Slow Pages Lose Customers
How Site Performance Optimisation Can Increase Revenue on Desktop and Mobile Sites

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Slow Pages Lose Customers

Fast loading web pages offer a great user experience but site performance does not always receive as much attention as other areas within a digital marketing campaign. Most of the time digital marketers allocate their budgets to natural search, paid search, social media, content and web development overlooking the enormous potential and impact Web Performance Optimisation (WPO) could have on their online businesses in terms of traffic and revenue.

Recent studies have demonstrated that investing in site performance can yield positive ROI as just a small increase in performance can significantly boost conversions. Fast loading pages benefit all of the main traffic channels such as direct, organic, paid and referring traffic. Understanding the direct impact on user experience and how it influences the conversion rate is essential for all digital marketers. With the exponential rise of users embracing smart phone and tablet devices, site performance is expected to become one of the main focus areas for online businesses and gain more attention.

According to Steve Souders\(^1\), web performance evangelist at Google, 80% of a page’s loading time takes place on the user’s end (front end) and the rest on the server (back-end), which includes hardware and infrastructure costs. In a similar manner, it has been estimated\(^2\) that 97% of mobile users’ page loading time occurs at the front end, clearly highlighting importance of site speed on mobile devices. Focusing on front-end enhancements has great potential and in many cases requires less time and resource. There is a big opportunity for online businesses to enrich the overall user experience, online customer’s satisfaction and revenue.

Users Respond to Speed

Several studies have shown that there is a strong correlation between a page’s loading time and traffic. In 2006 Google, one of the first organisations interested in analysing the impact of site speed on online users’ behaviour ran an experiment\(^3\) increasing the number of search results served to users, from 10 to 30. They found that traffic and revenue dropped by 20% only because the page with 30 results was loading half a second slower than the one with 10, despite the page with the 30 results being more useful.

Both Google\(^4\) and Bing carried out user performance tests before mutually concluding that “slow pages lose users”\(^5\). Facebook also conducted their own experiments\(^6\), commenting that the number of page views increased when pages were loading faster. With Google, Bing and Facebook having agreed on the linear relationship between server delays and user satisfaction it is not surprising that other large e-commerce organisations also decided to study the implications of site performance.

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\(^1\) High Performance Web Sites: Essential Knowledge for Front-End Engineers, Steve Souders (O’Reilly 2007)
\(^2\) Early findings: 97% of mobile end-user response time happens at the front end, Joshua Bixby (Strangeloop 2011) http://www.webperformancetoday.com/2011/04/20/desktop-vs-mobile-web-page-load-speed/
Slow Loading Pages Have Lower Conversion Rates

In 2009 Amazon found\(^7\) that every 100 milliseconds of latency cost them 1% in sales. In other words, one second of latency was negatively affecting Amazon’s revenue by approximately 10%. Another retail site (Shopzilla\(^8\)) reduced the average page loading time on their site from seven to two seconds and experienced an increase in the number of page views by 25%, while revenue also increased by 7-12%.

In a more recent study, Walmart\(^9\) reported a 2% increase in conversions for every second of improvement in their pages’ loading time, suggesting that site speed is deemed by users as even more important than suggested in previous studies. The following graph summarises Walmart’s findings on the relation between page loading time and conversion. There is clearly a dramatic decline in conversion rate as the page loading time increases from one to four seconds.

In another recent study, Tagman\(^{10}\) found that a one second delay in page-load time can result in a 7% loss in online sales. The following graph clearly shows that conversions peak when pages are loaded in one to two seconds and steadily diminish as latency increases. The most interesting observation is how similar Tagman’s findings are to Walmart’s with regards to the relation between conversion rate and page loading time.

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Analysing real user conversion data of 33 major retailers Gomez found\(^\text{11}\) that the conversion rate increases by 74% when page loading time drops from eight to two seconds.

**The Optimal Page Loading Time**

In 2006 consumers\(^\text{12}\) were expecting pages to load in less than four seconds. However, a 2009 survey conducted by Forrester Consulting on behalf of Akamai\(^\text{13}\) found that 47% of consumers were expecting an ecommerce page to load in two seconds or less. That means that in just three years there was a two second difference in online shoppers’ expectations with regards to the ideal page loading time on desktop. A 2012 Compuware survey\(^\text{14}\) also confirmed that the majority of tablet users (70%) expected a website to load in two seconds or less.

Despite users’ increasing web performance expectations it is worth noting that web pages contain more and more data than the past. In 2012 the average webpage exceeded 1MB in size and keeps growing as technology advances. Using a linear regression model it looks like the average web page size will exceed 2MBs early in 2016, making site performance optimisation even more important in the years to come.

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Repeat Purchases
It is worth pointing out that slow loading pages not only hurt conversions but also how users perceive online brands. The aforementioned Forrester/Akamai study found that 79% of users who experienced slow page loading times were less likely to buy from the same site again, while 27% were less likely to buy from the same business’s physical store. That shows that site speed can have a big impact on online and offline reputation as well as sales.

Site Speed is Extremely Important to Mobile Users
Web pages’ loading times on 3G (or even 4G) mobile networks are much higher due to latency. Mobile devices also have less processing and memory capabilities as well as a limited battery life. Thus, mobile performance needs to be addressed separately bearing in mind that Google’s smartphone crawler seems to favour fast sites for searches on mobile devices.

The following two graphs demonstrate how different networks offer totally different experiences to users. Undoubtedly, mobile users are more limited especially when downloading on a 3G network where latency is soaring.

Source: Compuware
A study from Gomez\textsuperscript{15} revealed that most users are now expecting a website to load on their smartphone as fast as it does on their desktop. Apparently, 74\% of users would give up after waiting for five seconds for a website to load on a mobile device. The following graph demonstrates how the abandonment rate increases steeply as page loading time increases on desktop and mobile sites.

![Abandonment Rate Graph](source: gomez.com)

Even though users of mobile devices are more patient, conversion rate still falls-off as the landing page loading time increases. Research conducted by Strangeloop\textsuperscript{16} showed that conversions on mobile devices peak at around five seconds and then progressively diminish. Gomez analysed\textsuperscript{17} the mobile site performance of 14 leading retailers and found that the average page loading time was 4.73 seconds.

However, with the constantly growing size of web pages, mobile users are the ones who will suffer the most if online businesses do not improve their websites’ performance on mobile devices.

**Google’s Stance on Site Performance**

In 2010 site speed was added to Google’s ranking factors, affecting 1\% of searches according to the official announcement\textsuperscript{18}.

> “Faster sites don’t just improve user experience; recent data shows that improving site speed also reduces operating costs. Like us, our users place a lot of value in speed — that’s why we’ve decided to take site speed into account in our search rankings.”

Despite Google’s acknowledgment, site performance still does not carry as much weight as the relevance of a page. However it is in Google’s best

interest to make the web faster so it’s no surprise that they incentivise webmasters to speed up their websites.

A faster internet would allow search engines to index sites quicker, while substantially reducing their infrastructure costs. Online businesses would also benefit as their web pages would be crawled and indexed quicker by the search engines. In general, fast loading sites make better use of their allocated crawl budget and therefore can achieve higher visibility in organic results.

How to Measure Site Performance

There are several tools and services to measure site performance, both free and paid. Depending on the way performance is measured, there are two main types of services each one with its own strengths and weaknesses.

Synthetic Measurement

These services simulate site performance by executing scripts which have been distributed across different servers so site performance can be measured for different browsers and geographic locations. This can be very useful when real user data is not available e.g. measuring site performance for a new site or site redesign before launch. The main disadvantage of this type of measurement is that it does not monitor data from actual visitors. Measuring the loading times for many different pages can be very time consuming and most of the time just a few typical pages will be measured.

WebPageTest.org is a popular synthetic measurement service that allows users to run tests from various locations, different internet connections and browsers. Page speed measurements are then analysed and the page’s resources loading times are reported in great detail. Pingdom Tools is another popular synthetic service that offers site performance recommendations, as well as grades.

Google also offers some synthetic measurement services such as Page Speed Tools to analyse web performance for desktop sites and the Gomometer for mobile sites. Total Site Performance offers a measurement service that compares a website’s loading time against the industry’s fastest website, while Blaze.io and Mobitest are two popular testing services for performance on mobile devices.
Real User Measurement

Even though synthetic measurement can provide some very useful insights, more and more online businesses are now embracing Real User Measurement (RUM) for more accurate data on site performance. RUM services use JavaScript to monitor page loading times in real time as users are visiting a website. This way, site performance can be tailored to meet the needs of actual visitors, rather than make assumptions about how fast their internet connection is, what browser and device they use and where they are geographically located. Currently, one out of five top Ecommerce sites rely on RUM according to Strangeloop.\(^{19}\)

Google provides Real User Monitoring performance data in Google Analytics, using the Navigation Timing API\(^{20}\) to measure page load time in different browsers and geographic areas. There is a lot of granularity in Google Analytics site speed reports including measurements for page loading, redirects, DNS lookups and more. The following table shows the average page timings on a website broken down in time buckets.

<table>
<thead>
<tr>
<th>Page Load Time Bucket (sec)</th>
<th>Page Load Sample</th>
<th>Percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1</td>
<td>26,052</td>
<td>45.00%</td>
</tr>
<tr>
<td>1 - 3</td>
<td>23,031</td>
<td>41.44%</td>
</tr>
<tr>
<td>1 - 1.5</td>
<td>10,959</td>
<td>19.02%</td>
</tr>
<tr>
<td>1.5 - 2</td>
<td>6,651</td>
<td>11.51%</td>
</tr>
<tr>
<td>2 - 2.5</td>
<td>3,926</td>
<td>6.79%</td>
</tr>
<tr>
<td>2.5 - 3</td>
<td>2,385</td>
<td>4.09%</td>
</tr>
<tr>
<td>3 - 7</td>
<td>5,779</td>
<td>10.00%</td>
</tr>
<tr>
<td>7 - 13</td>
<td>1,300</td>
<td>2.26%</td>
</tr>
<tr>
<td>13 - 21</td>
<td>404</td>
<td>0.70%</td>
</tr>
<tr>
<td>21 - 35</td>
<td>206</td>
<td>0.35%</td>
</tr>
<tr>
<td>35 - 60</td>
<td>69</td>
<td>0.12%</td>
</tr>
<tr>
<td>60+</td>
<td>49</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

Site performance report in Google Analytics

Combining these measurements with goals and conversions data can provide some invaluable insights. On the other hand, Google Analytics site performance data collection has as a limited sampling rate which can be boosted to a maximum of 10k samples per day. Also, the Navigation Timing API does not support all browsers; many old browsers as well as popular mobile devices are not supported, which is an essential weakness. Other third party RUM services offer more granular information because they cover more browsers, locations and pages users visit. Some of the most popular ones include Torbit Insight, LogNormal and New Relic. Such services provide very detailed site performance histograms, as well as real-time monitoring and many useful business metrics (e.g. bounce rate).

\(^{19}\) Only 1 out of 5 top ecommerce sites uses RUM, Joshua Bixby (2012) http://www.webperformancetoday.com/2012/11/13/real-user-monitoring-rum-ecommerce-sites/

How to Increase Site Performance

There are several ways to improve site performance and make pages load faster. Identifying the areas that can be improved is important but prioritising the different actions is equally important. This often varies from case to case depending on platform specific capabilities, available resources and effort estimates.

Top Tips:

1. **Number of HTTP Requests**
   
   This is one of the most common site performance obstacles caused by several file requests required for a page to fully render.
   
   - Combining JavaScript or CSS files where possible can substantially reduce the number of requests, hence boosting performance.
   - Use image Sprites. Where multiple small image files are being used extensively on a page, combining them into one image file will reduce the number of HTTP requests.
   - Reduce the number of social sharing buttons, so only the most useful ones are present. Having too many social sharing buttons can significantly increase a page’s loading time because each button makes additional requests to each social network’s server.

2. **Size of HTTP Requests**
   
   - Compressing HTML, CSS and JavaScript files using Gzip compression can bring significant performance benefits.
   - Minifying JavaScript and CSS files can allow browsers to download them faster. Minified versions of files are free from redundant characters such as comments and white spaces.

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• Cookies are not needed for static files; therefore static files can be served from separate cookie-less domains.

3. Parallel HTTP Requests vs. DNS Lookups
• This technique is also known as Domain Sharding\textsuperscript{22}. Enabling browsers to download different types of resources (files) in parallel can significantly increase a page’s loading time. Most modern browsers allow for a maximum of 6-8 parallel connections. When all files are served from the same host domain they end up being downloaded sequentially rather than simultaneously. Therefore, distributing the different page resources across multiple domains allows the different files to be downloaded concurrently.
• Reducing the number of DNS lookups can increase response times as can reducing the number of parallel downloads. Yahoo’s developer network\textsuperscript{23} recommends using at least two, but no more than four host domains to get the right balance between a low number of DNS lookups and concurrent downloads.

4. Order of HTTP Requests
• Because JavaScript files rarely change, placing the CSS files before the JavaScript files is recommended.
• Where possible, JavaScript files should be placed to the bottom of the page.

5. Caching
This is a technique that allows a web page’s resources to be stored locally to save serving additional HTTP requests that increase latency.
• Enabling caching for static files (e.g. images, CSS, JavaScript) will allow pages to load faster if the user has previously been to the site.
• Inline CSS and JavaScript files should be moved to external files so they can be cached.

6. Images
Image optimisation is very important because images are often the largest files to be downloaded by a browser.
• Optimise images by compressing them or making them smaller.
• All images need to be uploaded to the web server with the exact height and width that will be displayed. Specifying different image dimensions in the HTML source code can result in delays as the images get resized after they have been downloaded.
• Using the correct file format without losing image quality is also essential. The JPEG format is preferred for photos because it results in smaller file sizes. The PNG format is ideal for transparent images as well as icons, graphs and backgrounds. The GIF format should be used for animations.

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\textsuperscript{22} Sharding Dominant Domains (Steve Souders, 2009), \url{http://www.stevesouders.com/blog/2009/05/12/sharding-dominant-domains/}
7. **Hosting & Web Server**
   Investing in a faster web server or more reliable hosting provider with less downtime is strongly recommended.

8. **Redirects**
   By and large any kind of redirect increases a page’s loading time. Multiple (or chain) redirects need attention as they can lead to very poor site performance. Similarly, internal redirects need to be eliminated because they are redundant.

9. **Asynchronous Loading**
   - Loading some of the resources asynchronously means that some parts of a web page can be updated later e.g. after the user performs a certain action. For example, heavy images do not need to be downloaded when a web page loads for the first time. Instead, some lighter thumbnails can be loaded by default and the full images can be downloaded later.
   - Optimising the analytics tracking code can contribute to site performance. Updating the analytics script so it loads asynchronously will not block any resources that load later in the page. Also, utilising two or more analytics tracking codes from different analytics providers may not be necessary as each script adds to latency.

**Conclusion: Why Site Speed is a Great Opportunity**

Numerous studies have shown the linear relationship between site performance and conversions as well as overall user satisfaction. This report has highlighted the enormous potential that sits within the development teams of any mature online businesses. Site performance optimisation is a specialist area that requires thorough analysis, planning, benchmarking, flawless implementation and on-going testing to ensure that it is not negatively affecting users.

Mobile site performance needs to be addressed separately and online businesses that do not manage to provide a satisfactory mobile experience will almost certainly fall behind their competition. Whilst increased conversions and revenue are more than sufficient reasons to make this an area of investment, other benefits that cannot be overlooked include increased customer satisfaction, loyalty, confidence and trust, which are equally important to strengthen the online presence of existing or new online businesses.
About iCrossing

iCrossing UK is a digital marketing agency specialising in data driven strategies to build connected brands and create great experiences.

The company blends best-in-class digital marketing services — including paid media, search engine optimization, creative, Web development, social media, UX, research and analytics — to create integrated digital marketing programs that engage consumers and drive ROI.

iCrossing UK’s client base includes such recognised brands as The Coca-Cola Company, LG Electronics, The LEGO Group, Virgin Atlantic and John Lewis.

iCrossing UK is part of iCrossing, one of the world’s largest digital marketing agencies, which employs over 850 staff in 19 offices around the globe, including 150 staff based at UK offices in London, Manchester and Brighton.

iCrossing is a unit of Hearst Corporation, one of the nation's largest diversified media companies.

If You Have Any Other Questions...
Or if you would like to speak directly to our team, please do not hesitate to contact us at results@icrossing.co.uk or 01273 827700.