**University of Waterloo**

**Faculty of Mathematics**

**Multi-user Conference Room Design Based on HTML5**

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# Executive Summary

# 1.0 Introduction

(background)Web applications are becoming more and more popular among developers(elaborate).

* Introduction of the idea of user experience and responsive web design.
* Emergence of new, easy web development frameworks.
* Developers often research shallow in framework-specific optimization strategies

(motivation)Figure A shows the time users are willing to spend waiting for a web page to load. According to surveys conducted by Akamai and Gomez.com, 40 percent of the users who go to a website will abandon it if page load time exceeds three seconds.

(Gardner, B. S. (2011). Responsive web design: Enriching the user experience. *Sigma Journal: Inside the Digital Ecosystem*, *11*(1), 13-19.)

Moreover, Google, the most popular search engine, judges page load speed as a factor of the website’s pagerank. In other words, slower-loading pages are less likely to get visits from browsers than faster-loading pages with exact same content.

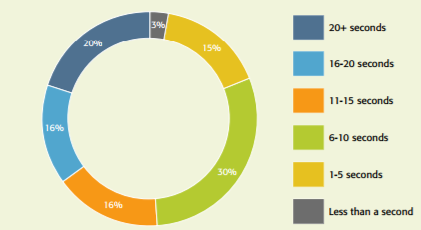


Figure A. Correlating page load time and user patience. Most users will wait only 6 to 10 seconds for a site to load. (Data from <http://blog.kissmetrics.com/loading-time>.)

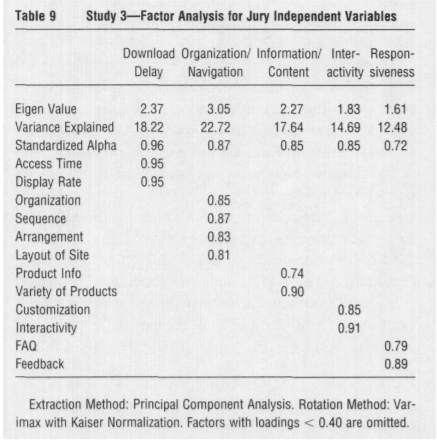
According to study, download delay is one crucial aspect of a web site’s success(Jonathan W.Palmer, 2002).

## 1.1 History of a Webpage’s Usability and Design

Usability of information systems was equivalent to a set of design principles, and one of the five key elements is response time (download delay), which focuses on the speed with which the system provided a response to user activity(Nielsen, 1993).

## 1.2 Studies Around Usability and Design Matrices:

Three studies were conducted to research the importances of the five elements and download delay were one of the most crucial factors of a website’s usability according to regression analysis, as the alpha-value is almost 1.

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(Jonathan W.Palmer, 2002)

# 2.0 Analysis

(insert summary for this section) In this section we are going to focus on how developers can improve the performance of a website by two important aspects: HTML/CSS resources and JavaScript resources.

## 2.1 HTML/CSS Resources

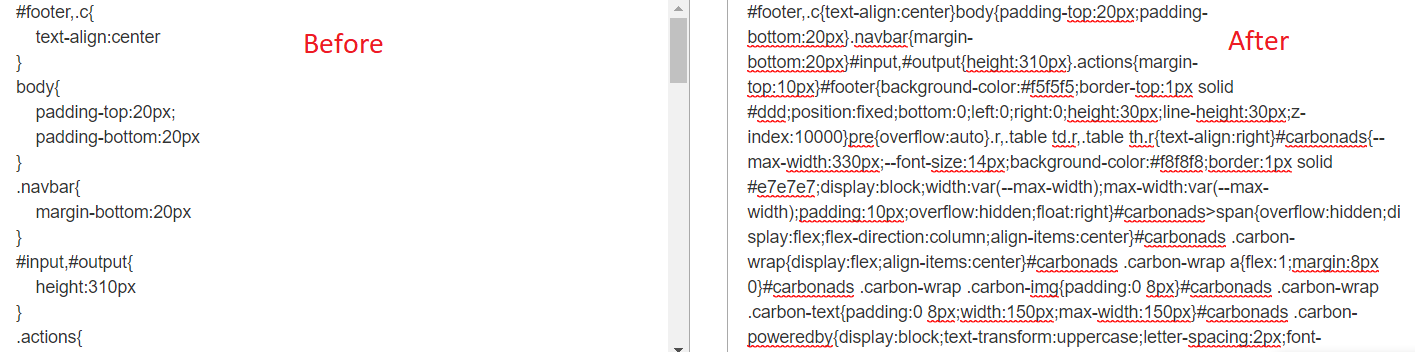
### 2.1.1 Resource Minification

When we develop our websites we often try to make it more human readable by writing a lot of comments, leaving white space and naming the variables with longer and better understandable names for human.

Removing all unnecessary spaces, comments and break will reduce the size of your HTML and speed up your site's page load times and obviously lighten the download for your user. The word ‘Minifying’ stands for this process.

Using minification we can also reduce the bandwidth consumption, what results in smaller energy consumptions for the servers and in the long-term scale it will reflect in smaller running costs.

MINÁRIK, Daniel. *Accelerated Mobile Pages*. Diss. Masarykova univerzita, Fakulta informatiky, 2017.



### 2.1.2 Resource Declaration Ordering

Summary: Having your CSS tags before any JavaScript enables better, parallel download which speed up browser rendering time.

Webpage Loading: When the browser goes to a website (url), it fetches the HTML formatted file first, then it starts asking for all the resources the HTML needs from the server (css, images, scripts, etc.) before rendering (Sexton, 2015). After all css files are loaded, the browser builds the CSSOM (CSS Object Model) which helps rendering project.

Parallel downloading: Resources can be downloaded synchronously. Graph below demonstrates an example of parallel downloading. Five requests, each takes around 77 ms, can be fetched within 100 ms. Whereas, if they were downloaded asynchronously, will take up around 400 ms to load.



Thus we can see that parallel downloading can increase a website’s loading time significantly, and this not only apply to initial load, but also affects page redirection.

According to Introduction to the CSS Object Model from Sexton, while stylesheets are parallel downloaded, script loading often blocks the loading of CSS, so placing all script resource declarations before CSS declarations can make most use of parallel downloading, therefore speeds up the CSSOM construction, the browser can start the rendering process earlier.

### 2.1.3 Non-Blocking CSS Resources

CSS files need to be non-blocking to prevent the DOM from taking time to load.

CSS files can block the page load and delay the rendering of your page.

Preloading allows developers to write fetch requests in the HTML header, specifies the requests that are needed very soon after load. Those resources if specified as ‘preload’, will start loading before the web page is being rendered.

Using preload can actually load the CSS files before the browser starts showing the content of the page. Preloading can also help developers prioritize resource loading.

## 2.2 JavaScripts

### 2.2.1 Remove Render-Blocking Javascripts

During the rendering process of browser, whenever a script block is encountered, the browser will stop everything and start trying to execute the script. It will wait for the script to be downloaded if the script is external and may incur one or more network round trips and delay the time to first render the webpage.

So, developers should include external script declarations together in the header instead of in the body and only have lightweight inline script blocks that are critical or enhances performance, as inline scripts are render-blocking

### Async or Defer Loading

Async attribute of a script element in HTML allows the script to be downloaded asynchronously while rendering. According to Google, by default javascript blocks DOM construction, which is an important part of the rendering process, and delays the time to first render. However, async scripts are not guaranteed to be executed before rendering or to be executed in the order they are declared.

This can help reduce loading speed significantly if the scripts referenced are not required to run before DOM construction.

Defer loading a script element in HTML means only start loading the script resource after the page content is loaded.

Comparing to async loading, this method does not necessarily reduce more time on a web page’s content loading, but can significantly reduce the waiting time on the completion of rendering.

1. Angularjs-specific performance boosts:

(11 Tips to Improve AngularJS Performance, Alex Kras, 2018)