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# Using TWID Service For Creating Websites

Responsive Online Coaching Websites

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<p>TWID Oy is a company that provides a service for creating customers online-coaching websites based on its own current platform: TWID3. Besides, TWID Oy is building a next platform in order to improve limitations on the current platform. The purpose of this thesis is to describe technology that is used at TWID Oy. This thesis includes three parts.</p> <p>First, part of the thesis describes the current technology such as HTML5, JQuery, and Skeleton as a framework of CSS used in the current platform: TWID3. Second, the thesis illustrates new technologies such as ReactJS, Virtual DOM, Bootstrap as a framework of CSS used in the next platform: TWID5. Finally, two platforms (TWID3 and TWID5) are compared in order to give a general view about the two platforms for readers.</p> <p>In conclusion, this thesis discusses technology used for creating websites. Although TWID3 still has some limitations about creating websites, TWID5 improves the functionality of TWID3 and this thesis also suggests trendy technology for creating websites.</p>	
Keywords	HTML5, CSS3, Photoshop, JQuery, JQuery Ui Reactjs, Virtual DOM, Skeleton, Bootstrap, Flexbox

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## Abbreviations

CSS	Cascading Style Sheets
DOM	Document Object Model
HTML	Hypertext Markup Language
JS	JavaScript
PSD	Photoshop Data file
PTS	Photoshop
RWD	Responsive Web Design
UI	User Interface
URL	Uniform Resource Location

## 1. Introduction

In the beginning of the Internet, websites were used for displaying static content. Nowadays with rapid development of websites, websites not only can display content from the administrator, but also clients and customers can buy and sell products on dynamic websites from their house or their office. There are different types of websites such as: static websites, e-commerce websites, and online-coaching websites. TWID Oy is one of the companies that provides a service for creating customers online-coaching websites. The company has its own platform to create the websites. As a result of using its platform, developers can create websites fast and efficiently. Besides, customers can change the contents of websites on the front-page by themselves.

Currently, TWID Oy uses TWID3 platform to help developers create websites easily, and customers can change the contents of websites on the front-page. Unfortunately, TWID3 was created six years ago, so the technology is quite old. Thus, now the company is creating a new platform that is called TWID5. In TWID5, developers and customers can create some sections on websites more easily than in TWID3. I have been working for the company for nine months, and my task is not only creating customers websites based on TWID3, but also testing and developing TWID5.

The aim of this thesis is to describe how TWID3 and TWID5 work. Then the two platforms are compared in order to discuss the advantages of the TWID platform, and my role in the TWID projects is analyzed.

## 2. Current Version Technologies and Implementation

Currently, TWID Oy uses TWID3 as a platform for creating websites. Technologies in TWID3 include HTML/HTML5, Skeleton as a framework of CSS, and JQuery/Jquery UI.

### 2.1. HTML/HTML5

HTML stands for Hyper Text Mark-up Language. It takes responsibility for creating the layout of the websites. Each individual mark-up called HTML tag is considered as an element. By convention, HTML tags include two parts: an opening tag and a closing tag. The opening tag refers to where a sentence begins. In contrast, the closing tag refers to where the sentence ends. [1,29-30.]

For example, if developers want to create a paragraph on a website, they need to use the HTML code to make browser display the text of the paragraph on the screen.

Listing 1 illustrates the HTML code for creating paragraph on website.

```
<p> This is a paragraph. </p>
```

Listing 1: Code for creating paragraph on website

<div> tag is used for defining an element in an HTML element [2.]. It is also used for opening and closing a section.

Besides, the <div> tag could be inside another <div>. It means in some cases developers can use a lot of <div> tags to create an element.

```
<div class="header">
  <h1> My site name </h1>
  <div class="nav">
    <ul>
      <li> Home </li>
      <li> About </li>
    </ul>
  </div>
</div>
<div class="sidebar">
  <h3> Links Heading </h3>
```

</div>

#### Listing 2: The limitation of HTML4

Listing 2 shows the limitation of HTML1 if developers use only the <div> tag to create an element. The code from Listing 2 is not wrong, but it brings several problems:

- 1) Developers make separately areas by using style classes. With classes that are a set of formatting, identifying can be applied to any elements [3,57]. However, calling a style class depends on the author. For example, developers call class's name "header" for the header of section, but for the others, they call "header" for their heading of text.
- 2) Some developers use a style ID which is a set of identifying which can be applied to only one element on the website [3,59] - rather than the style class.

Technology develops everyday, so HTML5 was released in October 2014. It brings a number of semantic structural elements such as <header>, <section>, <nav> or < footer>. A definition of <header>,<section>,<nav>, and <footer> is shown below.

- <header> element defines a header of a document
- <section> element defines a section in the document
- <nav> elements defines a set of navigation links
- <footer> defines a footer of the document

[4.]

Thus, developers can use these elements to configure areas on a web page. Developers can know the meaning of different content apart, but a browser cannot. The browser does not recognize the different role of <div> as a header, and footer. It just sees them as different <div> tags. It would be more useful if the browser and developer were able to know apparently identify. As the result of correct identification, developers can track the code from other developers.

There are two parts inside an HTML file: <head> and <body>. <head> is the place where developers import external files (Cascading Style Sheet - CSS file and Javascript - JS file) or place the js's code or css's code. Meanwhile, <body> is the place where they put the content of a website and create a structured layout for the website.

## 2.2. CSS

CSS stands for Cascading Style Sheets that describes what HTML look likes. If HTML plays an important role in creating layout, CSS takes responsibility for defining the appearance of different parts of the section. CSS is a language that is used for constructing the style such as font, colour, and position element. [1,46]. There are three ways to make CSS connect with HTML: importing a style sheet, importing a style sheet from within HTML, and embedded style settings. Besides, HTML code is connected with CSS code via the style classes and the style ID which developer set on the HTML code. Through the class and ID, CSS can construct the style for the element in HTML. [5,385-387.]

Listing 3 below describes CSS code for button.

```
.button{
background: #1CBAC8;
-webkit-border-radius: 5px;
-moz-border-radius: 5px;
border-radius: 5px;
color: #fff;
border:0 none;
text-transform:none;
margin-right:5px;
}
```

Listing 3: Styling button by CSS code

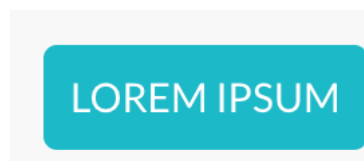


Figure 1: The result of styling by CSS in Listing 3

Figure 1 and Listing 3 show how CSS styles a button on the webpage. Currently, CSS3 is the latest version of CSS. CSS3 brings some new features to design such as Box Model, Borders, and Flex Box. The most important thing CSS3 brings is media queries which help developers make sure the layout of website works on difference devices.



Nowadays, developers use a lot of different frameworks for CSS such as: Bootstrap, Skeleton, and Foundation to help them create website quickly and efficiently. In TWID Oy, I use the skeleton framework for creating websites.

### 2.2.1 Skeleton

TWID Oy chose the Skeleton framework, because Skeleton is a light framework and it is easy to implement it and build TWID's own responsive framework. Skeleton is a light framework of CSS. It has sixteen columns for creating layout websites. Its max width is 960px. [6.] Besides, Skeleton also uses fluid grid for websites. Fluid grid plays an important role in creating the front-page of websites. Nowadays, people can access the Internet through many devices such as desktops, laptops, tablets, or mobile devices. That is why making a website responsive is one of the most important things developers need to consider. With fluid grid, Skeleton framework will set the max-width of container for devices based on the screen, so that the contents on the websites are going to flow and adapt to the user's device. [7.]

Figure 2 below shows an example website which uses the Skeleton framework.

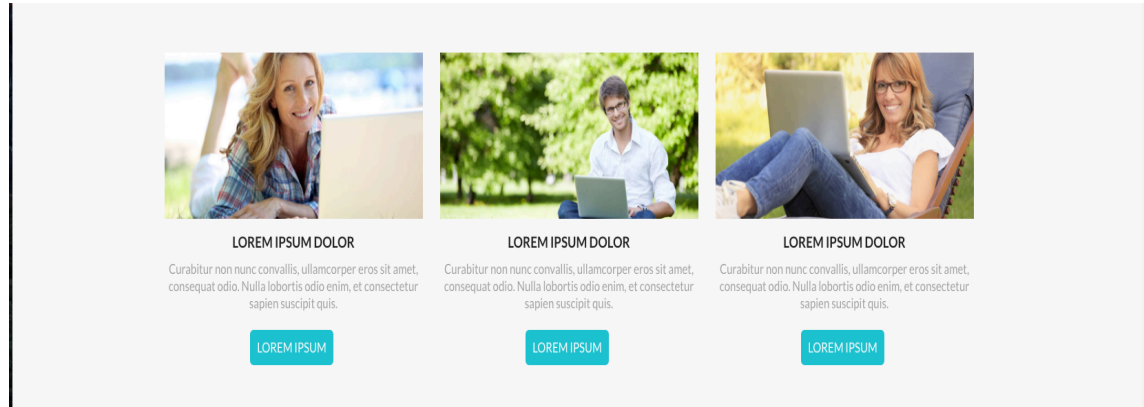


Figure 2: An example of a website which uses the Skeleton framework

Listing 4, listing 5, and listing 6 below illustrate the structure of HTML code in order to use the Skeleton framework.

```
<div class="one-third column alpha">
  <div class="nosto-wrapper">
```

```

        
        <h2 class="product-raiser-header nosto-otsikko">Lorem ipsum
dolor</h2>
        <p class="product-raiser-text nostoteksti"> Curabitur non
nunc convallis, ullamcorper eros sit amet, consequat odio. Nulla lo-
bortis odio enim, et consectetur sapien suscipit quis.</p>
        <a class="nosto button" href="#" title="Lorem ipsum!">Lorem
ipsum</a>
    </div>
</div>

```

Listing 4: Code for creating the first column of Figure 2 by the Skeleton framework

```

<div class="one-third column alpha">
    <div class="nosto-wrapper">
        
        <h2 class="product-raiser-header nosto-otsikko">Lorem ipsum
dolor</h2>
        <p class="product-raiser-text nostoteksti"> Curabitur non
nunc convallis, ullamcorper eros sit amet, consequat odio. Nulla lo-
bortis odio enim, et consectetur sapien suscipit quis.</p>
        <a class="nosto button" href="#" title="Lorem ipsum!">Lorem
ipsum</a>
    </div>
</div>

```

Listing 5: Code for creating the second column of Figure 2 by the Skeleton framework

```

<div class="one-third column alpha">
    <div class="nosto-wrapper">
        
        <h2 class="product-raiser-header nosto-otsikko">Lorem ipsum
dolor</h2>
        <p class="product-raiser-text nostoteksti"> Curabitur non
nunc convallis, ullamcorper eros sit amet, consequat odio. Nulla lo-
bortis odio enim, et consectetur sapien suscipit quis.</p>

```

```

        <a class="nosto button" href="#" title="Lorem ipsum! ">Lorem
    ipsum</a>
    </div>
</div>

```

Listing 6: Code for creating the third column of Figure 2 by the Skeleton framework

Listing 4, 5 and 6 and Figure 2 show the way to use Skeleton Framework and the result of using Skeleton Framework. Codes seen in listing 4 creates the contents of left hand side in the Figure 2 such as image, text, and button. Meanwhile, codes seen in listing 5 create the middle contents in the Figure 2 such as image, text, and button. Finally, codes seen in listing 6 create the contents of right hand side picture in figure 2 such as image, text, and button.

Thus, using Skeleton Framework, developers do not need to be worried about the position of the content of websites when they display on large devices or small devices.

## 2.2.2 Responsive Web Design

In the era of the developing Internet, websites can be accessed by a lot of devices such as: mobile phones, tablets, laptops, desktop computers. Developers need to be sure that the website can be displayed on difference devices. Responsive Web Design (RWD) aims that websites should response to the user's device based on screen size, platform or orientation. To achieve the RWD, developers can use framework or CSS media queries. [8.] With media queries, the layout of website will be rendered based on screen size.

For example, on the computers, clients not only want to read contents, but also focus on images. Meanwhile, on mobile phones and on tablets, because of small screen size, the clients just want to read the necessary contents. Images do not play an important role in some cases. Thus, a layout of website on the computer, on the tablet, and one the mobile phone needs to be adapted, so that website can give important contents to the clients.

Figure 3 below illustrates the layout of a website on the desktop, on the tablet, and on the mobile phone.



Figure 3: Layout of website on the computer, on the tablet, and on the mobile. Copied from: Responsive Web Layout Vector Graphic [9]

### 2.3 Photoshop

Photoshop (PTS) is considered as one of leaders in photo editing. Adobe System Inc manufactures PTS. Developers and designers use PTS for editing photos by a lot of PTS tools such as: cropping, changing color, and resizing image [10]. Making a standard website, the first thing which developers and designers need to be concerned about is making the color of the website consistent. If the main color of website is orange, they need to use PTS for matching the color of a logo or the color of the menu image with the main color of the website. Besides, when customers give their images to developers, sizes of images are normally different from each other and quality of images is bad. Thus, developers and designers use PTS for making the size of images the same, and improving the quality of the images. Figure 4 illustrates the useful PTS.



Figure 4: Useful of PTS

## 2.4 JavaScript

Javascript (JS) is a client-side scripting language that runs inside the web browser. In 1995, Javascript was an additional support for Java technology in the browser. Then, it became more powerful when the HTML element got a structured definition called Document Object Model or DOM.

DOM is a node tree. It contains attributes, elements, and contents. DOM also defines a standard for accessing documents. JS is allowed to access and update and style of documents by DOM [11].

Developers call JavaScript a client-side language, because it makes website not only static but also dynamic. It helps website to create some animation such as: pop up, slide down menu, or fade in element in the browser [4, 291].

By convention, developers put JavaScript code between the opening-tag `<script>` and closing-tag `</script>`. There are two ways to implement the JavaScript code. First, developers can put the JavaScript code into the head of HTML. Second, they can import the external script file in the head of HTML. Figure 5 shows that.

<pre>&lt;script src="js/jquery.parascroll.js"&gt;&lt;/script&gt;</pre>	<pre>&lt;script type="text/javascript"&gt;     \$( document ).ready(function() {     \$('reference_section').parally({offset: -40});     }); &lt;/script&gt;</pre>
--	--

Figure 5: Two ways to locate the JavaScript code

Developers at TWID Oy prefer to use the first way, because JavaScript code should be separated into multiple files so that they can check their code efficiently and fast.

### 2.4.1 JQuery

Jquery is a library of JavaScript. Without JQuery, developers need to write multiple lines of code in order to access the DOM tree and implement their code work on specific piece of the HTML document's structure. With JQuery, they can access DOM easily and make the exact portion of the document which needs to be implemented. [12,9.] For example, the author wants to create a "button" on the website, so the developer's HTML code is:

```
<input id="button1" type="button" value="clickMe"/>.
```

Listing 7: An example code connects HTML with JS

I show what the code looks like with JQuery and without JQuery.

Without JQuery:

```
var el = document.getElementById("box");
el.style.backgroundColor = "#000";
var new_el = document.createElement("div");
el.innerHTML = "<p>some content</p>";
el.appendChild(new_el);
```

Listing 8: An example of Javascript code

With JQuery:

```
$("#box")
  .css({ "background-color": "#000" })
  .append("<div><p>some content</p></div>");
```

Listing 9: An example of JQuery code

As can be seen, using JQuery brings many benefits for developers. Besides, JQuery also has multiple useful JQuery plug-ins for developers. A plug-in is a portion of code written in a JavaScript file. In a plug-in, there is a common function such as: 'click' function or 'scroll' function for website so that developers can use it on their site. The benefit of using a plug-in is about creating a function within a few time. [13.]

## 2.4.2 JQuery UI

Jquery UI is a set of plug-ins for JQuery that adds new functionalities to the JQuery core library. These plug-ins such as: Tabs, Calendars, Dialog boxes, and Sliders help developers make an interactive website with the user. Besides, the interaction is easier to manage in comparison to using JQuery only. [14,1.]

Jquery UI has its own CSS files and JS files. To implement JQuery UI, first the developers need to insert JS files and CSS files from JQuery UI into their HTML file. Then, they will follow structure of HTML code as Skeleton framework. For example, if developers from TWID Oy want to create tabs on their project, their code should be the same as in Listing 10 below.

```

<script>
  $( function() {
    $( "#tabs" ).tabs();
  } );
</script>
</head>
<body>

<div id="tabs">
  <ul>
    <li><a href="#tabs-1">Nunc tincidunt</a></li>
    <li><a href="#tabs-2">Proin dolor</a></li>
    <li><a href="#tabs-3">Aenean lacinia</a></li>
  </ul>
  <div id="tabs-1">
    <p>Proin elit arcu, rutrum commodo, vehicula tempus, commodo a,
    risus. Curabitur nec arcu. Donec sollicitudin mi sit amet mauris. Nam
    elementum quam ullamcorper ante. Etiam aliquet massa et lorem. Mauris
    dapibus lacus auctor risus. Aenean tempor ullamcorper leo. Vivamus sed
    magna quis ligula eleifend adipiscing. Duis orci. Aliquam sodales
    tortor vitae ipsum. Aliquam nulla. Duis aliquam molestie erat. Ut et
    mauris vel pede varius sollicitudin. Sed ut dolor nec orci tincidunt
    interdum. Phasellus ipsum. Nunc tristique tempus lectus.</p>
  </div>
  <div id="tabs-2">
    <p>Morbi tincidunt, dui sit amet facilisis feugiat, odio metus
    gravida ante, ut pharetra massa metus id nunc. Duis scelerisque mo-
    lestie turpis. Sed fringilla, massa eget luctus malesuada, metus eros
    molestie lectus, ut tempus eros massa ut dolor. Aenean aliquet frin-
    gilla sem. Suspendisse sed ligula in ligula suscipit aliquam. Praesent
    in eros vestibulum mi adipiscing adipiscing. Morbi facilisis. Curabi-
    tur ornare consequat nunc. Aenean vel metus. Ut posuere viverra nulla.
    Aliquam erat volutpat. Pellentesque convallis. Maecenas feugiat, tel-
    lus pellentesque pretium posuere, felis lorem euismod felis, eu ornare
    leo nisi vel felis. Mauris consectetur tortor et purus.</p>
  </div>
  <div id="tabs-3">
    <p>Mauris eleifend est et turpis. Duis id erat. Suspendisse poten-
    ti. Aliquam vulputate, pede vel vehicula accumsan, mi neque rutrum
    erat, eu congue orci lorem eget lorem. Vestibulum non ante. Class ap-
    tent taciti sociosqu ad litora torquent per conubia nostra, per incept-
    os himenaeos. Fusce sodales. Quisque eu urna vel enim commodo pel-
    lentesque. Praesent eu risus hendrerit ligula tempus pretium. Curabi-
    tur lorem enim, pretium nec, feugiat nec, luctus a, lacus.</p>
    <p>Duis cursus. Maecenas ligula eros, blandit nec, pharetra at,
    semper at, magna. Nullam ac lacus. Nulla facilisi. Praesent viverra
    justo vitae neque. Praesent blandit adipiscing velit. Suspendisse po-
    tenti. Donec mattis, pede vel pharetra blandit, magna ligula faucibus
    eros, id euismod lacus dolor eget odio. Nam scelerisque. Donec non li-
    bero sed nulla mattis commodo. Ut sagittis.</p>
  </div>
</div>

```

Listing 10: Code for creating tabs by Jquery UI. Copied from: Tabs.[15]

After using Jquery UI, Figure 6 shows how tabs look like.



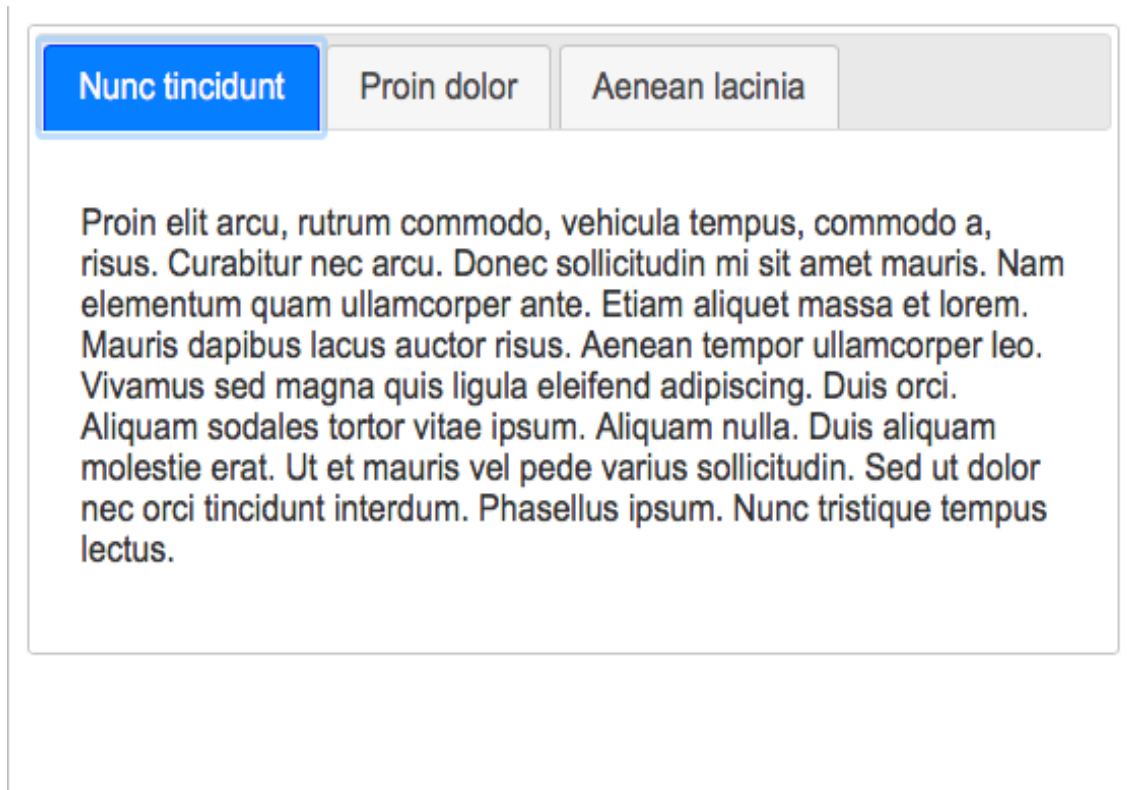


Figure 6. JQuery Tabs on a website. Copied from: Tabs.[15]

If developers follow instruction rules of JQuery UI, they can save time to create Tabs, Calendars or Sliders in their project.

## 2.5 TWID3 Platform

Currently, the developers at TWID Oy are using TWID3 platform to create websites for customers. In TWID3, there are two separate places: administration page and front-page. On administration page, customers or developers upload files, create pages or add content to the pages. Figure 7 below shows the administration page in TWID3.

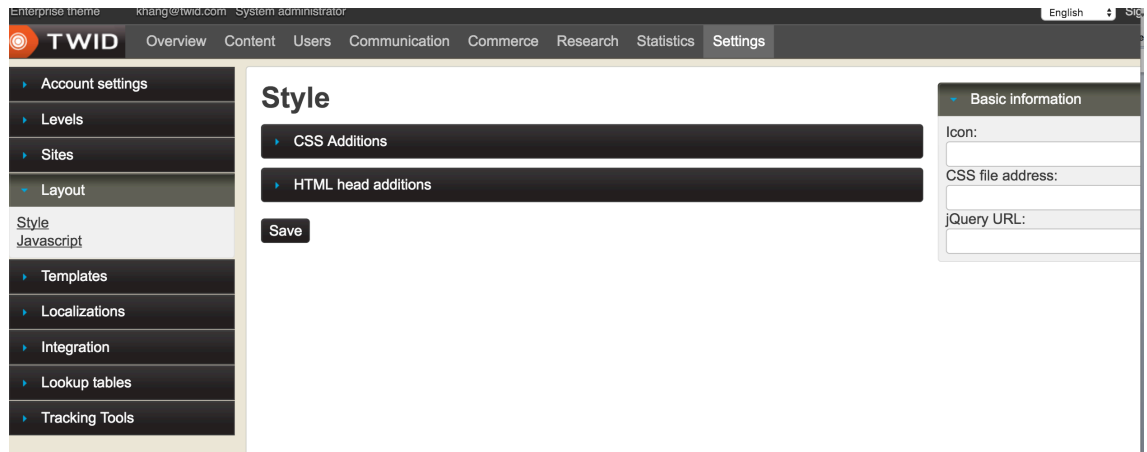


Figure 7: Administration page in TWID3

On front-page, customers or developers can create HTML code to display content on websites. Figure 8 below illustrates the front-page in TWID3.

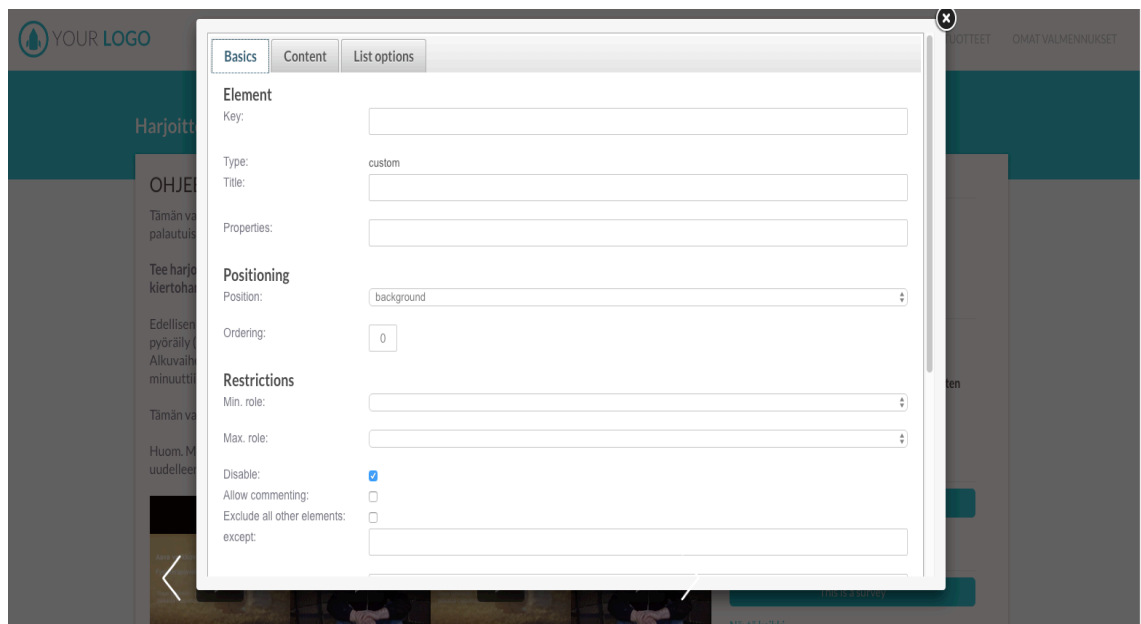


Figure 8: Creating the HTML code on the front-page

Based on the TWID3 and technologies such as: HTML, CSS, PTS, and JS, technologies should be used efficiently for creating websites for TWID's projects. Take Tutoring Finland is a good example. Tutoring Finland is a business education customer. It trains

a person who wants to learn Microsoft Office online. TWID Oy helps customers to create an online-coaching website for Tutoring Finland. The author took responsibility for creating the front-end of online-coaching website and campaign page for the customer.

After the project manager at TWID Oy discussed with a customer an idea of layout website, the project manager told customer's idea to a designer from TWID Oy. Then, the designer spent two days on designing the layout of website. After the customer approved the layout, the layout was passed to the author. Next, the author analyzed the layout such as font-style, color code, and layout of website. Then, HTML codes and CSS codes were used in order to create the website as the layout from the designer.

On the campaign-page, the customer wanted to have a pop-up order newsletter that a user clicks a button. JQuery UI was used in order to create dialog for creating the popup. Next, JQuery effects –Fading was also used for making the popup so that the popup was shown slowly and hidden slowly. Figure 9 shows what the pop up looks like on the campaign-page on the Tutoring site.

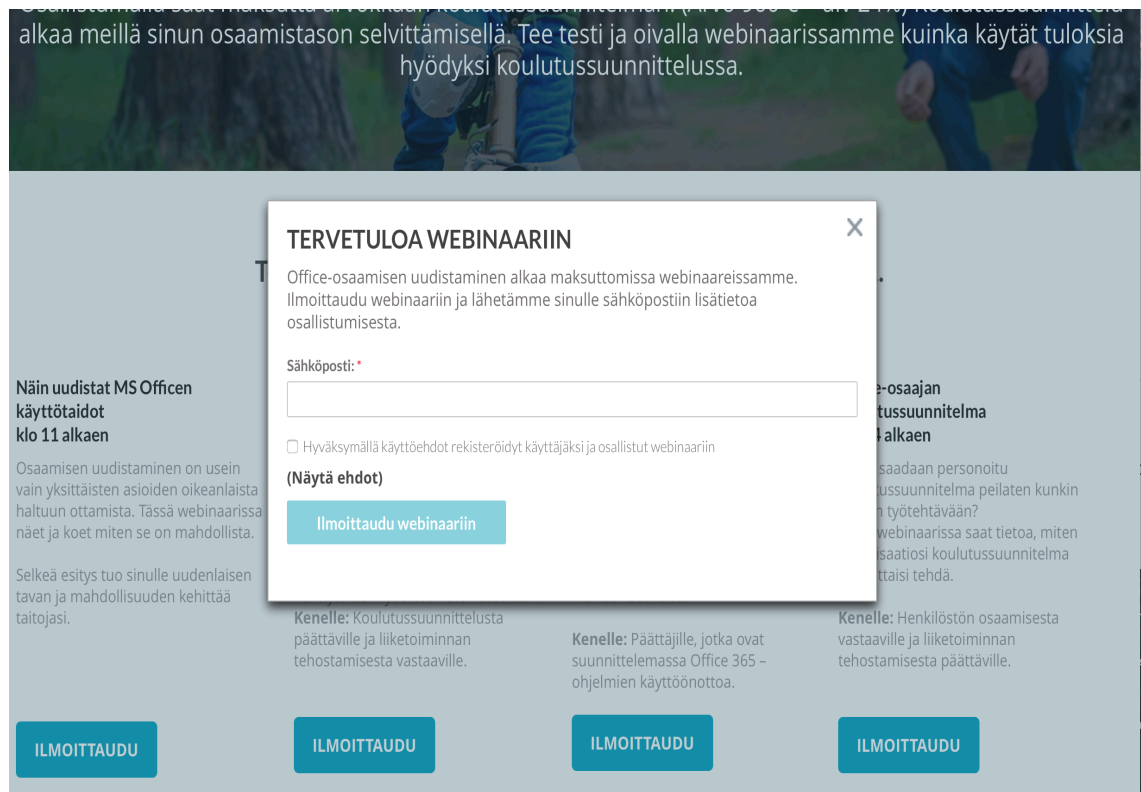


Figure 9: The popup on Tutoring Site

On the front-page, besides using HTML codes CSS codes to create the page, the customer also wanted the user to be able to click on a link that leads to a specific position of another page. Thus, the author uses anchors with the name method of HTML code. I had to insert a name of an anchor into an invisible marker. The name of the anchor is considered as a hyperlink where HTML code is concerned. The anchor is added into the specific position of another page. Listing 11 shows what code looks like:

```
<h2> <a name="first_palvelu"> KOULUTUSSUUNNITELMA </a></h2>
```

Listing 11: An example of a named anchored

Then, on the front-page, I created a link that lead to a position of a named anchor. The author added "#first\_palvelu" after the URL link which pointed to another page. Listing 12 illustrates what code looks like:

```
<a class="nosto button"
href="http://www.tutoring.fi/palvelu#first_palvelu" title="LUE
LISÄÄ">LUE LISÄÄ</a>
```

Listing 12: An example of link

The biggest challenge in Tutoring project is creating a website, I need to be sure that the website should be as the PSD file from designer. Besides, I need to know how to use JQuery-UI such as dialog box, and JQuery such as effect fading and click function efficiently so that they can be combined together according to customer's demand.

Figure 10 illustrates one of customer's website from TWID Oy.



Figure 10: An example of a customer's website created by TWID Oy

Next, because TWID offers a service for creating an online-coaching website for customers, most websites that customers use have a lot of videos. There are two places for customers for uploading videos: Youtube, and Vimeo. Based on the purpose of using videos, customers will choose the place where they upload. When the author put the videos on their website, the author needs to consider two things. First, the videos should be responsive in every device. Second, the privacy of the videos should be checked in order to make sure that the videos work on their site only.

Lastly, in the future, if the customers from TWID Oy want to do something on front-page such as place embedded Facebook code, place embedded social feed, or have animation on the front-page, the author will create them for customers on the front-page.

Although TWID3 seems to be good at creating websites, it has some limitations that I cannot ignore. First, because TWID3 was created six years ago, TWID3 does not support the latest JQuery and JQuery UI. Nowadays, a lot of modern JQuery plug-ins requiring the system need to use the latest version of JQuery. Using the latest version of JQuery, developers at TWID Oy can create an interactive website within a few hours. Second, if customers want to change the content of their website, they need to have a

little bit of knowledge of HTML code so that they can know where they should change a text and where they should change an image. With the rapid development web applications, there are some platforms which help customers create a website easily such as Wordpress, Joomla or Wix. Moreover, they can change the content of their site without learning HTML code. Unfortunately, customers of TWID Oy want to change contents or images for their website, they need to know a little bit about HTML code or developers at TWID Oy help them to change.

Therefore, TWID Oy is creating a new platform called TWID5. In TWID5, the platform uses modern technologies such as: ReactJS, Bootstrap, and FlexBox. Finally, TWID5 brings many benefits for TWID's customers.

### **3. New Version Technologies and Implementation**

Currently, TWID Oy is building a new platform in order to help customers and developers at TWID Oy to create websites more easily. Technology in the new platform includes: ReactJS, Bootstrap with Flexbox, and Virtual DOM.

#### **3.1 ReactJS**

Many years ago, a lot of developers just used JS for creating animation for the front-page of websites. However, nowadays JS develops rapidly and plays an important role in creating websites. It not only creates animation for front-page, but also it takes responsibility for whole front-page. ReactJS is a modern client-side programming language. It becomes a UI library in order to make the creation of interactive, state and reusable UI components easier.

The main advantage of using ReactJS is that it not only works on front-page, but also is used for working on server-side. [16] The syntax of ReactJS is the same as JQuery's due to being a library of JS. Not only ReactJS can create JS code, but also it takes responsibility for creating HTML code. Thus, an extension file name of ReactJS is jsx.

Listing 13 below illustrates the syntax of ReactJS.

```
render(){
var name = this.state.name;
return(
  <div>
    <div className="invitation">
      <p> Hello World </p>
    </div>
  </div>
)
}
```

Listing 13: An example of ReactJS's syntax

Unlike the other programming languages such as: Python, Php, or Java EE, ReactJS uses Virtual DOM at front-end.

### 3.1.1 Virtual DOM

Virtual DOM is an abstraction of DOM, so it is also a node tree that has elements, attributes and content. It uses React's render() method for creating a node tree based on React Component and updating the node tree based on changes in the data model. Thus, ReactJS goes through three steps to update the DOM:

- 1) The total UI will be re-rendered in the Virtual DOM representation if something has been changed
- 2) The difference between the new Virtual DOM representation and the previous one will be figured out
- 3) The real DOM has been updated with what has actually changed.

[17.]

Figure 11 below describes the process of updating the real DOM.

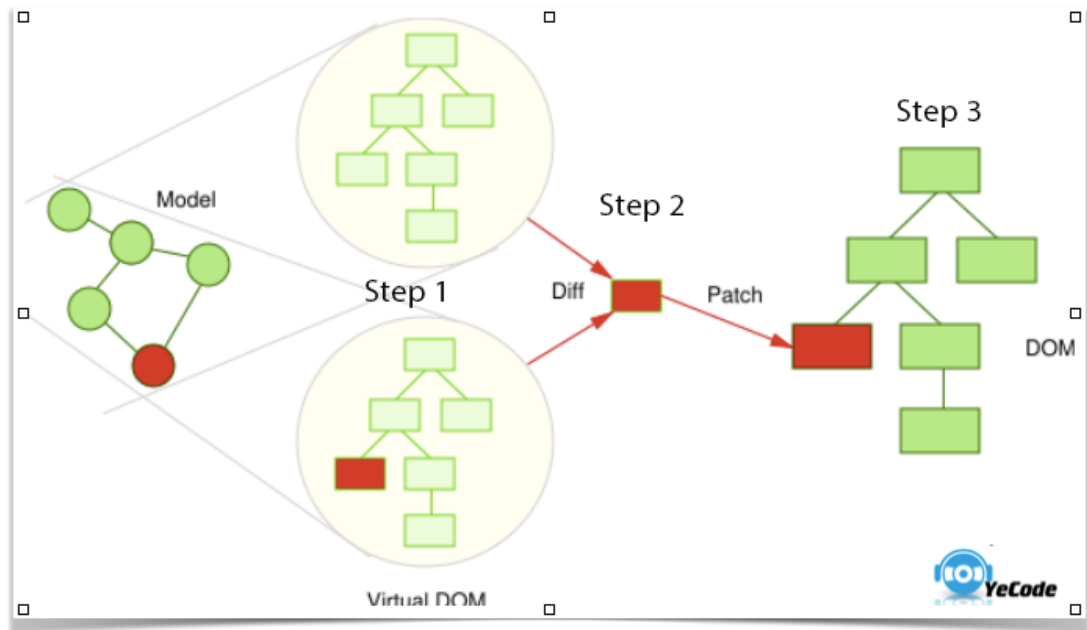


Figure 11: The process of updating the real DOM. Modified from ReactJS | Learning Virtual Dom And React Diff Algorithm. [18]

### 3.1.2 Components

Component in React splits a UI of website into many small pieces called subclass. Therefore, the component is considered as a parent class. There are some subclasses extending from `React.Component`. [19.] For example, there is a subclass for Home Page, and another subclass for About Page. The subclass controls UI of the page, so it takes responsibility for creating HTML code, and JS code.

For creating HTML code, components accept an arbitrary inputs called props and return React elements describing in the `render()` method in order to display content of website on the screen [20].

For creating JS code, React.JS uses the Virtual DOM for the front-page, so creating JS code is absolutely different from creating code in the Real DOM. It is based on lifecycle methods. The lifecycle method includes seven steps:

1. `componentWillMount`: it is done before `render()` method, on both server side and client side



2. `componentDidMount`: it is used for updating the state is executed after first `render()` only on the client side
3. `componentWillReceiveProps`: it is called as soon as the props are updated but before another component rendered is invoked.
4. `shouldComponentUpdate`: it detects whether a component is updated or not, so it should return true or false value
5. `componentWillUpdate`: it is called just before `render()`
6. `componentDidUpdate`: it is called just after `render()`
7. `componentWillUnmount`: it is invoked after the component is unmounted from the Real DOM.

[21.]

Figure 12 below illustrates what React.JS code looks like.

```

class App extends React.Component {
  constructor(props) {
    super(props);

    this.state = {
      data: 0
    }

    this.setNewNumber = this.setNewNumber.bind(this)
  };

  setNewNumber() {
    this.setState({data: this.state.data + 1})
  }

  render() {
    return (
      <div>
        <button onClick = {this.setNewNumber}>INCREMENT</button>
        <Content myNumber = {this.state.data}></Content>
      </div>
    );
  }
}

class Content extends React.Component {
  componentWillMount() {
    console.log('Component WILL MOUNT!')
  }

  componentDidMount() {
    console.log('Component DID MOUNT!')
  }

  componentWillReceiveProps(newProps) {
    console.log('Component WILL RECIEVE PROPS!')
  }

  shouldComponentUpdate(newProps, newState) {
    return true;
  }

  componentWillUpdate(nextProps, nextState) {
    console.log('Component WILL UPDATE!');
  }

  componentDidUpdate(prevProps, prevState) {
    console.log('Component DID UPDATE!')
  }

  componentWillUnmount() {
    console.log('Component WILL UNMOUNT!')
  }

  render() {
    return (
      <div>
        <h3>{this.props.myNumber}</h3>
      </div>
    );
  }
}

```

step 1

step 2

step 3

step 4

step 5

step 6

step 7

Figure 12: The React.JS code. Modified from ReactJS – Component Life Cycle.[21]

### 3.2 Bootstrap

Bootstrap is one of the most popular frameworks for creating responsive websites. It also uses the grid layout for creating the structure of a layout on website. However, bootstrap has several different features from Skeleton such as forms, buttons, images, or typography. Besides, it also supports many reusable components such as: glyphs, navbar, or pagination. [22]

Next, Bootstrap has its own CSS and JS file for creating carousels, tabs, or collisions. Six years ago, if developers at TWID Oy wanted to create a carousel, they needed to find JQuery plug-in about the carousel. It took a huge amount of time to find the best plug-in for their website. Besides, the author wanted to create navigation bar in TWID3 manually, so it took time to create a proper HTML code for navigation bar in desktop view and mobile view as well.

Currently, with Bootstrap, developers at TWID Oy do not need to spend time on finding JQuery-plugins and the author does not need to waste time on creating HTML code for the navigation bar, because Bootstrap supports everything for them. Figure 13 shows one of example website using Bootstrap.

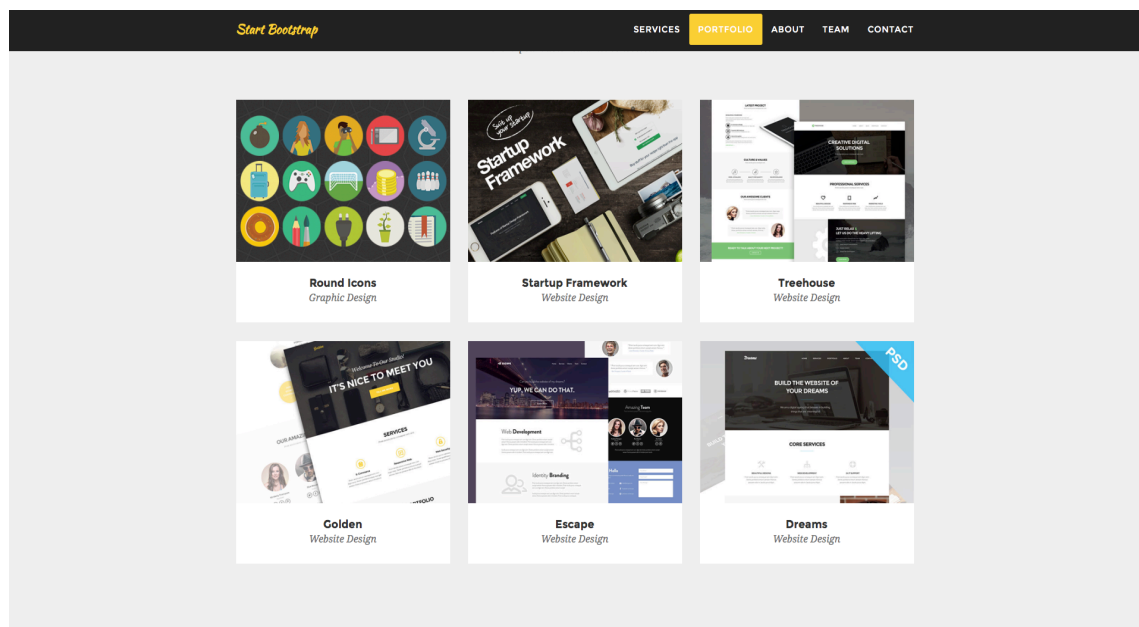


Figure 13: Example website using Bootstrap. Copied from Start Bootstrap.[23]

Like Skeleton, Bootstrap also has its own structure HTML code. Figure 14 shows a part of the HTML code creating an example website from Figure 13.

```

▼<section id="portfolio">
  ▼<div class="container">
    ::before
    ▶<div class="row">...</div>
    ▼<div class="row">
      ::before
      ▼<div class="col-sm-4 portfolio-item">
        ▶<a href="#portfolioModal1" class="portfolio-link" data-toggle="modal">...</a>
        </div>
        ▶<div class="col-sm-4 portfolio-item">...</div>
        ▶<div class="col-sm-4 portfolio-item">...</div>
        ▶<div class="col-sm-4 portfolio-item">...</div>
        ▶<div class="col-sm-4 portfolio-item">...</div>
        ▶<div class="col-sm-4 portfolio-item">...</div>
      ::after
    </div>
    ::after
  </div>
</section>

```

Figure 14: Structure of HTML code using Bootstrap. Copied from: Start Bootstrap.[23]

### 3.3 Flexbox

Flexbox is a new layout model in CSS3 which is the latest version of CSS. A flexbox layout includes a flex container. In the flex container, there are few flex items. The flex container can be placed horizontally or vertically, which is considered as main axis. The flex items are put along the main axis. The size of the flex items can be flexible so that they can fill unused space in the container or shrink to avoid overflowing [24]. Figure 15 below describes what the flexbox layout looks like.

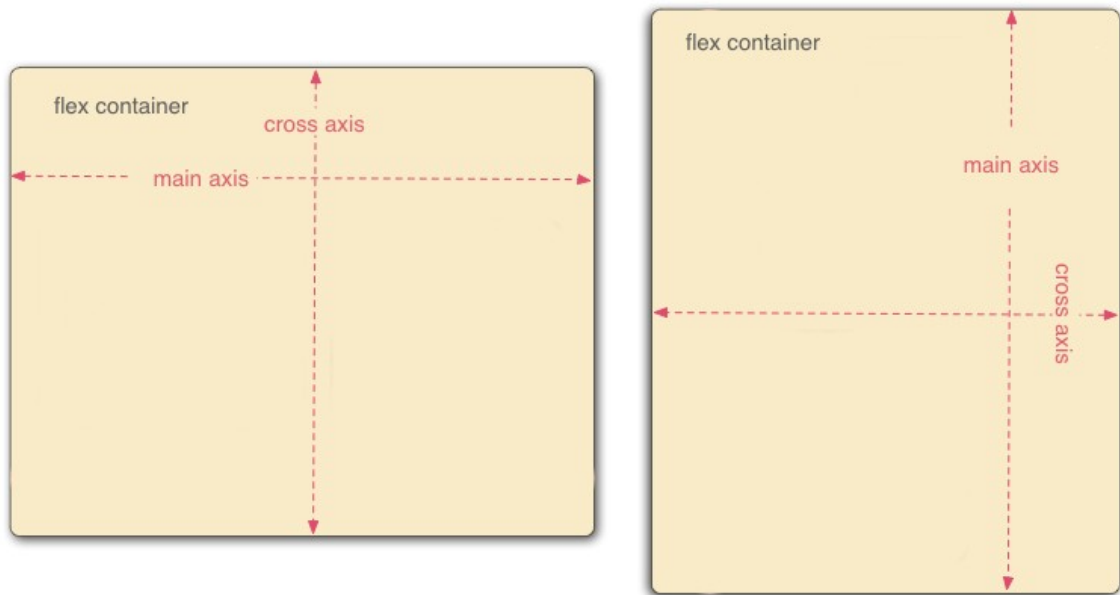


Figure 15: Flexbox layout. Copied from Understanding React Native Flexbox Layout. [25]

In TWID5, developers at TWID Oy use the flexbox layout for creating structure of websites and Bootstrap for the carousel, button, typography, and navigation bar.

### 3.4 TWID5

In TWID5, there are also two separate places: a front-page and an administration master-page. In the administration master-page, developers at TWID Oy can create a new site for a customer. Besides, there are a lot of current TWID5 sites. Lastly, developers at TWID Oy can add CSS code, upload a JS file or CSS file, and insert a <link> tag into the head of HTML. Figure 16 shows the administration master-page of TWID5

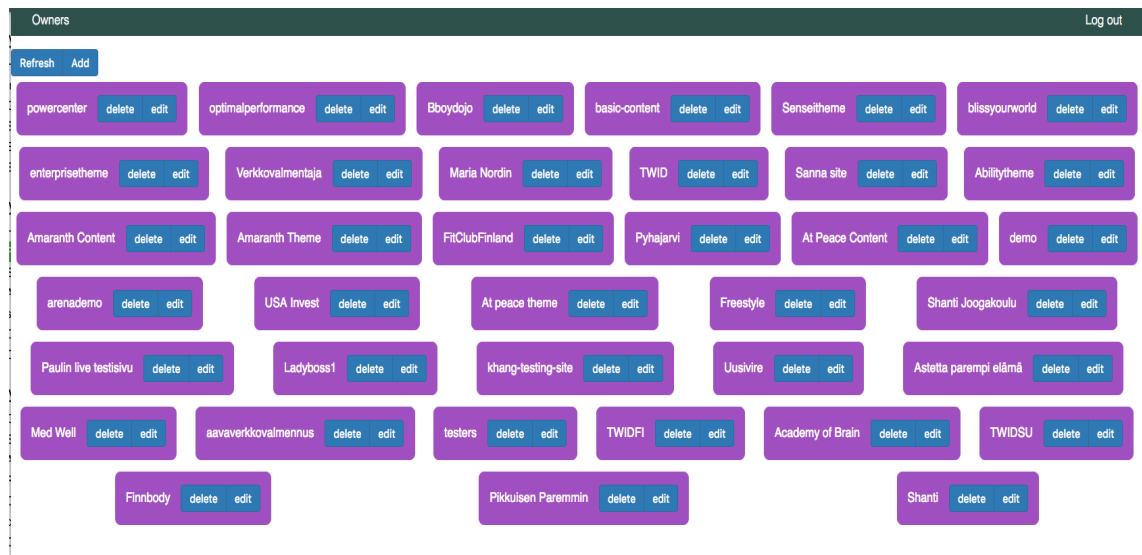


Figure 16: The administration master-page of TWID5

On the front-page, developers and customers can create HTML code by the dragging-and-dropping the container. After dragging-and-dropping the containers, the HTML5 code is generated by React.JS. There are four types of container for customers and developers choose: 1 column container, a 2-column container, a 3-column container, and a 4-column container. Besides, there are many elements such as: text element, image element, or video element for customers and developers. With “the text element”, they can add a content to a website. With “the image element”, they can add an image to a website from the images in their computers. With “ the video element”, they can add Youtube video or Vimeo video through adding the URL link.

In TWID5, developers cannot implement JS code by adding files into the head of HTML because of using React.JS in TWID5. The lifecycles method in React.JS was discussed in chapter 3.1.2. Based on that, JS code should be added into React Component. Thus, JS code is added into TWID5 elements on the front-page. Then, in TWID5, there is functionality color code, which allows developers, or customers to change the color of the section element in TWID5. Last but not least, developers and customers can add a class name into each element by themselves. Figure 17 shows the front-page of TWID5.



Figure 17: The front-page of TWID5

Currently, TWID5 is still built, so it has some bugs. Thus, the duty of author on TWID5 is creating a theme site for TWID Oy so that the author can detect bugs on TWID5.

The Amaranth theme serves a good example, as the purpose of creating this site is that the project manager could show potential customers what the website on TWID5 looks like. Besides, the author could reuse the theme when creating a website for the customer. From a design, I also analyzed the color code, font-style, and structure layout of the design. Then, I used features which are provided by TWID5 such as container, button element, or text element to create the layout website. Next, I also set the class name into a specific element so that the author can style specific element.

Besides, a developer who is a software developer creating the structure HTML code for TWID5, so he does not have knowledge of front-end web development such as implementing a bootstrap container, and a bootstrap component on TWID5. Therefore, when I created a site on TWID5, there were some bugs on HTML code. I took responsibility for writing documentation about how to implement bootstrap in TWID5 for the developer.

Next, the author also tested a new feature coming on TWID5. When a new feature comes, I tested feature. If there was a bug, I found where the bug came from. Then, I found a solution based on TWID5 for developers. After that, he will fix the bug. That will help the developer save time to detect the bug and solve the bug.

The biggest challenge for the author in TWID5 is that the author does not have experience about testing. Thus, the author needs to test new features carefully, so that I can write a proper report to project manager.

## 4. Comparing the Two Platforms

TWID3 and TWID5 give the best solution for creating websites for customers and developers. The differences between the two platforms from the customer's viewpoint are compared in this chapter.

### 4.1 Customer's Viewpoint

The biggest difference between TWID3 and TWID5 for customers is HTML code. In TWID3, when the customers want to create the content for the front-page, they need to know a little bit about HTML code. If they do not know, staff from TWID Oy will train them how to create HTML code so that they can create the content for the front-page or change content on the front-page such as changing image, or changing text. For example, if customers want to change image, they need to go to administration system first so that they copy URL of the image. Then, they go back to the front-page, and put the URL link into the `<img>` tag. These steps are quite complex, so developers at TWID Oy should train the customers. However, the customers do not have time to learn, so whenever they want a change, they need help from TWID.

Fortunately, in TWID5, the problem is solved. The customers do not need to know about HTML code, because the HTML codes are created by React.JS. Besides, TWID5 also gives many elements: text elements, button elements, or image elements. With TWID5's benefits, they can create their content site and change their content site within a few minutes without any help from the TWID staff.

Figure 18 shows the difference between the creating HTML code in TWID3 and TWID5. The left hand-side image is of TWID3, and the right hand-side image is of TWID5.



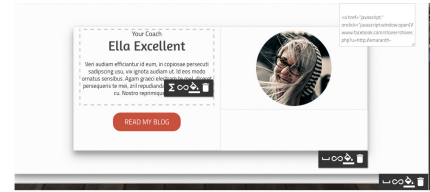
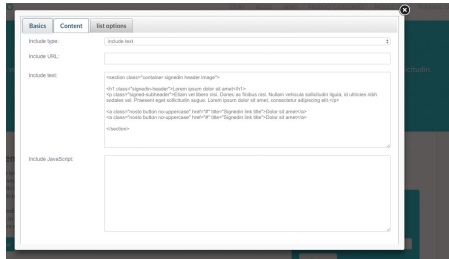


Figure 18: The difference between creating HTML code in TWID3 and TWID5

## 4.2 Technology

In TWID3, the platform uses old technologies such as: DOM for HTML elements, Skeleton for the framework of CSS. Next, TWID3 is not able to work the latest version of JQuery. If the author tries to use the latest one, it will destroy other JQuery code. Because the platform was built six years ago, so the technology cannot be compatible with the latest JQuery. This limits developers implementing many useful JQuery-plugins. Meanwhile, in TWI5, the platform uses trendy technologies such as: Virtual DOM for HTML elements, Bootstrap as a framework of CSS.

Lastly, ReactJS takes responsibility for the whole front-page. Besides, TWID5 is also compatible with the latest version of JQuery code. Now, the author compares in pairs: Skeleton vs Bootstrap, DOM vs Virtual DOM, and JQuery vs ReactJS.

## 4.3 Skeleton vs Bootstrap

Skeleton and Bootstrap both are useful frameworks for creating websites. However, Skeleton is just a light framework, and it cannot give the same amount of benefits as Bootstrap. For example, Bootstrap sets font-size for header, paragraph, and list. Meanwhile, Skeleton does not support typography, so the author sets the font-size manually.

Next, Bootstrap also supports the navigation, carousel, and dropdown list. Skeleton cannot give the same benefits as Bootstrap. Thus, in TWID3, the author spends a lot of time to find JQuery plug-ins or create functions in order to create the carousel, dropdown, and dropdown list. Therefore, Bootstrap saves a huge amount of time in terms of creating websites.

Then, Bootstrap also supports icon-fonts for front-end developers. Icon-fonts include many useful icons such as an arrow icon, a Facebook icon, an Instagram icon, or a Twitter icon. Currently, icon-fonts are the trend for developers who create icons. In TWID3, I need to use images to create social media icon: Facebook, Twitter, or Instagram. The drawback of using the images is whenever the author changes the color of image, I need to use PTS to replace the color in order to match the color of image with the color of website. This is very time consuming. Now, with the support from Bootstrap, whenever I want to change the color of the icon, the color is replaced by CSS code within a few minutes.

I created table 1 in order to summarize all different information such as: user, grids, user interface (ui) tools, browser support, history, and version between Skeleton and Bootstrap

Table 1: Comparison between Skeleton and Bootstrap. Modified from RWD Savjet – Koristile CSS Framework.[26]

	Bootstrap	Skeleton
User:	Large user base	Medium user base
Grids:	Fluid and fixed	Fixed
UI tools:	Many widgets; good for rapid prototyping	Limited
Browser Support:	Desktop: Chrome, Firefox, Safari, Opera, IE7+ Mobile: "tablets and smartphones"	Desktop: Chrome, Firefox, Safari, IE7+ Mobile: Iphone, Ipad, Android
History:	Built by Twitter as a style guide for internal tools	Style agnostic and intentionally lightweight
Version:	4.0.0 alpha	1.2

#### 4.4 DOM vs Virtual DOM

As suggested in Chapter 2.4, DOM stands for Document Object Model. It contains all HTML elements. The JQuery function connects with DOM through the "id" or the

"class" of the element. Nowadays, a dynamic website is complex, so the DOM tree becomes huge and developers always need to modify the DOM tree constantly. That leads to 2 problems for developers:

- It is hard to manage code. For example, if developers lost context, they need to go deep into the code so that they can know how the code works. That takes developers a huge amount of time to do. Besides, developers can create some bugs.
- It is an inefficient method. Developers should update a specific element.

[27.]

In Virtual Dom, ReactComponent takes responsibility for creating HTML code and updating nodes. Thus, a node has a specific ReactComponent. Developers at TWID Oy want to update the node by creating JQuery function inside ReactComponent. In the future, if they want to check JQuery code, they just need to find which ReactComponent is responsible for the code. That saves a huge amount of time for developers. Besides, it also prevents developers from creating bugs.

#### **4.5 JQuery vs ReactJS**

Jquery and ReactJS are both a library of Javascript but totally different in use.

Jquery has several useful functions to create many animations, so it makes websites interactive with clients. In contrast, ReactJS includes not only Javascript code but also HTML code. Thus, ReactJS requires developers' experience about HTML structure.

The advantages of using ReactJS are:

1. As a result of implementing Virtual DOM entirely in JS, it is easy for developers to write UI test cases.
2. Component can be reused easily throughout the websites
3. ReactJS can interact with some popular JS library such as: Angular, and JQuery
4. Whenever developers change underlying data, React will automatically manage all UI updates.

5. Developers can detect components that render a specific piece of UI easily because of ReactJS Chrome extension.

[28.]

Figure 19 below illustrates how ReactJS and JQuery differ in style.

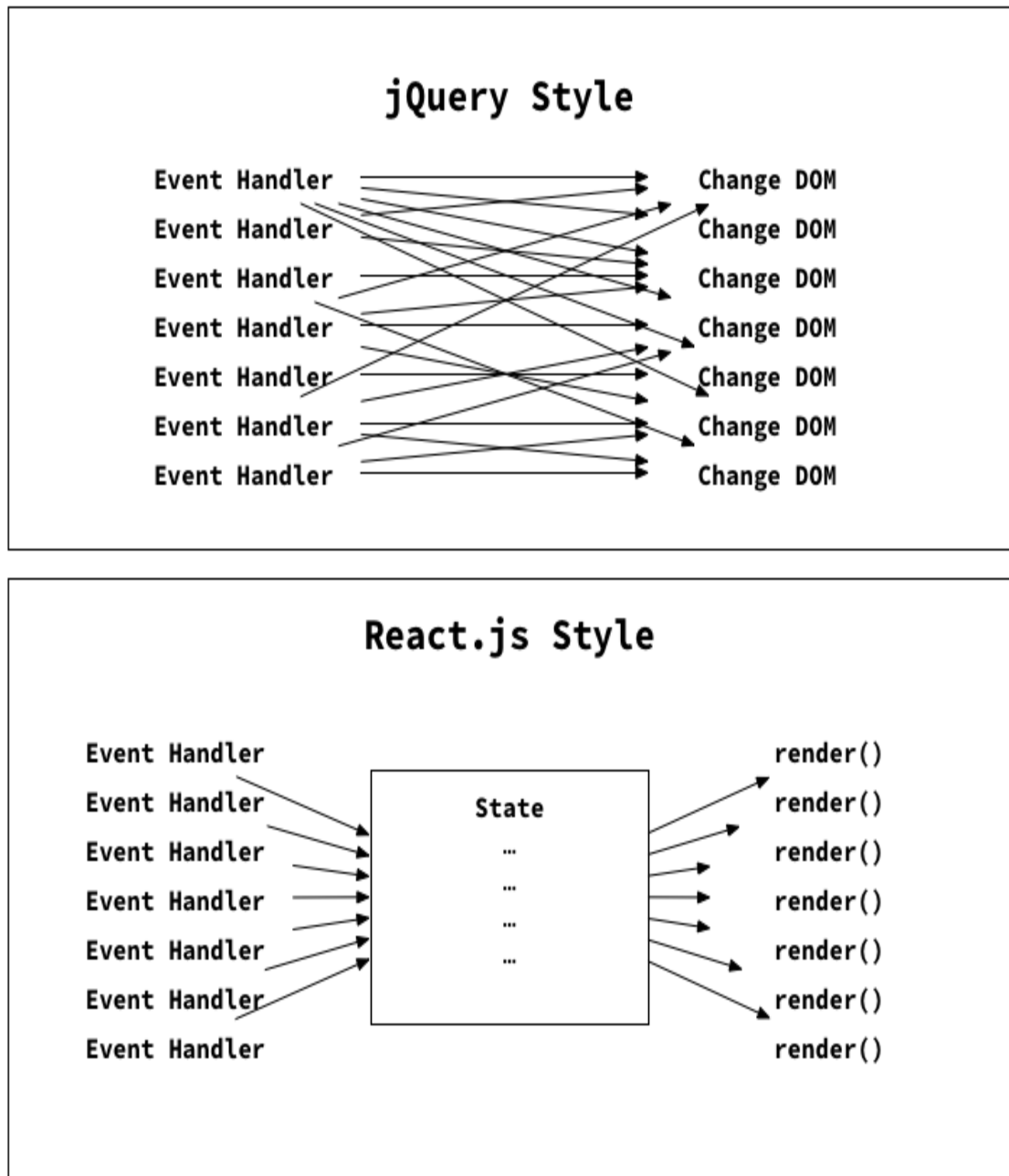


Figure 19: The difference style of ReactJS and JQuery. Copied from React.JS Introduction For People Who Know Just Enough jQuery To Get By. [29]

Then, I created table 2 in order to summarize all the differences between TWID3 and TWID5 for readers.

Table 2: Comparison between TWID3 and TWID5

	TWID3	TWID5
HTML	HTML5	HTML5
Framework of CSS	Skeleton	Bootstrap and Flexbox
Front-end programming language	JavaEE and JQuery	ReactJS
Year	2010	2016

## 5. Experience from Company

Working at TWID Oy, I gained a lot of useful experience. Before the author started working, the author just knew theory of HTML, CSS, JQuery, but the author did not know how to work with CSS framework, create a proper HTML code, and use JQuery efficiently. Thanks to working at TWID Oy, I can work with CSS framework and use JQuery to create animations, and modify the position of HTML code. For example, in TWID3, there are some HTML elements which are created in the center of page by the system. Sometimes, if customers want to change position of elements, I need to use JS code to relocate the elements. Besides, TWID Oy offers a service for creating online-coaching websites, and I handle a lot of different types of images. However, I did not have any experience of PTS before. At the same time, TWID Oy requires every staff member to be able to work individually. Thus, I tried to learn PTS quickly and apply PTS tools in order to redesign an image. When it comes to TWID5, I did not have any experience of ReactJS, because ReactJS is quite complex to learn. I tried to learn self-study ReactJS. Then, based on knowledge and experience of ReactJS, I worked as a testing developer. Besides creating a website based on TWID3, testing the TWID5 platform, I also handled marketing-tools: Hubspot. With Hubspot, I created a lot of landing-pages, and campaign-pages for company. Thus, working at TWID Oy helped the author to gain a huge amount of experience of front-end development, testing, and marketing-tools. The biggest challenge was learning technology quickly. Technology develops everyday, but the customers do not wait for the commissioner to learn. Thus, every problem needs to be solved as fast as possible.

## 6. Conclusion

In conclusion, the goal of this thesis, to compare benefits of two platforms and to show my role in a TWID project, was met. This thesis includes theoretical information of front-end programming languages such as HTML, CSS, JQuery, ReactJS, and image tools: PTS. Based on the theoretical, the thesis shows how TWID3 and TWID5 work.

In general, both platforms bring the best results of creating website for customers. However, because TWID3 was created six years ago, the technology in TWID3 is quite old. Developers at TWID Oy cannot use the latest version of modern language in TWID3. Lastly, TWID3 is also not easy to use with customers. If they want to change a text content or an image, they need to go through several steps to make changes. As a result of developing rapid technology, TWID has developed a new platform called TWID5. Developers use the modern languages in TWID5. Besides, TWID5 is also customers-friendly. Customers can change everything in TWID5 within a few minutes. However, TWID5 is still in the process of being built, as there still are some bugs in TWID5. Developers try to finish all the features in TWID5 so that it can be published in the market in January of 2017.

Last but not least, my role in TWID's project is creating a website based on TWID3, and testing new features in TWID5. When creating a website, I need to create sustainable code so that the website is good looking in every device. Besides, when I test new features in TWID5, I need to write proper documentation in order to describe the correct issue of the new feature and give a solution to the issue.

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