varsa 7-12 kk
Rauta (Fe)	500	600	900	550
Kupari (Cu)	60	125	125	60
Sinkki (Zn)	500	600	600	300

Vitamin recommendations

Painoluokka: 500 kg

	Joutilas/kevyt työ	Valmennus/työ	Tiine ja imettävä tamma	Vieroitettu varsa 7-12 kk
A-vitamiini ky/pv	30000-40000	40000-60000	40000-75000	45000-60000
D-vitamiini ky/pv	3000-4000	3000-5000	6000-9000	4000-6000
E-vitamiini mg/pv	400-450	1500-2500	700-1000	400-500

Dry matter recommendations

Prosenttia elopainosta

Urheiluhevonen	1,5 - 2,5 %
Kantava tamma	1,5 - 2,5 %
Imettävä tamma	
imetyskauden alku	2,0 - 3,0 %
imetyskauden loppu	1,5 - 2,5 %
Varsa ja nuori hevonen	
- vieroitettu	2,5 - 3,0 %
- 1-vuotias	3,00 %
- 2-vuotias	2,50 %

Attachment 2. Control template for button

```
1834 <!-- Button -->
1835 <Style TargetType="Button">
1836   <Setter Property="Background" Value="#FFF"/>
1837   <Setter Property="Foreground" Value="#000"/>
1838   <Setter Property="Padding" Value="3"/>
1839   <Setter Property="BorderThickness" Value="1"/>
1840   <Setter Property="BorderBrush" Value="{StaticResource BorderBrush}"/>
1841   <Setter Property="Template">
1842     <Setter.Value>
1843       <ControlTemplate TargetType="Button">
1844         <Grid>
1845           <vsm:VisualStateManager.VisualStateGroups>
1846             <vsm:VisualStateGroup x:Name="CommonStates">
1847               <vsm:VisualState x:Name="Normal"/>
1848               <vsm:VisualState x:Name="MouseOver">
1849                 <Storyboard>
1850                   <DoubleAnimation Duration="0" Storyboard.TargetName="BackgroundHover"
1851                     Storyboard.TargetProperty="Opacity" To="1"/>
1852                 </Storyboard>
1853               </vsm:VisualState>
1854               <vsm:VisualState x:Name="Pressed">
1855                 <Storyboard>
1856                   <ColorAnimation Duration="0" Storyboard.TargetName="Background" To="#D3C5FA"
1857                     Storyboard.TargetProperty="(Border.Background).(SolidColorBrush.Color)" />
1858                 </Storyboard>
1859               </vsm:VisualState>
1860               <vsm:VisualState x:Name="Disabled">
1861                 <Storyboard>
1862                   <DoubleAnimation Duration="0" Storyboard.TargetName="DisabledVisualElement"
1863                     Storyboard.TargetProperty="Opacity" To=".55"/>
1864                 </Storyboard>
1865               </vsm:VisualState>
1866             </vsm:VisualStateGroup>
1867             <vsm:VisualStateGroup x:Name="FocusStates">
1868               <vsm:VisualState x:Name="Focused">
1869                 <Storyboard>
1870                   <DoubleAnimation Duration="0" Storyboard.TargetName="FocusVisualElement"
1871                     Storyboard.TargetProperty="Opacity" To="1"/>
1872                 </Storyboard>
1873               </vsm:VisualState>
1874               <vsm:VisualState x:Name="Unfocused" />
1875             </vsm:VisualStateGroup>
1876           </vsm:VisualStateManager.VisualStateGroups>
1877           <Border x:Name="Background" CornerRadius="3" Background="White"
1878             BorderThickness="{TemplateBinding BorderThickness}" BorderBrush="{TemplateBinding BorderBrush}" />
1879         </Border>
1880         <Border x:Name="BackgroundHover" CornerRadius="3" Background="{StaticResource ButtonBackgroundHover}"
1881           BorderThickness="{TemplateBinding BorderThickness}" BorderBrush="{TemplateBinding BorderBrush}"
1882           Opacity="0"/>
1883         <ContentPresenter
1884           x:Name="contentPresenter"
1885           Content="{TemplateBinding Content}"
1886           ContentTemplate="{TemplateBinding ContentTemplate}"
1887           VerticalAlignment="{TemplateBinding VerticalContentAlignment}"
1888           HorizontalAlignment="{TemplateBinding HorizontalContentAlignment}"
1889           Margin="{TemplateBinding Padding}"/>
1890         <Rectangle x:Name="DisabledVisualElement" RadiusX="3" RadiusY="3" Fill="FFFFFFFF" Opacity="0"
1891           IsHitTestVisible="false" />
1892         <Rectangle x:Name="FocusVisualElement" RadiusX="2" RadiusY="2" Margin="1" Stroke="000" StrokeThickness="1"
1893           Opacity="0" IsHitTestVisible="false" />
1894       </Grid>
1895     </ControlTemplate>
1896   </Setter.Value>
1897 </Setter>
1898 </Style>
```


Attachment 3. Implementing INotifyProperty interface

```
1 using System.ComponentModel;
2
3 namespace EquusAcana
4 {
5     public class SampleClass : INotifyPropertyChanged
6     {
7         public event PropertyChangedEventHandler PropertyChanged;
8
9         private string _firstName;
10        public string FirstName
11        {
12            get { return _firstName; }
13            set
14            {
15                _firstName = value;
16                NotifyPropertyChanged("FirstName");
17            }
18        }
19
20        public void NotifyPropertyChanged(string propertyName)
21        {
22            if (PropertyChanged != null)
23            {
24                PropertyChanged(this,
25                    new PropertyChangedEventArgs(propertyName));
26            }
27        }
28    }
29 }
30
31
```

Attachment 4. Boolean to visibility value converter

```
2 | using System.Windows;
3 | using System.Windows.Data;
4 |
5 | namespace EquusAcana.Converters
6 | {
7 |     public class BooleanToVisibilityConverter : IValueConverter
8 |     {
9 |
10 |         #region IValueConverter Members
11 |
12 |         public object Convert(object value, Type targetType, object parameter, System.Globalization.CultureInfo culture)
13 |         {
14 |             bool isVisible = (bool)value;
15 |             if (isVisible)
16 |                 return Visibility.Visible;
17 |             else
18 |                 return Visibility.Collapsed;
19 |         }
20 |
21 |         public object ConvertBack(object value, Type targetType, object parameter, System.Globalization.CultureInfo culture)
22 |         {
23 |             throw new NotImplementedException();
24 |         }
25 |
26 |         #endregion
27 |     }
28 | }
29 |
```

Attachment 5. Mock-up of user interface

Hevosien tiedot

Tyyppi | V | Painoluokka | V |

Levossa 1-3 vuotias treenissä
 Kevyt työ 1-3 vuotias levossa
 Kohtalainen työ
 Raskas työ

Heinä

ME arvo (MJ/kg ka) D-arvo, g/kg ka
Raskavalkuainen (g/kg ka) Kuitu, g/kg ka
SRV, g/kg ka Sokeri g/kg ka

Väkirehut

Item One
Item Two
Item Three
Item four
Item five

Määrä (litraa) Valitut rehut


 Item One
Item Two
Item Three
Item four
Item five

Muu rehu

Raskavalkuainen Sokeri Fosfori
Raskaravin ME Natrium
Raskakuitu Kalium Magnesium

Määrä (litraa)

Label



Attachment 6. XML file structure

```
3 <Rehu>
4   <Valmistaja>Racing</Valmistaja>
5   <Nimi>Pegasus Mix</Nimi>
6   <MJ>11.6</MJ>
7   <Raakavalkuainen>12.2</Raakavalkuainen>
8   <SRV>0</SRV>
9   <Sokeri>7</Sokeri>
10  <Lysiini>0</Lysiini>
11  <Kalsium>0.61</Kalsium>
12  <Fosfori>0.44</Fosfori>
13  <Magnesium>0</Magnesium>
14  <Natrium>0.34</Natrium>
15  <AVitamiini>2000</AVitamiini>
16  <DVitamiini>2000</DVitamiini>
17  <EVitamiini>800</EVitamiini>
18  <B1Vitamiini>20</B1Vitamiini>
19  <B2Vitamiini>20</B2Vitamiini>
20  <B6Vitamiini>4</B6Vitamiini>
21  <B12Vitamiini>0.2</B12Vitamiini>
22  <CVitamiini>0</CVitamiini>
23  <Sinkki>200</Sinkki>
24  <Kupari>65</Kupari>
25  <Rauta>0</Rauta>
26  <Litrapaino>550</Litrapaino>
27 </Rehu>
```

Attachment 7. Reading XML-file

```
596 private void ReadXml()
597 {
598     Uri url = new Uri("rehut.xml", UriKind.Relative);
599     WebClient client = new WebClient();
600     client.DownloadStringCompleted +=
601         new DownloadStringCompletedEventHandler(Client_DownloadStringCompleted);
602     client.DownloadStringAsync(url);
603 }
604 void Client_DownloadStringCompleted(object sender, DownloadStringCompletedEventArgs e)
605 {
606     try
607     {
608         XDocument xdoc = XDocument.Parse(e.Result, LoadOptions.None);
609
610         var data = from a in xdoc.Descendants("Rehu")
611                   select new Rehu
612                   {
613                       Valmistaja = (string)a.Element("Valmistaja"),
614                       Nimi = (string)a.Element("Nimi"),
615                       MJ = (double)a.Element("MJ"),
616                       Raakavalkuainen = (double)a.Element("Raakavalkuainen"),
617                       SRV = (double)a.Element("SRV"),
618                       Sokeri = (double)a.Element("Sokeri"),
619                       Lysiini = (double)a.Element("Lysiini"),
620                       Kalsium = (double)a.Element("Kalsium"),
621                       Fosfori = (double)a.Element("Fosfori"),
622                       Magnesium = (double)a.Element("Magnesium"),
623                       Natrium = (double)a.Element("Natrium"),
624                       AVitamiini = (double)a.Element("AVitamiini"),
625                       DVitamiini = (double)a.Element("DVitamiini"),
626                       EVitamiini = (double)a.Element("EVitamiini"),
627                       B1Vitamiini = (double)a.Element("B1Vitamiini"),
628                       B2Vitamiini = (double)a.Element("B2Vitamiini"),
629                       B6Vitamiini = (double)a.Element("B6Vitamiini"),
630                       B12Vitamiini = (double)a.Element("B12Vitamiini"),
631                       CVitamiini = (double)a.Element("CVitamiini"),
632                       Sinkki = (double)a.Element("Sinkki"),
633                       Kupari = (double)a.Element("Kupari"),
634                       Rauta = (double)a.Element("Rauta"),
635                       Litrapaino = (double)a.Element("Litrapaino"),
636                       _Id = Guid.NewGuid()
637                   };
638         if (data != null)
639         {
640             var rehut = data.OrderBy(r => r.Valmistaja).ThenBy(n => n.Nimi);
641             Vakirehut = rehut.ToObservableCollection();
642         }
643     }
644     catch (Exception ex)
645     {
646         if (Debugger.IsAttached)
647             MessageBox.Show(ex.Message);
648         else
649             MessageBox.Show("Rehujen lataamisessa ilmeni ongelma");
650     }
651     IsBusy = false;
652 }
```

Attachment 8. Extension method for IEnumerable

```
1 using System.Collections.Generic;
2 using System.Collections.ObjectModel;
3
4 namespace EquusAcana
5 {
6     public static class CollectionExtensions
7     {
8         public static ObservableCollection<T> ToObservableCollection<T>(this IEnumerable<T> enumerable)
9         {
10             var col = new ObservableCollection<T>();
11             foreach (var cur in enumerable)
12             {
13                 col.Add(cur);
14             }
15             return col;
16         }
17     }
18 }
```

Attachment 9. Survey

1. Oletko aikaisemmin tehnyt tai teettänyt ruokinta-analyysin?

- Kyllä
 En

2. Jos vastasit edelliseen kysymykseen kyllä, missä olet teettänyt ruokinta-analyysin?

- Tehnyt itse
 Hoptilla
 Asiantuntijalla

Muu (täsmennä)

3. Arvioi astekolla kyllä, en, en osaa sanoa

	Kyllä	En	En osaa sanoa
Pidätkö Equus Acanaa luotettavana	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Suosittelisitko Equus Acanaa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Käyttäisitkö Equus Acanaa uudestaan	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ovatko laskurissa esiintyvät termit entuudestaan tuttuja (esim. kg ka)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Perustelu

4. Arvioi asteikolla 1-5 (1 heikko ja 5 erinomainen)

	1	2	3	4	5
Ulkoasu	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helppokäyttöisyys	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Listalta puuttuvan väkirehun lisäämisen helppous	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tuloksen luettavuus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. Löytyikö käyttämäsi väkirehut valikoimasta?

- Yksikään ei löytynyt
 Osa löytyi
 Kaikki löytyivät
 En käytä väkirehujä ruokinnassa

6. Minkä rehuvalmistajan rehuja toivoisit Equus Acanaan? (Voit luetella useita)

7. Mitä ruokintalaskurista mielestäsi puuttuu?

*8. Oliko koneellasi Silverlight asennettuna? (Mikäli sait sivun näkyviin asentamatta mitään, se oli asennettuna.)

- Kyllä
 Ei

9. Vapaa sana. Kommentit voivat liittyä esimerkiksi ulkoasuun (elementtien sijoittelu, värien käyttö), helppokäyttöisyyteen, laskelmiin tai puutteisiin laskurissa.