

School of Computing

Botanic Garden Endowment Trust Website Development

Course number	AC52010
Project Title	Botanic Garden Endowment Trust Website Development
Author	Pedro Jorge Duarte Silva Ramos
Name of Degree	MSc Information Technology and International Business
University	University of Dundee
Supervisor	Prof Janet Hughes
Date	10 September 2015



Executive Summary

The Botanic Garden Endowment Trust Website Development project took place between 13 May 2015 and 10 September 2015. The Dundee Botanic Garden Endowment Trust required a website to promote itself to the local community and beyond. Additionally, the Endowment Trust website was to be developed in order to be a platform where visitors could find out more about the organisation and the Garden and perform certain tasks. Development of the website ended on 25 August 2015 and the finished product was shown at a public demonstration at the School of Computing on 08 September 2015.

Declaration

“I declare that the special study described in this dissertation has been carried out and the dissertation composed by me, and that the dissertation has not been accepted in fulfilment of the requirements of any other degree or professional qualification.”

(Pedro Jorge Duarte Silva Ramos)

Certificate

“I certify that Pedro Jorge Duarte Silva Ramos has satisfied the conditions of the Ordinance and Regulations and is qualified to submit this dissertation in application for the degree of Master of Science.”

(Janet Hughes)

Acknowledgements

I would like to thank Professor Janet Hughes, the project supervisor, for her guidance throughout the entire project, and Mr Gordon Ramsay, the Trust Development Officer and project sponsor, for his assistance and cooperation during the development of the *Dundee Botanic Garden Endowment Trust* website.

I would also like to thank Ms Caroline Petrie, Mr Michael Berry and Mr Ross Haggart of the University of Dundee's Web Team for their assistance with the technical aspects of web development.

Finally, I would like to thank my parents for their enormous support and for always believing in me.

Table of Contents

1. Introduction	1
2. Background.....	2
3. Requirements specification.....	4
3.1. Introduction	4
3.2. Annotations on websites about botanic gardens.....	5
3.3. Conclusion.....	11
4. Design.....	13
4.1. CMS or not	13
4.2. Which CMS?	13
4.2.1. Drupal.....	13
4.2.2. Joomla.....	14
4.2.3. WordPress.....	14
4.3. External deployment or internal?	15
4.4. Conclusion.....	16
5. Implementation.....	17
5.1. Local sever environment	17
5.2. Application to the Ethics Committee.....	17
5.3. <i>Dundee Botanic Garden Endowment Trust</i> website (Development Version).....	18
5.4. <i>Dundee Botanic Garden Endowment Trust</i> website (Final Version)	23
6. Testing	26
6.1. User-centred	26
6.2. Plugins	26
6.2.1. Local environment.....	26
6.2.2. Development environment	26
6.3. Pages.....	27
6.3.1. Presence.....	27
6.3.2. User approval.....	27
6.4. Feedback session (staff, students and people outside the University).....	27
6.5. W3C and WCAG 2.0.....	32
6.5.1. Accessibility errors	32
6.5.2. Browser testing	32

6.6. Live environment.....	32
6.6.1. Review.....	32
6.6.2. Plugins.....	32
7. Evaluation.....	33
7.1. Website.....	33
7.2. Project.....	33
7.2.1. Quality.....	33
8. Summary and Conclusions.....	36
9. References.....	37

List of Figures and Tables

Table 1 - Initial Requirements	4
Table 2 - <i>The Birmingham Botanical Gardens</i>	6
Table 3 - <i>Cambridge University Botanic Garden</i>	7
Table 4 - <i>Cruickshank Botanic Garden</i> (University of Aberdeen).....	8
Table 5 - <i>Royal Botanic Garden Edinburgh</i>	9
Table 6 - <i>University of Oxford Botanic Garden</i>	10
Table 7 - Summary of Requirements.....	12
Figure 1 - Website hosting in University of Dundee server	3
Figure 2 - Relationships of the Trust Development Officer during development	3
Figure 3 - External deployment or internal deployment?.....	15
Figure 4 - Development version of the website.....	18
Figure 5 - Theme installation.....	19
Figure 6 - Development version detailed	20
Figure 7 - Home page of the Development version of the website	22
Figure 8 - Home page of the Development version of the website	22
Figure 9 - Home page of the Development version of the website	23
Figure 10 - Final version in the development environment.....	24
Figure 11 - Final version in the live environment	24
Figure 12 - Final version detailed.....	24
Figure 13 - Home page of the Final version of the website.....	25
Figure 14 - Home page of the Final version of the website.....	25
Figure 15 - Home page of the Final version of the website.....	25

1. Introduction

The Dundee Botanic Garden Endowment Trust is an organisation created to support the University of Dundee's Botanic Garden. The Endowment Trust required a website to promote itself to the local community and beyond. Additionally, the *Endowment Trust* website was to be developed in order to be a platform where visitors could:

- find out about the Endowment Trust's mission and goals for supporting the Botanic Garden;
- how the Endowment Trust contributes to the Dundee community;
- discover the history of the Botanic Garden and its curators;
- how to make a donation to the Endowment Trust;
- read the latest news about the Endowment Trust and the Botanic Garden;
- find out about events taking place in the Botanic Garden, organised by the Endowment Trust and other institutions.

Development of the *Dundee Botanic Garden Endowment Trust* website began on 13 May 2015 and ended on 25 August 2015. The website was shown at a public demonstration at the School of Computing on 08 September 2015.

The following report describes the overall project and the development of the *Dundee Botanic Garden Endowment Trust* website.

2. Background

According to *Oxford Dictionaries* (2015), a botanic garden is “[a]n establishment where plants are grown for scientific study and display to the public.” Study, exhibition and teaching about plants “define what a classical botanical garden is.” Additionally, they “have a broader and more comprehensive mission than other kinds of plant-focused institutions, such as display gardens, environmental education centers, universities, or public gardens, that participate in only some of these activities” (*The New York Botanical Garden*, 2015). The *International Agenda for Botanic Gardens in Conservation* also states: “Botanic gardens are institutions holding documented collections of living plants for the purposes of scientific research, conservation, display and education” (*Botanic Gardens Conservation International*, 2015a).

Although gardens and the cultivation of plants date back nearly 3000 years ago in Ancient Egypt and Mesopotamia, the first botanic garden was established by Luca Ghini in 1543 at the University of Pisa. Soon after, other Italian universities also established their own botanic gardens. They “were purely for the academic study of medicinal plants.” During the 16th and 17th centuries, botanic gardens were created throughout Europe. The oldest botanic garden in the United Kingdom is at the University of Oxford. It was established in 1621 “to promote learning and the glory of God” (*Botanic Gardens Conservation International*, 2015b).

Investopedia (2015) defines an endowment fund as “[a]n investment fund set up by an institution in which regular withdrawals from the invested capital are used for ongoing operations or other specified purposes. Endowment funds are often used by nonprofits, universities, hospitals and churches. They are funded by donations, which are tax deductible for donors.” *York University* (2015) goes further and explains the difference between endowments and trusts.

Endowments are original donations which are “held and invested in perpetuity” and “[o]nly a portion of the income earned on investment is made available for spending on a yearly basis for a designated purpose.” Additionally, “[e]ndowed funds have a capital balance and this capital is invested externally in an investment pool” (*York University*, 2015).

Trusts are “[e]xpendable donations” or funds which “are held and spent within a finite period of time.” Additionally, trusts constitute “[r]evenues in the form of donations” and “[e]xpenditures towards the purpose of the Trust;” “[f]unds held in Trusts are not invested externally and do not receive interest allocations” (*York University*, 2015).

Both endowments and trusts can be used for various purposes, such as scholarships, bursaries, awards and support of chairs, professorships, operations or capital projects (*York University*, 2015).

The Dundee Botanic Garden Endowment Trust was founded in 2013 and formally launched in October 2014 to support the University of Dundee’s Botanic Garden. No website for the Dundee Botanic Garden Endowment Trust existed at the outset. The Trust Development Officer, currently Mr Gordon Ramsay, who had some experience of social media but no experience in web development influenced the development of the website. For example, the website was to be hosted using University of Dundee facilities.

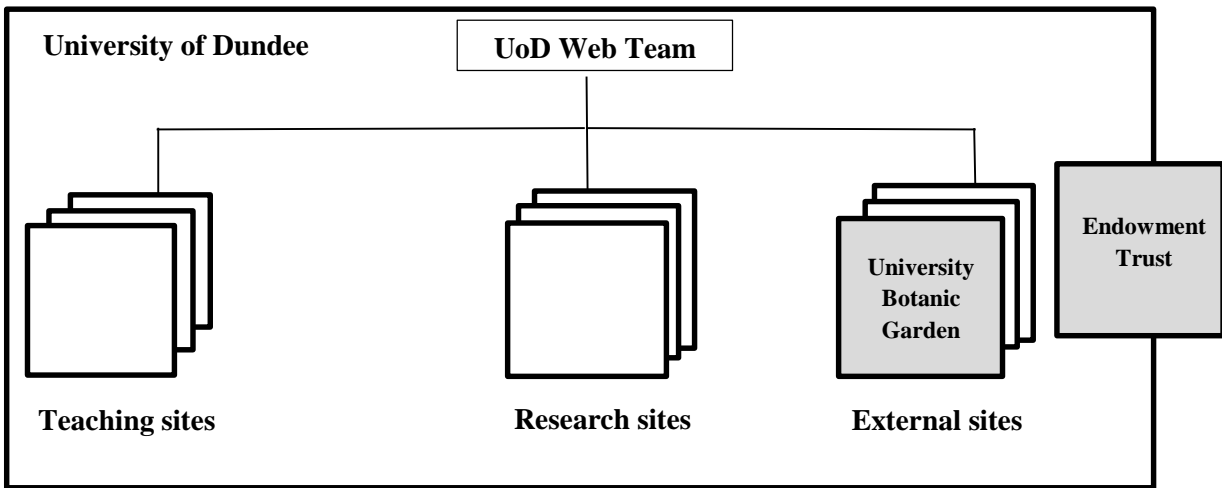


Figure 1 - Website hosting in University of Dundee server

Mr Ramsay assisted the developer throughout the development process by providing content to be featured on the website. He also liaised with The Countess of Dalhousie, the Patron of the Endowment Trust, and with the Trustees, whom influenced the requirements that the website should fulfil.

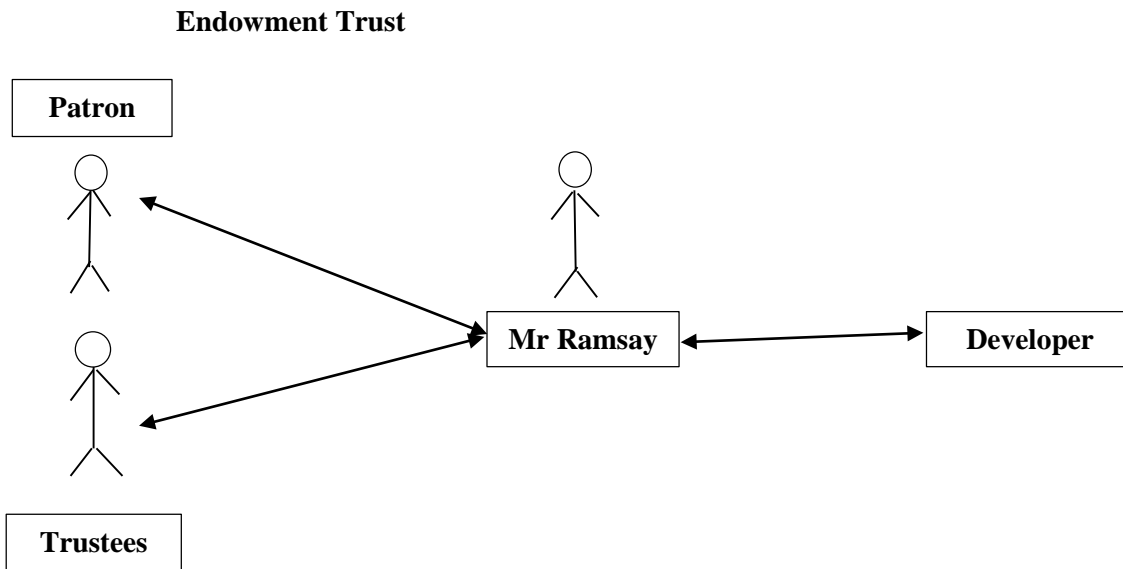


Figure 2 - Relationships of the Trust Development Officer during development

The *Dundee Botanic Garden Endowment Trust* website was designed as a vehicle to promote the Endowment Trust to try to support the organisation's goals, since the Trust has a goal of raising £3 million pounds in order to support the financial future of the Botanic Garden. Additionally, the website was designed in order to be administered by someone other than a web specialist, as required by the Trust Development Officer.

3. Requirements specification

3.1. Introduction

The project sponsor, who was the Trust Development Officer, provided a list of initial requirements at the start of the project (Appendix 1 and Table 1). These focused on content and function but there were also non-functional requirements:

- what pages and links needed to be featured on the website for visitors (R1, R2.1, 2.2, 2.4 – 2.10, 2.15, 2.16, R3, R5.1, 5.2, 5.4, 5.5);
- inclusion of a donation link for visitors to make a secure online donation (R4);
- inclusion of a PDF version of the Endowment Trust leaflet for visitors to download (R12);
- design the website in a way that users would be comfortable navigating on (R14-17);
- that the website be easily administered (R18).

After analysing the initial requirements, the developer also searched for websites about botanic gardens to aid in the development of the *Dundee Botanic Garden Endowment Trust* website.

Table 1 - Initial Requirements

Functional Requirements
R1 Display Home/Main page
R2 Display static pages
R2.1 “The Garden” page
R2.2 “History” page
R2.4 “About the Trust” page
R2.5 “Purpose” page
R2.6 “Vision” page
R2.7 “Goals” page
R2.8 “The Countess of Dalhousie” page
R2.9 “Events” page
R2.10 “Support Us” page
R2.15 “Directions” page
R2.16 “Contacts Us” page
R3 Display “News” page
R4 Display donation link
R5 Display links to external websites and social media
R5.1 <i>University Botanic Garden</i> website
R5.2 <i>Friends of the Botanic Garden</i> website
R5.4 <i>Dundee Botanic Garden Endowment Trust</i> Facebook page
R5.5 <i>Dundee Botanic Garden Endowment Trust</i> Twitter page
R6 Scottish Charity Status
R12 Download Accessible PDF Leaflet
Non-functional requirements
R14 Website hosted on the University of Dundee server
R15 Navigation within 10 minutes without training
R16 Access the menu without training
R17 Find any page within a minute
R18 Administration with minimal training

3.2. Annotations on websites about botanic gardens

An important step before building the *Dundee Botanic Garden Endowment Trust* website was to search for and analyse the positive and negative aspects of similar websites. The websites in question were all concerned with botanic gardens, whether part of an academic institution or not: *The Birmingham Botanical Gardens*, *Cambridge University Botanic Garden*, *Cruickshank Botanic Garden* (University of Aberdeen), *Royal Botanic Garden Edinburgh* and *The University of Oxford Botanic Garden*.

All websites were found using search engines and the findings were narrowed down to botanic gardens located in the United Kingdom, including those owned by universities, since the Dundee Botanic Garden was founded by the University of Dundee.

By taking notes of the positive and negative aspects of each website, information was gathered to aid in the development of the *Dundee Botanic Garden Endowment Trust* website by emulating the positive aspects and also avoiding or fixing the negative aspects. Some considerations, however, are subjective and may vary from person to person. The purpose was to focus on design aspects not actual content.

The project supervisor also suggested using web accessibility tools in order to verify “conformance with accessibility standards to ensure the content can be accessed by everyone” (AChecker, 2011). The tools used for the website accessibility tests were AChecker (2011) and WAVE (2015).

The next section of the report provides an individual table with its best and worst features of each website and a short summary.

Table 2 - The Birmingham Botanical Gardens

Positive Aspects	Negative Aspects
Includes “Welcome” text on the main page.	Two headers. One is a picture slideshow, which can be distracting.
“Contact Us” and “Directions” as separate pages and menu entries.	Menu between headers.
Some featured links on the main page, after the text, but could be featured on the left side.	Social links and search field in the top header.
Good use of colours (happy colours).	Sitemap, Privacy Policy and Terms and Conditions in very small print.
According to <i>WAVE</i> , the website achieved the score of 13 positive features in website accessibility related to the use of alternative text for images (WCAG 2.0 Level A).	“News” bar as a slideshow. It could be a table on the main page instead. However, it is a separate page and menu entry.
	No “Directions” or “What’s On” on the main page.
	According to <i>WAVE</i> , the website has one error in website accessibility: 1 missing form label (WCAG 2.0 Level A).
	According to <i>AChecker</i> , the website has 6 errors in website accessibility, such as label navigation and colour contrast errors (WCAG 2.0 Levels A, AA and AAA).

The *Birmingham Botanical Gardens* website was the most appealing to visitors in its use of colours. Additionally, it was one of three websites that scored highest on positive accessibility features, according to *WAVE*. Nevertheless, some links had very small print, which made them hard to read, while others were located in inconvenient sections on the main page.

Table 3 - Cambridge University Botanic Garden

Positive Aspects	Negative Aspects
Social links are highlighted in a separate box to the right on the main page. A BBC Weather Report link is also included.	Does not make good use of colours and layout.
“What’s On” section includes a calendar.	Search field is also in the header.
Every page includes the address of the Botanic Garden on the left side after the menu.	“About us”, “Support us” and “Contact us” buttons above the header.
Header also acts as link to the main page.	Perhaps too much content on the main page.
Includes Home button in the menu.	Includes emblem of the University and a link to the University’s website but these are located at the very bottom of the page.
According to <i>WAVE</i> , the website achieved the score of 15 positive features in website accessibility related to the use of alternative text for images and link navigation (WCAG 2.0 Level A).	Some pages feature repeated entries on both the page and as menu entries, which is redundant.
	While a “News” section is featured on the main page, the website does not have a “News” menu entry in the menu.
	Does not include sitemap.
	According to <i>WAVE</i> , the website has six errors in website accessibility: 1 missing form label and 5 empty links (WCAG 2.0 Level A).
	According to <i>AChecker</i> , the website has 42 errors in website accessibility, mostly colour contrast errors (WCAG 2.0 Levels A and AAA).

Out of the five websites, the *Cambridge University Botanic Garden* website was the most unappealing and had too much content on the main page, which could overwhelm visitors. Additionally, the main page included redundant content and links and some links were located in rather inconvenient sections. It also did not include a sitemap, an important feature for accessibility and search-engine optimisation (SEO) (Barron, 2014). It was also the website with the highest number of accessibility errors, according to *AChecker*.

Positive features included highlighted social links, a BBC Weather Report link, a Home button in the menu and a calendar. It was the website that scored highest in positive accessibility features, according to *WAVE*.

Table 4 - Cruickshank Botanic Garden (University of Aberdeen)

Positive Aspects	Negative Aspects
Includes “Welcome” text on the main page. Facebook link is highlighted right after.	Header features a picture slideshow, which can be distracting. It also includes text and a “Learn More” link; these links could be featured on the left side of the website, which is underused (only includes two “Essential Links”).
“News” and “Events” sections featured on the right side of the main page.	“Visit Old Aberdeen” and “Giving to the Gardens” could be included in the “Essential Links” section instead of being right after the “Welcome” text.
Includes Home button in the menu.	Menu is above the header, which visitors may not notice at first.
Includes sitemap.	“History” and “Contacts” could be main menu entries instead of being sub-entries in the “About us” page.
According to <i>WAVE</i> , the website achieved the score of 14 positive features in website accessibility related to the use of alternative text for images, null alternative text, form label and link navigation (WCAG 2.0 Level A).	“Location” and “Map” are featured in the “Visiting the Gardens” section but could be highlighted as separate pages/menu entries or on the main page.
	No “Privacy Policy” and “Terms and Conditions” links.
	Some quick links are featured in top-right corner of the website but could have a more prominent position.
	According to <i>WAVE</i> , the website has 2 errors in website accessibility: 1 image missing alternative text and 1 empty button (WCAG 2.0 Level A).
	According to <i>AChecker</i> , the website has 9 errors in website accessibility, such as missing alternative text for image and 8 formatting errors (WCAG 2.0 Levels A and AA).

While the *Cruickshank Botanic Garden* website had fewer accessibility errors than the *Cambridge University Botanic Garden* website, some content was not easy to find and the main page was somewhat unorganised.

Table 5 - Royal Botanic Garden Edinburgh

Positive Aspects	Negative Aspects
Header features announcement of a time limited event.	Does not include “Welcome” text.
Social link right below the menu.	Does not include Home button in the menu.
“Visitor Information” table on the main page.	Quick links should be featured on the left side and not at the bottom of the page.
“What’s On” section as a table on the right side of the main page. It is also included as a separate page and menu entry.	“Home” and “Contacts” links above the header. They should be featured in the menu.
Header also acts as link to the main page.	Directions should be easier to find. Could be included on the main page and highlighted in the menu.
Includes sitemap.	According to <i>WAVE</i> , the website has 5 errors in website accessibility: 1 image missing alternative text, 1 document language missing, 1 empty button and 2 empty links (WCAG 2.0 Level A).
Includes “Accessibility” and “Website Accessibility” links.	According to <i>AChecker</i> , the website has 7 errors in website accessibility, such as missing alternative text for image and document language as well as label and link navigation (WCAG 2.0 Levels A and AA).
According to <i>WAVE</i> , the website achieved the score of 4 positive features in website accessibility related to the use of alternative text for images and form label (WCAG 2.0 Level A).	

The *Royal Botanic Garden Edinburgh* website, along with the *University of Oxford Botanic Garden* website, were the only balanced websites, having roughly the same number of positive aspects and negative aspects. The *Royal Botanic Garden Edinburgh* website was the only website that included information on accessibility (2015b). While some important content was featured on the main page, information on directions should have been easier to find.

Table 6 - University of Oxford Botanic Garden

Positive Aspects	Negative Aspects
Clean presentation; layout; good use of colours (light colours); text is readable.	“History” is at the bottom of the main page. It should be a separate entry in the menu, for ease of access.
Menu located on the left side.	Example: highlights in the “Visitor Information” page could be after the text and not in the middle.
Includes “Welcome” text on the main page.	Instead of a separate signature at the bottom of the pages, the “Harcourt Arboretum” could be a separate menu entry (unnecessary space is used).
Some content is highlighted on the main page.	“Contact Us” should be highlighted as a menu entry and not at the bottom of the page (easier to find).
“Find Us” and “Opening hours” sections featured on the main page to the left, after the menu.	Facebook and Twitter links at the very bottom on the left side. They should have a more prominent position.
Header includes the emblem of the University of Oxford, which is also a link to the University’s website.	Search field should not be in the header, since it does not look good aesthetically. It could be on the left side, probably after the menu or before the “Find Us” section.
Header also acts as a link to the main page of the website.	Menu does not include Home button.
Includes sitemap.	According to <i>WAVE</i> , the website has 4 errors in website accessibility: 3 images missing alternative text and 1 broken link (WCAG 2.0 Level A).
According to <i>WAVE</i> , the website achieved the score of 5 positive features in website accessibility related to the use of alternative text for images, form label and link navigation (WCAG 2.0 Level A).	According to <i>AChecker</i> , the website has 3 errors in website accessibility: images missing alternative text (WCAG 2.0 Level A).

Roughly the same could be said for the *University of Oxford Botanic Garden* website as for the *Royal Botanic Garden Edinburgh* website. Some links were highlighted on the home page, while important information such as “History” and contacts should have been easier to access.

3.3. Conclusion

The research on botanic garden websites detailed in the previous section helped outline the requirements specification for the *Dundee Botanic Garden Endowment Trust* website. Those requirements (Table 7 and Appendix 2) were then used in the design of the website, including the initial requirements from the project sponsor (Table 1 and Appendix 1).

Requirements were gathered in three stages. The first stage comprised of the initial requirements that were provided by the Trust Development Officer in the first meeting on 03 June 2015. The second stage took place between 04 June and 23 June 2015, before the second meeting with the project sponsor on 24 June 2015. An investigation of additional requirements that the client might be interested took place during that stage, which resulted in the following requirements:

- R2.17 (add an “Accessibility” page)
- R9 – 11 (add further methods to access the website)
- R13 (assign different user levels)

Finally, the third stage of requirements gathering took place between 25 June and 08 July 2015, during meetings with the project sponsor. These were:

- R2.3 (add a “Coffee Shop” page)
- R2.11 – 2.14 (add information about further ways to donate to the Endowment Trust)
- R5.3 (add a link to the *Friends of the Botanic Garden* blog)
- R5.7 (add a “Disclaimer” link)
- R7 (add a cookie banner)
- R8 (add an online pledge form)

Table 7 - Summary of Requirements

Functional Requirements	Origin
R1 Display Home/Main page ¹	GR (Gordon Ramsay)
R2 Display static pages	
R2.1 “The Garden” page	GR
R2.2 “History” page	GR
R2.3 “Coffee Shop” page	GR
R2.4 “About the Trust” page	GR
R2.5 “Purpose” page	GR
R2.6 “Vision” page	GR
R2.7 “Goals” page	GR
R2.8 “The Countess of Dalhousie” page	GR
R2.9 “Events” page	GR
R2.10 “Support Us” page	GR
R2.11 “Gift Aid” page	GR
R2.12 “Leaving a Legacy” page	GR
R2.13 “Pecuniary Legacies – Suggested Wording” page	GR
R2.14 “Residuary Gift – Suggested Wording” page	GR
R2.15 “Directions” page	GR
R2.16 “Contacts Us” page	GR
R2.17 “Accessibility” page	DEV (Developer)/ <i>Royal Botanic Garden Edinburgh</i>
R3 Display “News” page	GR
R4 Display donation link	GR
R5 Display links to external websites and social media	
R5.1 <i>University Botanic Garden</i> website	GR
R5.2 <i>Friends of the Botanic Garden</i> website	GR
R5.3 <i>Friends of the Botanic Garden</i> blog	GR
R5.4 <i>Dundee Botanic Garden Endowment Trust</i> Facebook page	GR
R5.5 <i>Dundee Botanic Garden Endowment Trust</i> Twitter page	GR
R5.6 <i>Dundee Botanic Garden Endowment Trust</i> Flickr page	DEV
R5.7 “Disclaimer” page	DEV
R6 Scottish Charity Status	GR
R7 Display “Cookie Policy” banner	DEV
R8 Online Pledge Form on “Leaving a Legacy” page	GR
R9 Contact Form on “Contact Us” page	DEV
R10 Sharing buttons on posts and specific pages	DEV
R11 Mobile version for smartphones	DEV
R12 Download Accessible PDF Leaflet	GR/DEV (Accessible PDF)
R13 Assign different user levels	DEV
Non-functional requirements	
R14 Website hosted on the University of Dundee server	GR
R15 Navigation within 10 minutes without training	GR
R16 Access the menu without training	GR
R17 Find any page within a minute	GR
R18 Administration with minimal training	GR
R19 W3C Guidelines	DEV
R20 Web Content Accessibility Guidelines	DEV
R21 Documentation Standards	DEV

The next section of this report explains how these requirements were implemented.

¹ Originally, R1 and R2.4 were separate pages but, after consultation with the Trust Development Officer, they were merged into a single page.

4. Design

4.1. CMS or not

According to *W3Techs* (2015), “Content management systems are web-based applications for creating and managing the content of a website,” which also includes “systems that are often classified as wikis, blog engines or discussion boards.” These applications might manage content such as “news, documents, images, video and any other online content type imaginable” and are normally used for websites with several editors and sections, for example, news and governmental websites (*BuiltWith*, 2015).

A CMS platform is recommended for people with “almost no technical skill or knowledge to manage,” since it manages all content itself (*Joomla*, 2015b). Mening (2015) further adds that CMS applications “have made creating a website accessible to everyone” compared to more than ten years ago, when building websites required strong knowledge of HTML, CSS and Flash. The reason behind this choice was the fact that the client required that the website be easily administered. It is possible that future administrators may have little experience in web development, coding and databases, so it was important to choose the right tool to build the website.

4.2. Which CMS?

Afterwards, it was necessary to choose the CMS application most suitable for this project. As there are many CMS applications to choose from, the possibilities were narrowed to three of the most widely used (Drupal, Joomla and WordPress), as corroborated by Mening (2013), *Rackspace* (2015) and *W3Techs* (2015), while considering each application’s features, as well as advantages and disadvantages.

4.2.1. Drupal

Drupal is a free open-source² content management system that is highly customisable. The project was started by Dries Buytaert in 1999. Several organisations use Drupal to build their websites: the Oxford and Harvard Universities, the White House and the French Government, the Louvre Museum, the BBC and also the official website of The Beatles (*Drupal*, 2015a).

According to Mening (2013), “Drupal is the second most popular content management system available today,” while also being “extremely powerful” and “less resource intensive” than WordPress. It is “the most technically advanced” compared to Joomla and WordPress. Therefore, upgrading to premium hosting services is not immediately necessary. Websites have “faster response times” and it is also possible to edit “the root files” of the software. Drupal is also renowned “for its powerful taxonomy and ability to tag, categorize and organize complex content” (*Rackspace*, 2015).

Therefore, it is the platform of choice for many “web developers and experienced coders” (Mening, 2015). Nevertheless, Mening (2013) does not recommend Drupal for people starting to learn

² “Open source software is software that can be freely used, changed, and shared (in modified or unmodified form) by anyone. Open source software is made by many people, and distributed under licenses that comply with the Open Source Definition” (*Open Source Initiative*, 2015).

web development, since it is necessary to have “some in depth knowledge of the programming and technology behind it” to identify and resolve issues. This is especially more difficult for people without sufficient skills, since they may have to resort to paid technical support. *Rackspace* (2015) and even *Drupal* (2014) reiterate these disadvantages. *Drupal* (2014) takes a step further and recommends WordPress for people wishing to publish a personal blog, even though blogs can be created using Drupal. Even though Marcus Neto from Blue Fish Design Studio acknowledged that Drupal was better than Joomla and WordPress, he admitted that it “is just too complex” (Mening, 2013).

While it would have certainly been interesting to learn the intricacies of Drupal, it would have taken some time to be comfortable with the platform. Additionally, a stronger knowledge of programming languages was required, which would have also taken time. Therefore, Drupal was not the best choice to meet the client’s requirement that the website be easily administered.

4.2.2. Joomla

As with Drupal, Joomla is a free open-source content management system, particularly praised for “its ease-of-use and extensibility.” Several websites are built on Joomla, which include *The Graduate School of Arts and Sciences* of Harvard University, *Citibank* and *PlayShakespeare.com* (Joomla, 2015b). Mening (2015) states that “Joomla is similar to WordPress and works great for online stores.” He further adds that Joomla is “the compromise between WordPress and Drupal” (Mening, 2013).

According to the official website, Joomla provides features such as smart search and indexing, website statistics and the ability to create and manage content “without any knowledge of code” (Joomla, 2015a), although Mening (2015) believes that some “technical coding” knowledge is required to adjust Joomla to one’s needs. Joomla also offers a smooth performance “on most web servers” but is not as technically advanced as Drupal. Joomla seems to be the platform of choice for creating social networks and commerce sites (Mening, 2013), since it was intended “to perform as a community platform, with strong social networking features” and supports E-commerce (*Rackspace*, 2015).

Joomla would have been a good platform to build the *Dundee Botanic Garden Endowment Trust* website but, in the end, WordPress was chosen, and the reasons will be explained in the next section.

4.2.3. WordPress

WordPress began in 2003 as a blogging platform but became a content management system over the years. As with Drupal and Joomla, it is also free and open-source. According to its official website, it is “the largest self-hosted blogging tool in the world” (*WordPress*, 2015a). WordPress can be used to build websites, blogs, portals and applications. One of the key messages that WordPress conveys is that it “combines simplicity for users and publishers with under-the-hood complexity for developers” (*WordPress*, 2015d). As of 2015, WordPress “powers more than 24% of the web” (*WordPress*, 2015d) and 48.37% of websites using CMS used WordPress, as of 18 May 2015 (*BuiltWith*, 2015). According to Mark (2011), the success of WordPress is explained by the fact that the platform’s features “were driven by content people,” since they “had to be usable by bloggers, including non-technical ones” and, in the end, “the Web is all about content.”

For Mening (2015), WordPress is an intuitive platform to work with, while being flexible enough to suit both simple and complex needs; adding and managing content are made simpler, WordPress receives regular security updates and does not require strong knowledge of HTML and CSS (Mening, 2013).

WordPress powers websites such as the *NASA Ames Research Centre*, *The New York Observer* and *CNN Political Ticker* (Rackspace, 2015). WordPress is renowned for its high customisation, offering a greater number of plugins, themes than other content management systems, since it is the most popular platform. Another major advantage of WordPress is the strong community support. Aside from numerous websites and video tutorials about using the platform, WordPress also has its own support forum (Mening, 2013).

According to Mark Atkinson from Red Giant Design, WordPress is easier to update and maintain than its competitors (Mening, 2013). *Rackspace* (2015) further adds: “It’s powerful enough for web developers or designers to efficiently build sites for clients; then, with minimal instruction, clients can take over the site management.”

However, WordPress is not perfect. It can consume “significant server resources” if it is a large website and its framework is “difficult to change” (Mening, 2013).

4.3. External deployment or internal?

R14 determined that the *Dundee Botanic Garden Endowment Trust* website be deployed via the University of Dundee Web server. This requirement also influenced the choice of CMS to build the website. The University of Dundee IT Department offered the University WordPress Network, which “provides a centralised tool, allowing academic and service departments to promote activities and allow collaboration and interactivity with its end-users” (*University of Dundee IT*, 2015).

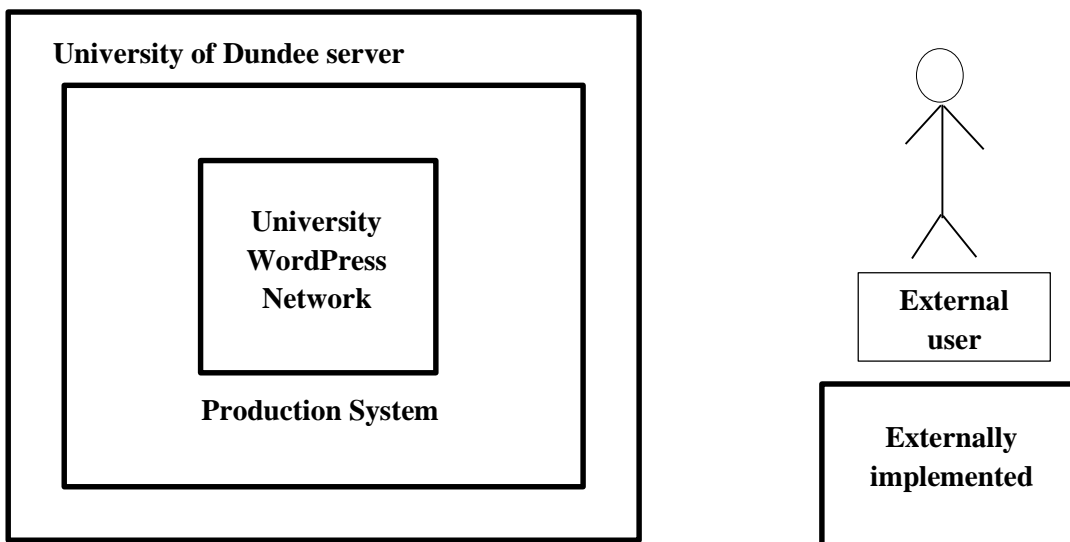


Figure 3 - External deployment or internal deployment?

4.4. Conclusion

After researching about the three CMS discussed here, WordPress was chosen to build the *Dundee Botanic Garden Endowment Trust* website. While Joomla would have been a good choice as well, WordPress was preferable. Firstly, the issue of administration was very important. After the website was finished, it would most likely be maintained by people with little or no experience in web development and WordPress would make that task easier. Secondly, WordPress was the recommended CMS for beginners in web design and web development. Thirdly, the flexibility of WordPress and the availability of plugins and themes. Finally, website accessibility was also considered and WordPress was a suitable platform to make the *Endowment Trust* website more accessible, since it offered plugins for that purpose. One of the most important features of WordPress is that websites built on the platform are compatible with mobile devices, such as smartphones and tablets (Mening, 2015), thus complying with Guideline 4.1 of WCAG 2.0: “Maximize compatibility with current and future user agents, including assistive technologies” (W3C, 2008a). Additionally, WordPress fully complies with W3C Standards and offers search engine optimisation (WordPress, 2015d).

5. Implementation

In this section, the experimental and deployment systems will be outlined, beginning with the preliminary investigation of WordPress.

5.1. Local sever environment

A local server environment was established on a laptop to explore all aspects of the WordPress platform. For this purpose, the MAMP³ package was installed, as suggested by Rand-Hendriksen (2015). This tool was used throughout the project to test the *Dundee Botanic Garden Endowment Trust* website, its core features, widgets⁴ and plugins⁵ that added extra features and the online questionnaire used to obtain participant feedback.

By working in a local server environment, features could be tested before being implemented in the development version of the Endowment Trust website, which was set up in the University WordPress Network.

The following six plugins were tested and worked in the local server environment:

- Access Keys for WordPress Menus
- EU Cookie Law
- My Calendar
- WP Accessibility
- WPTouch Mobile Plugin

The only plugin that did not fully work was the Jetpack plugin, which was developed by the WordPress team (WordPress, 2015e), since some features would only work in an actual server environment.

The local server environment was particularly useful in the early stages of the project to design an initial version of the *Endowment Trust* website, before the sandboxed version of the website was set up on the University of Dundee server on 22 June 2015. Therefore, the transition from a local server environment to an actual server was easier and quicker.

5.2. Application to the Ethics Committee

Another important stage in the project was the application to the School of Computing Ethics Committee to obtain approval for participant recruitment to gather feedback about the development version of the *Dundee Botanic Garden Endowment Trust* website. Approval was obtained on 30 June 2015 after the application was originally submitted on 8 June 2015. Recruitment methods included

³ MAMP stands for My Apache, My SQL and PHP (MAMP, 2015).

⁴ A widget is an object that is included in the design of a theme with a specific purpose that adds additional functionality (Harfield, p. 50).

⁵ A plugin is “a group of PHP functions” that adds additional features and functionality (Harfield, p. 252).

invitation through the University of Dundee's Hermes and School of Computing Forum services and invitation by email to relatives, friends and associates.

5.3. Dundee Botanic Garden Endowment Trust website (Development Version)

An initial implementation and testing decision made by the University of Dundee's Web Team was the implementation of a sandboxed version of the *Endowment Trust* website on the University of Dundee server. The reasoning behind this decision was that the website should only be publicly accessible when it was finished and that its development would be better suited in a sandboxed environment. However, the major drawback of the sandboxed version of the *Endowment Trust* website was that it was only accessible on campus and this would restrict the number of participants that could provide feedback on the website. The firewall settings were changed by the Networks and Servers team to allow people to access the website off-campus.

The development version of the *Dundee Botanic Garden Endowment Trust* website was developed after the first meeting with the project sponsor, the Trust Development Officer, on 03 June 2015. While the researcher waited for the Web Team to implement the sandboxed version of the website, development of the *Endowment Trust* website continued on the local server environment, using MAMP.

The sandboxed version was set up on 22 June 2015. However, there were restrictions regarding control and freedom in the version set up in the University's WordPress Network. Not all administration features and tools were available to the researcher (even though he was an administrator), such as editing CSS or plugin code. Plugins could not be installed without the approval of the Web Team. They would only install plugins if they deemed them secure to run in the University WordPress Network in order to prevent security breaches.

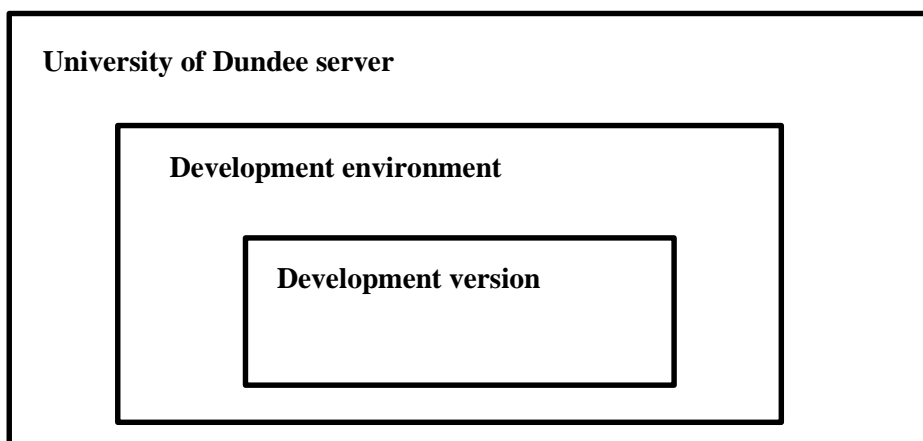


Figure 4 - Development version of the website

The development version of the *Dundee Botanic Garden Endowment Trust* website used the Twenty Fourteen theme developed by the WordPress team, since it was appropriate for this type of website, in terms of features, navigation and aesthetics:

- responsive layout (adapts the website for suitable viewing on mobile devices);
- three widget areas for customisation;
- custom background, header and menu.

Additionally, the theme was developed with accessibility in mind (WordPress, 2015g).

WordPress allows the installation of themes via the Dashboard. For the development version of the website, the Twenty Fourteen theme was installed by the Web Team. New themes are installed in the wp-content folder within the WordPress installation. Within the themes folder, a folder for the Twenty Fourteen theme was created containing PHP, HTML, CSS and JavaScript files. Since it was not possible to access the WordPress core files in the University WordPress Network, this was confirmed in the local server environment instead.

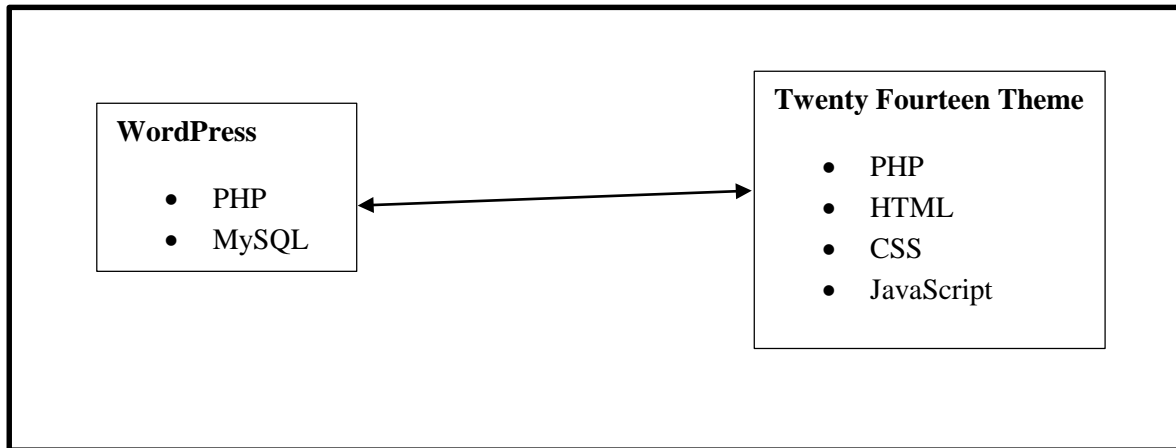


Figure 5 - Theme installation

For this version, the aim was to fulfil all of the client’s initial functional requirements (Table 1 and Appendix 1):

- R1 (add a home page)
- R2.1, 2.2, 2.4 – 2.10, 2.15, 2.16 (add pages about the Endowment Trust and the Botanic Garden)
- R3 (add a “News” page)
- R4 (add donation link to make a secure online donation)
- R5.1, 5.2, 5.4, 5.5 (add links to external sites and social media)
- R6 (add charity status)
- R12 (add PDF leaflet about the Endowment Trust)

Additional features that the client might be interested in were also added:

- R2.17 (add an “Accessibility” page)
- R9 – 11 (add further methods to access the website)
- R13 (assign different user levels)

A Facebook Like Box, a Twitter Timeline, a calendar, an image gallery, contact information on the home page (including a map of the Botanic Garden), different headers for the website that changed randomly, featured images for pages and the Dundee Botanic Garden Endowment Trust logo were also added.

The Web Team were also contacted about the appropriateness of including any kind of social media content on the website.

For the development version of the *Endowment Trust* website, the following plugins were implemented:

- Access Keys for WordPress Menus

- EU Cookie Law
- Gravity Forms
- Jetpack
- My Calendar
- WP Accessibility
- WPtouch Mobile Plugin

The purpose of the EU Cookie Law was to provide a cookie banner explaining the use of cookies (R7), both in the desktop and mobile versions (*WordPress*, 2015c). The project supervisor recommended using the same cookie policy information and links offered by the *University of Dundee* website (2015) on the *Endowment Trust* website. The Web Team were also contacted about this and they said that a cookie banner was not necessary unless the website collected visitor information. The Trust Development Officer pointed out that the website would probably collect visitor information in the future, therefore the project supervisor suggested the implementation of the cookie banner.

The Jetpack plugin was used to provide sharing buttons, social media links and contact forms on the *Endowment Trust* website (R8 – 10) (*WordPress*, 2015e). The plugin also enabled website subscription via email and RSS, notification of new comments and posts via email, a customised site icon and logo, and provided a small location map with contact information and address. Jetpack also offered administrators the options of monitoring website statistics and of being reported by email if the website was down. Finally, the Jetpack plugin also allowed posting new content on the *Endowment Trust* website and connected social media accounts at the same time, a feature that the project sponsor was interested in because of his experience in social media.

The My Calendar plugin was chosen for creating and managing events for the Events page on the *Endowment Trust* website (*WordPress*, 2015f).

The WPtouch Mobile plugin was implemented to offer a customised mobile version of the *Endowment Trust* website for smartphones, as suggested by Rand-Hendriksen (2014).

An online questionnaire was used to gather participant feedback on the *Endowment Trust* website. For the development version of the website, the Gravity Forms plugin (*Gravity Forms*, 2015) was used, since it was offered by the University WordPress service.

Plugins were also installed in the wp-content folder within the WordPress installation. Within the plugins folder, a folder for each installed plugin was created, each with its specific files. For example, the folder for the Jetpack plugin contained PHP, CSS and JavaScript files. As previously said, it was not possible to access the WordPress core files in the University WordPress Network, therefore, this was done in the local server environment.

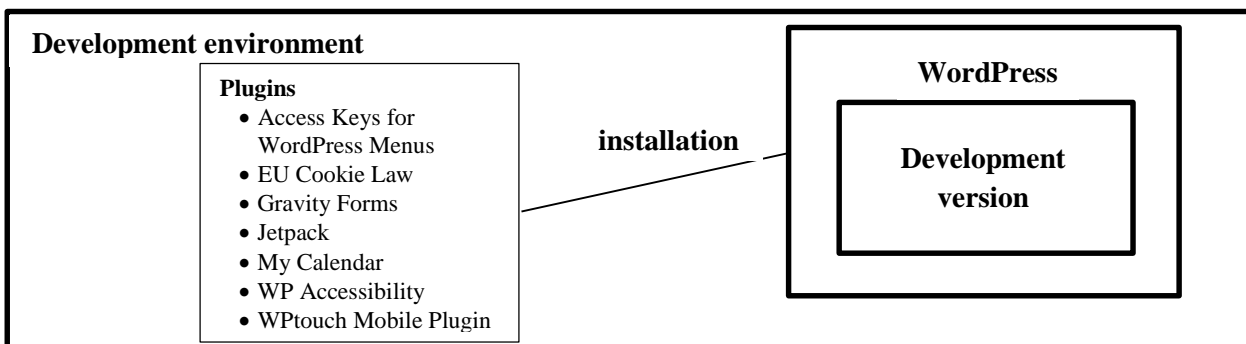


Figure 6 - Development version detailed

As some of the botanic garden websites that were analysed included privacy policy and terms and conditions, they were taken into consideration for the *Endowment Trust* website. However, the project supervisor stated that the inclusion of a “Disclaimer” link (R5.7), as part of the Web Code of Practice (*University of Dundee IT*, 2013b), was sufficient, since the website fell under the University of Dundee’s jurisdiction.

The project supervisor also advised researching *BT MyDonate* to ensure that the donation service used by the *Dundee Botanic Garden Endowment Trust* was trustworthy and secure for the inclusion of a link on the *Endowment Trust* website. The Web Team were also contacted about this matter and said that as long as the website was not taking payments in itself, the inclusion of a donation link was acceptable.

It was also important to make the website as accessible as possible. Numerous sources on website accessibility were consulted, including the WCAG 2.0 guidelines (W3C, 2008a) and the ‘University Web Accessibility Definition of Best Practice’ (*University of Dundee IT*, 2013a), with a particular focus on how to make WordPress sites more accessible through the use of accessibility plugins.

One of the first accessibility features implemented was alternative text for images used on the *Endowment Trust* website. However, in order to fully implement this feature, assistance from the Trust Development Officer was required to identify all images to be used on the website as well as images in the PDF version of the Endowment Trust leaflet.

For accessibility purposes, the following plugins were implemented on the website:

- Access Keys for WP Navigation Menu
- WP Accessibility plugin

The WP Accessibility plugin was developed by Joe Dolson (*WordPress*, 2015h) and was recommended by Barron (2014), McKinnon (2015) and *WordPress* (2015i). This plugin added missing accessibility features to WordPress themes, while also fixing accessibility issues:

- adding skip links;
- removing redundant title attributes;
- adding language attributes, among others.

It was also a recommended plugin for “non-technical site owners” who wished to make their site accessible (*WordPress*, 2015i).

Keyboard navigation was also implemented by using the plugin Access Keys for WP Navigation Menu, as suggested by McKeown (2011). As for skip navigation links, these were already provided by the Twenty Fourteen theme, which could be accessed by pressing the Tab key.

Finally, PDF accessibility was also implemented so that the *Endowment Trust* website would provide an accessible PDF leaflet (*WebAIM*, 2015b). As previously said, assistance from the Trust Development Officer was required to include alternative text for images used in the leaflet.

The second meeting with the project sponsor took place on 24 June 2015. Both client and supervisor approved the development version and approval from the School of Computing Ethics Committee to gather participant feedback was received on 30 June 2015. After the meeting, the Web Team were contacted to make the *Endowment Trust* website available off-campus so that participants off-campus could provide feedback.

Before the feedback session took place between 09 and 28 July, additional features were implemented in meetings between the project sponsor and the developer (from 25 June to 08 July 2015):

- R2.3 (add a “Coffee Shop” page)
- R2.11 – 2.14 (add information about further ways to donate to the Endowment Trust)

- R5.3 (add a link to the *Friends of the Botanic Garden* blog)
- R5.7 (add a “Disclaimer” link)
- R7 (add a cookie banner)
- R8 (add an online pledge form)

Finally, the developer also assisted the Trust Development Officer in creating Flickr and YouTube accounts for storing photos and videos about the Endowment Trust and the Botanic Garden.

Flickr was recommended by Harfield (p. 232) and Rand-Hendriksen (2014) as a third-party service to store photos, since the *Endowment Trust* website would feature photographs related to the organisation and the Botanic Garden and these would increase over time. Additionally, the University WordPress service provided little amount storage for uploaded media (250 MB) and the maximum file size was 8 MB.

A YouTube account was also set up at the request of the project sponsor, since the Endowment Trust could use YouTube to provide videos of the organisation and the Botanic Garden to visitors.

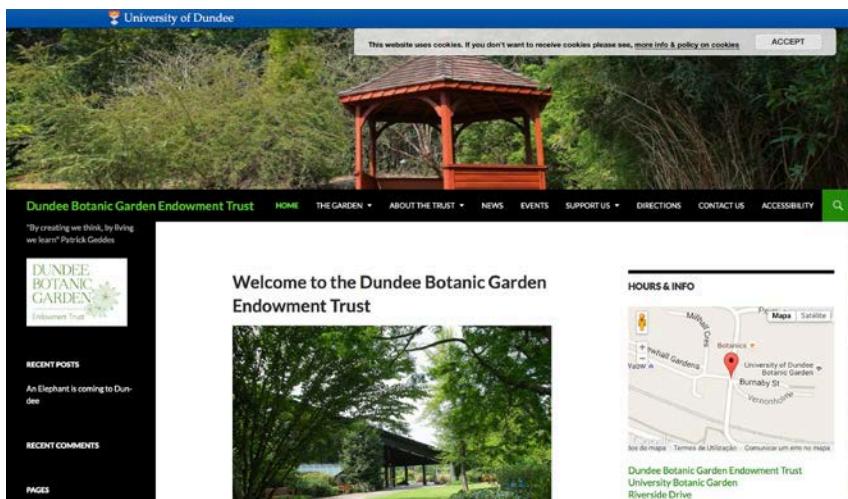


Figure 7 - Home page of the Development version of the website

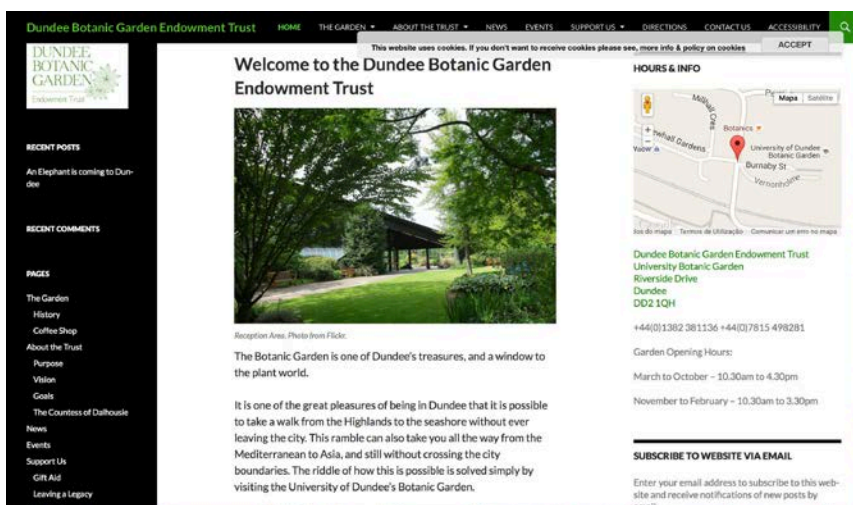


Figure 8 - Home page of the Development version of the website

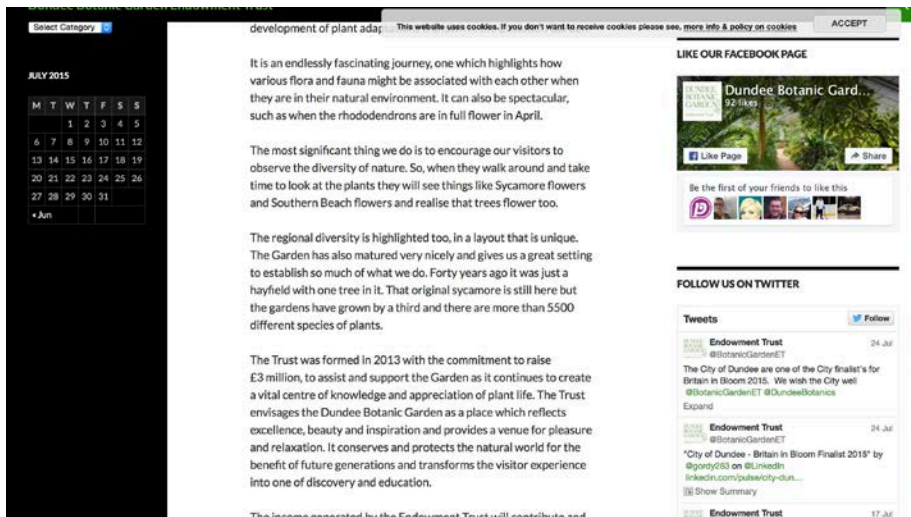


Figure 9 - Home page of the Development version of the website

5.4. Dundee Botanic Garden Endowment Trust website (Final Version)

After the feedback session for the development version of the *Dundee Botanic Garden Endowment Trust* website ended on 28 July 2015, development of the final version began on 05 August 2015 and ended on 25 August 2015.

The Trust Development Officer provided a list of amendments for the final version of the *Endowment Trust* website:

- A donation link was added on the left side of the sidebar section;
- The Trust Development Officer’s mobile phone was removed from the right side of the sidebar section on the main page and a telephone number for the Endowment Trust office was added instead;
- The Endowment Trust logo was replaced with a higher quality logo;
- The text from the About the Trust page replaced the text used on the main page. As a result, the main page was renamed About the Trust and the previous About the Trust page was removed;
- The Support Us tab in the main menu was placed after the Home/About the Trust tab, since the fundraising aspect is very important for the Dundee Botanic Garden Endowment Trust;
- The Garden tab in the main menu was placed after the Support Us tab, since the Endowment Trust website is about the organisation first and then the botanic garden;
- All external links in the main menu, except the donation link, were removed from the main menu. These were still present on The Garden page;
- The donation link in the main menu was renamed “Donate,” which was previously named “BT MyDonate.”

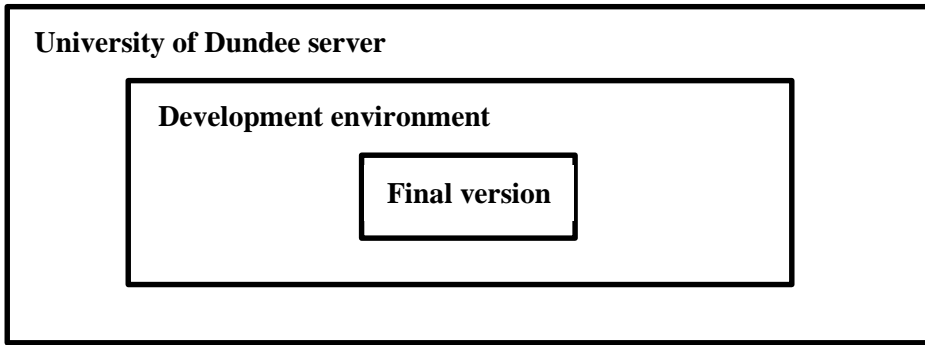


Figure 10 - Final version in the development environment

After consultation with both the project supervisor and sponsor, the *Dundee Botanic Garden Endowment Trust* website was moved to a live environment by the Networks and Servers team on 25 August 2015. The website could now be accessed at: <https://sites.dundee.ac.uk/botanicgardentrust/>.

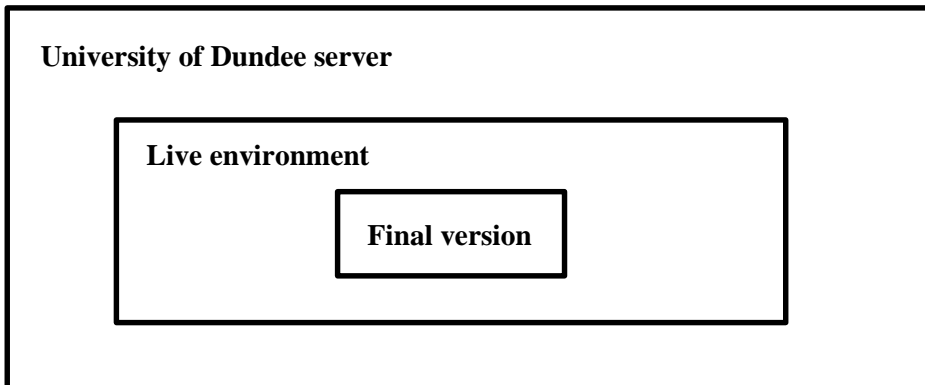


Figure 11 - Final version in the live environment

An additional plugin was installed for the final version of the *Dundee Botanic Garden Endowment Trust* website: All in One SEO Pack (WordPress, 2015b). This plugin was installed in order to provide a sitemap for the website, as seen on the analysis about competitor websites, which is particularly useful for search-engine optimisation (SEO) and also accessibility. The plugin can also be used to enhance SEO, which can be beneficial for administrators. It was recommended by Harfield (p. 233) and Rand-Hendriksen (2013).

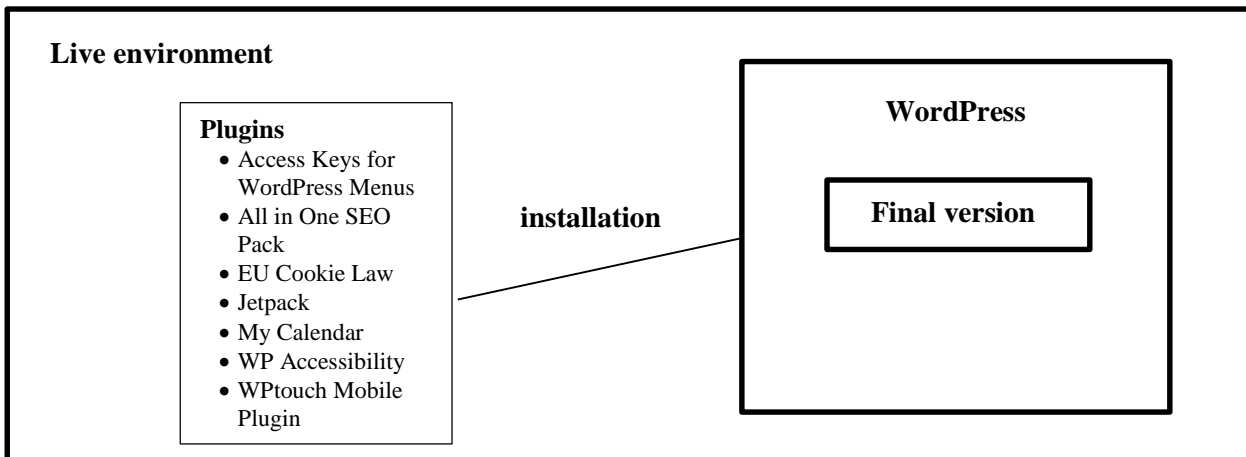


Figure 12 - Final version detailed

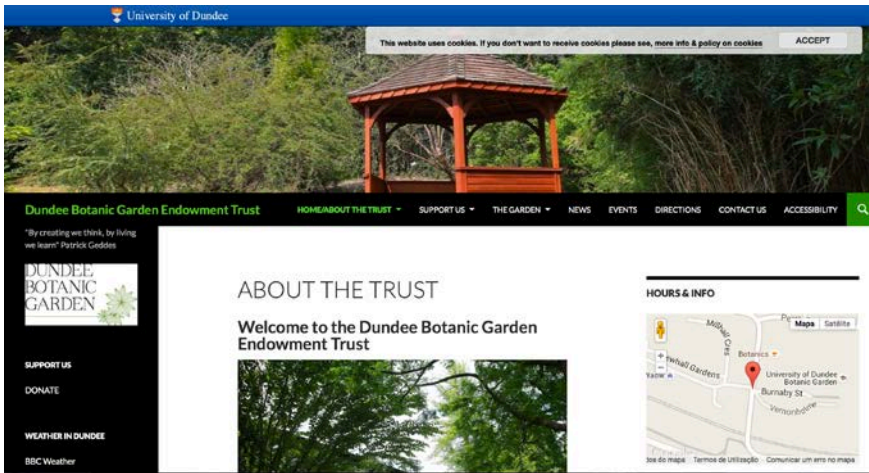


Figure 13 - Home page of the Final version of the website

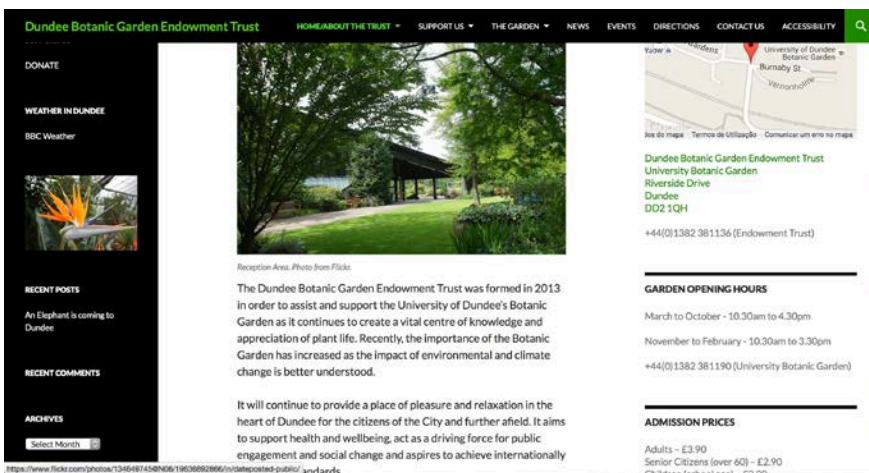


Figure 14 - Home page of the Final version of the website

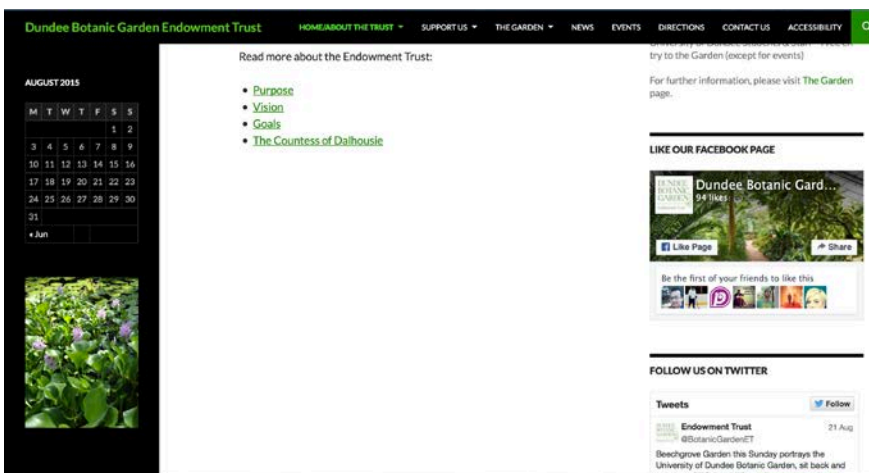


Figure 15 - Home page of the Final version of the website

6. Testing

A range approach of testing was taken with six different methods for the *Dundee Botanic Garden Endowment Trust* website throughout its development.

6.1. User-centred

This was done in regularly held meetings with the project sponsor, Mr Ramsay. He represented different personas to identify any areas to do primarily with functional requirements:

- Trust Development Officer/Administrator
- Trustee
- Visitors
- Sponsors

6.2. Plugins

6.2.1. Local environment

For the initial version of the *Dundee Botanic Garden Endowment Trust* website presented to the project sponsor on 03 June 2015, the following plugins were tested in order to determine if they provided the features required for the website:

- Access Keys for WordPress Menus
- Jetpack
- My Calendar
- WP Accessibility
- WPtouch Mobile Plugin

All of the above plugins functioned without issues, except for the Jetpack plugin, since some of its features would only work in an actual server environment. For the development version, the Web Team were contacted to install the plugins, since these had to meet their approval. After approving their installation, the plugins were then implemented.

6.2.2. Development environment

The plugins mentioned in section 6.2.1 were again tested in the development version of the *Endowment Trust* website to verify if they functioned in the sandboxed environment. Jetpack fully worked in this environment with all of its features available to use. For example, it was now possible to

connect WordPress with social media accounts in order to publish content at the same time in different platforms, which the project sponsor was interested in.

Two additional plugins were tested for implementation:

- EU Cookie Law
- Gravity Forms

Gravity Forms was tested for the online questionnaire used to gather feedback about the development version of the website.

6.3. Pages

6.3.1. Presence

This form of testing for the pages on the *Dundee Botanic Garden Endowment Trust* was applied to confirm if all content was present and links were functional for user-approval. This was applied in both the development and live environments.

6.3.2. User approval

As previously mentioned in 6.1, the project sponsor represented the different types of users of the *Endowment Trust* website. Meetings were regularly held with Mr Ramsay to confirm if the pages and links were suitable for the type of website and if they could be accessed.

During the feedback session, discussed in the next section, participants also confirmed if they were able to access all content offered by the *Endowment Trust* website.

6.4. Feedback session (staff, students and people outside the University)

As previously said in the Implementation section, the feedback session for the development version of the *Dundee Botanic Garden Endowment Trust* website took place between 09 and 28 July 2015. An online questionnaire was used to gather participant feedback. Participant recruitment methods included invitation through the University of Dundee's Hermes and School of Computing Forum services and invitation by email to relatives, friends and associates, as mentioned in section 5.2.

The online questionnaire contained 16 questions in total: 1 scale-question, 4 open-answer questions and 11 closed-answer questions. Participants were not required to answer all questions, since they were optional. 41 participants in total provided feedback about the development version of the *Dundee Botanic Garden Endowment Trust* website.

The purpose of the questionnaire was to find out what participants thought about features that were already implemented in the development version of the Endowment Trust website (Questions 2, 7, 9, 11, 12, 13, 14 and 15) and potential future features for the final version (Questions 3, 4, 5).

Question 1

On a scale of 1 to 5, how straightforward was it to navigate the *Dundee Botanic Garden Endowment Trust* website? [1 = not very straightforward; 5 = very straightforward]

- 26 participants thought that navigation was very straightforward (5);
- 9 participants awarded navigation a score of 4;
- 5 participants gave a score of 3;
- Only 1 participant believed that navigation was not very straightforward (1).

The average score was 4.4, while the lowest and highest scores were 1 and 5, respectively.

Question 2

The *Dundee Botanic Garden Endowment Trust* website offers a main menu at the top by which visitors can access the main pages of the website. The website also features these same pages in the sidebar located down the left side as an additional means of access. Do you believe this second feature is needed?

20 participants thought that this feature was useful, while 21 participants believed it was unnecessary.

Since the main menu of the *Dundee Botanic Garden Endowment Trust* website is always present, whenever a visitor scrolls up or down, this feature was removed. The Trust Development Officer also believed that this feature was not essential and requested to have two photos of plants on the left side of the sidebar section in its place.

Question 3

External links such as the *Friends of the Botanic Garden*, *University's Botanic Garden* website and *BT MyDonate* are included in the main menu of the *Dundee Botanic Garden Endowment Trust* website. When you hover your mouse over these links, would you like to view a text pop-up dialogue that explains what they are about?

22 participants wished to see a pop-up dialogue over external links accessible from the main menu, while 19 participants believed that the link title was descriptive enough.

As part of the list of amendments suggested by the Trust Development Officer (section 5.4), all external links on the main menu, except the donation link, were to be removed and only be included on "The Garden" page. Therefore, a title attribute (or link description) was added to the "Donate" link only, previously named "BT MyDonate:" "Make a secure online donation."

Question 4

Information about Admission Prices is included on "The Garden" page. Would you like the home page to include this information as well?

23 participants wanted to also view information regarding admission prices, while 16 participants thought that it was not necessary to repeat this information on the main page.

As a result, information about admission prices was included on the right side of the sidebar section on the main page with a link to "The Garden" page for more details.

Question 5

Would you like to see a BBC Weather link on the home page to check the current weather in Dundee?

27 participants were in favour of including a BBC Weather link on the main page of the website in order to check the current weather in Dundee, while 13 participants were not.

Therefore, a BBC Weather link for the weather in Dundee was included on the left side of the sidebar section on the main page. *The Cambridge University Botanic Garden* website also featured a BBC Weather link on its main page (Table 3).

Question 6

If you answered YES to question 5, would you like to see it featured in the main area of the home page or in the sidebar section (left or right)?

This question was directly related to the previous one:

- 14 participants wished to see the Weather link on the left sidebar section;
- 4 participants preferred the link on the main page;
- 9 participants chose the right sidebar section.

Question 7

Would you like to see an image gallery of photos of the Dundee Botanic Garden Endowment Trust?

38 participants wished to see an image gallery of photos on the website, while 3 participants did not.

The feedback for this feature did not result in any changes, since the website already included an image gallery on the “Coffee Shop” page and would include additional galleries on “The Garden” and “History” pages.

Question 8

If you answered YES to question 7, where would you like to see the image gallery?

This question was directly related with the previous one:

- 4 participants preferred to see the image gallery on the main page;
- 6 participants voted to see the image gallery on the “History” page;
- 28 participants wished to see the image gallery on “The Garden” page.

Although most participants believed that an image gallery would look more appropriate on “The Garden” page, the Trust Development Officer also wished to include additional image galleries with specific photos on the “History” and “Coffee Shop” pages.

Question 9

Do you feel that the *Dundee Botanic Garden Endowment Trust* website provides sufficient information about the Botanic Garden and the Endowment Trust?

36 participants believed that the website provided enough information about the Botanic Garden and the Endowment Trust, while 5 participants thought that additional information was required.

Question 10

If you answered NO to question 9, what kind of additional information would you like to see provided?

One participant suggested more information and photos about the plants in the Botanic Garden. An image gallery of photos of plants was already planned. It was included, along with plant names, on “The Garden” page for the final version of the *Dundee Botanic Garden Endowment Trust* website. A link to the Endowment Trust’s Flickr page was also included on the same page (and the “History” page) if visitors wished to see more photos besides those featured on the *Endowment Trust* website.

A second participant asked for information about the purpose of donations to the Endowment Trust but this information was already available on the “Support Us” page.

A third participant suggested additional information about how the Endowment Trust and the Friends of the Botanic Garden cooperated in raising funds to support the Botanic Garden. The Endowment Trust’s purposes and objectives were already included on the “Support Us” page and sub-pages (“Purpose,” “Vision” and “Goals”). As for the Friends of the Botanic Garden, a link to their website and blog was already included on “The Garden” page. More importantly, the website was to be focused on the Endowment Trust.

Question 11

Many websites today include links to social media networks, such as Facebook and Twitter. These include social media buttons that when clicked take the user to the corresponding social media pages. There can also be Facebook Like boxes (where everyone can see profile pictures of people who like a Facebook page) or Twitter timelines (where everyone can see the most recent tweets and replies).

What kind(s) of social media links would you like to see on the *Dundee Botanic Garden Endowment Trust* home page?

16 participants wished to see the inclusion of Facebook and/or Twitter links on the *Dundee Botanic Garden Endowment Trust* website. Other social media networks were suggested, such as Instagram and Pinterest, which focus on photos, but Flickr already served this purpose.

13 participants did not wish to see any kind of social media links on the *Dundee Botanic Garden Endowment Trust* website.

Question 12

Many websites and blogs allow visitors to subscribe to RSS feeds, *BBC News* for example, which are used to publish frequently updated information, such as post and news. Because of the emergence of social media, RSS feeds have declined in popularity. Would you like the *Dundee Botanic Garden Endowment Trust* website to offer this option?

28 participants did not think that providing website subscription via RSS feeds was essential, while 11 participants believed it was useful.

As a result, this feature was removed for the final version of the *Dundee Botanic Garden Endowment Trust* website.

Question 13

Many websites and blogs, *BBC News* for example, also offer visitors the option to subscribe in order to receive notifications of new posts by email. Would you like the *Dundee Botanic Garden Endowment Trust* website to offer this option?

22 participants thought that offering website subscription via email would benefit the website, while 18 participants said it was not relevant.

Participants were more in favour of subscription via email than RSS. This feature was already replicated in Question 14.

Question 14

New posts will be published in the “News” section of the *Dundee Botanic Garden Endowment Trust* website and visitors will be able to post comments. At the moment, when visitors post a comment, they are offered the options of notification of new comments via email and notification of new posts via email. Would you like the *Dundee Botanic Garden Endowment Trust* website to offer these choices?

20 participants were interested in being notified of new comments and posts on the website via email, while 19 participants were not.

Question 15

The *Dundee Botanic Garden Endowment Trust* website offers a mobile version adapted to small screens, such as those on smartphones. If you accessed the website on your smartphone, would you like to make any comments and/or suggestions?

10 participants gave feedback on the mobile version of the *Dundee Botanic Garden Endowment Trust* website.

8 out of 10 praised its design and the easy access to content it provided them, while 2 out of 10 felt the mobile version could have been more user-friendly.

As a result of this feedback and the fact that the Trust Development Officer was satisfied with the mobile version, no amendments were made.

Question 16

Are there any further comments and/or suggestions you would like to make?

3 participants believed that the *Dundee Botanic Garden Endowment Trust* website should focus more on the Endowment Trust and not so much on the Botanic Garden. The amendments proposed by the Trust Development Officer for the final version of the website improved that focus.

6 participants praised the design, clarity and easy access to all content of the *Dundee Botanic Garden Endowment Trust* website. One participant specifically praised the detailed information about the Endowment Trust and the Botanic Garden. Another participant believed that the website was well suited to the type of organisation that the Endowment Trust is. A sitemap was also suggested for advanced users by one participant, a feature already planned for the final version.

6.5. W3C and WCAG 2.0

6.5.1. Accessibility errors

The *Dundee Botanic Garden Endowment Trust* website was tested for accessibility errors with *AChecker* and *WAVE*, the tools used for the analysis of botanic garden websites in section 3.2. There were no errors (Levels A, AA and AAA), both in the development and live environments.

Keyboard navigation was also tested to confirm its functionality in Google Chrome, Internet Explorer, Mozilla Firefox and Safari.

6.5.2. Browser testing

Browser compatibility was tested by accessing the website on different browsers: Google Chrome, Internet Explorer, Mozilla Firefox and Safari. Mobile devices, such as smartphones and tablets, were also used to confirm compatibility. The project sponsor also assisted in this form of testing. Finally, the Lynx browser was used for testing, as suggested by the 'University of Dundee Web Accessibility Definition of Best Practice' document (*University of Dundee IT*, 2013a).

6.6. Live environment

6.6.1. Review

The *Dundee Botanic Garden Endowment Trust* website was moved to a live environment on 25 August 2015, when development ended. After the transition, the website was tested to confirm if all content was present. Some links had to be updated with the new website address to be functional in the live environment.

6.6.2. Plugins

Plugins were also tested to confirm their previous functionality. All plugins had to be implemented again, since their settings and functionality were lost during the transition. For example, the EU Cookie Law plugin, which was used to display a cookie banner on the website.

The All in One SEO Pack was only tested in the live environment, since its features were only available in this environment and not in the sandboxed one.

7. Evaluation

7.1. Website

The *Dundee Botanic Garden Endowment Trust* website was developed from 13 May 2015 to 25 August 2015. The purpose of the finished product was to primarily fulfil the project sponsor's requirements but also, in the time available, to go beyond those requirements by implementing additional features that could be useful in the short and long-term for the Endowment Trust to further engage with the community.

The finished product was a success. As Mr Ramsay, the Trust Development Officer, stated about the final version of the website and the overall project: "The project has been a great success" and "The collaboration of work with Pedro [the developer], the School of Computing, the Web Team and the Endowment Trust has been excellent."

7.2. Project

7.2.1. Quality

As said in the previous section, Mr Ramsay, the project sponsor, affirmed that the project had been "a great success." 100% of the requirements were completed. The finished product does the following:

- Visitors can access these pages:
 - Home/About the Trust
 - The Garden
 - History
 - Coffee Shop
 - Purpose
 - Vision
 - Goals
 - The Countess of Dalhousie
 - News
 - Events
 - Support Us
 - Gift Aid
 - Leaving a Legacy
 - Pecuniary Legacies – Suggested Wording
 - Residuary Gift – Suggested Wording
 - Directions
 - Contact Us
 - Accessibility
- Visitors can perform these tasks:
 - Access an external donation service via link to make a secure online donation;

- Access the *University Botanic Garden* and *Friends of the Botanic Garden* websites, as well as the *Friends of the Botanic Garden* blog via links;
 - Access the Endowment Trust’s social media accounts (Facebook, Twitter and Flickr) via links and widgets;
 - View events organised by the Endowment Trust and other institutions in a calendar view on the “Events” page;
 - Fill out the Online Pledge Form and Contact Us forms to directly contact the Endowment Trust;
 - Share website content through social media buttons (Facebook, Twitter and LinkedIn);
 - Access a mobile version of the website on smartphones;
 - Download an accessible PDF leaflet about the Endowment Trust;
 - Use the keyboard to navigate the website.
- Administrators can:
 - Manage the website with minimal training;
 - Assign different user levels for content management;
 - Include alternative text for images directly on WordPress;
 - Assign keyboard keys for menus directly on WordPress;
 - Create and manage events by using the My Calendar plugin;
 - Monitor website statistics by using the Jetpack plugin.

7.2.2. Critical Appraisal and Future Work

The Botanic Garden Endowment Trust Website Development project was a valuable opportunity to learn skills that are relevant not only in an academic setting but also in a workplace setting.

In terms of technical skills, the project was a chance to learn about web development and how to work with WordPress. As explained in the Design section, the website was built using WordPress, a CMS platform. While the website could have been built using a different CMS platform, such as Drupal and Joomla, or without using a CMS, WordPress was chosen to fulfil the project sponsor’s requirement that the website be easily administered by people with little experience in web development, coding and databases. WordPress is also a suitable tool for people who already have some experience with social media, such as the Trust Development Officer, and are interested in web development. Nevertheless, it is possible that a different CMS platform, or building the website by using HTML and CSS, might be preferable for the *Endowment Trust* website in the future, depending on the needs of administrators and website content.

The plugins mentioned in this report were chosen to fulfil the project sponsor’s requirements and also to make the website more accessible. WordPress offers an immense repository of plugins and new plugins are continuously being developed and released, which means that new plugins could be an improvement to the plugins installed for the *Endowment Trust* website or if the current plugins stop being supported. The website may also have to fulfil different needs in the short or long term, for which additional plugins may be needed to help support those needs. This also applies to the current theme implemented on the website.

Website accessibility was one of the strengths of the project. It was an opportunity to learn more about accessibility by making the website usable by people with disabilities, thus providing a positive experience for them and reaching a broader audience. The benefits of website accessibility were also discussed with the project sponsor, since there are still many websites that are not considered accessible.

As for project management skills, these were further improved throughout the project and in meetings with both the project supervisor and the project sponsor. Interacting with the project sponsor was a new challenge, since it meant dealing with someone outside the School of Computing, but it was a very positive experience. Related to this was a comprehensive approach to requirements gathering. These were also strengths of the project.

The Botanic Garden Endowment Trust Website Development project followed the project plan that was devised at the start of the project and everything was delivered within the time-scales. The website was made available on 25 August 2015, two weeks before the public demonstration on 08 September 2015.

8. Summary and Conclusions

The Botanic Garden Website Development project was about creating an official online platform for the Dundee Botanic Garden Endowment Trust in order for the organisation to further engage with the local community and beyond. The website was also created to try to support the Endowment Trust's goals, since the organisation has a goal of raising £3 million pounds in order to sustain the financial future of the Botanic Garden. Additionally, the website was designed in order to be administered with minimal training.

Development of the website started on 13 May 2015 and finished on 25 August 2015. The finished product was shown at a public demonstration at the School of Computing on 08 September 2015 and the project ended on 10 September 2015.

The project was a valuable opportunity to acquire new skills in web development and improve skills in project management.

9. References

AChecker (2011) Available at: <http://achecker.ca/checker/index.php> (Accessed: 18 May 2015).

Accessibility and Usability at Penn State (2015) Available at: <http://accessibility.psu.edu/wcag2/> (Accessed: 18 May 2015).

Barron, B. (2014) *Elegant Themes* Available at: <http://www.elegantthemes.com/blog/tips-tricks/how-to-make-your-wordpress-website-more-accessible> (Accessed: 18 May 2015).

The Birmingham Botanical Gardens (2015) Available at: <http://www.birminghambotanicalgardens.org.uk/> (Accessed: 18 May 2015).

Blair, E. (2012) *SitePoint* Available at: <http://www.sitepoint.com/4-ways-to-make-your-wordpress-site-more-accessible/> (Accessed: 13 May 2015).

Botanic Gardens Conservation International (2015a) Available at: <https://www.bgci.org/resources/1528/> (Accessed: 29 May 2015).

--- (2015b) Available at: <https://www.bgci.org/resources/history/> (Accessed: 29 May 2015).

BT MyDonate (2015a) Available at: <https://www.btplc.com/mydonate/Help/FAQs/FAQsfordonors/index.aspx> (Accessed: 18 May 2015).

--- (2015b) Available at: <https://www.btplc.com/mydonate/findoutmore/> (Accessed: 18 May 2015).

--- (2015c) Available at: <https://www.btplc.com/mydonate/AboutMyDonate/Termsandconditions/Donorterms.aspx> (Accessed: 18 May 2015).

BuiltWith (2015) Available at: <http://trends.builtwith.com/cms> (Accessed: 20 May 2015).

Cambridge University Botanic Garden (2015) Available at:

<http://www.botanic.cam.ac.uk/Botanic/Home.aspx> (Accessed: 18 May 2015).

Cruickshank Botanic Garden (2015) Available at: <http://www.abdn.ac.uk/botanic-garden/> (Accessed: 18 May 2015).

Drupal (2014) Available at: <https://www.drupal.org/node/346217> (Accessed: 20 May 2015).

--- (2015a) Available at: <https://www.drupal.org/about> (Accessed: 20 May 2015).

--- (2015b) Available at: <https://www.drupal.org/features> (Accessed: 20 May 2015).

Gravity Forms (2015) Available at: <http://www.gravityforms.com/> (Accessed: 22 June 2015).

Harfield, D. (ed.) (2011) *WordPress for Beginners*. Bournemouth: Image Publishing.

Investopedia (2015) Available at: <http://www.investopedia.com/terms/e/endowment-fund.asp> (Accessed: 01 June 2015).

Joomla (2015a) Available at: <http://www.joomla.org/core-features.html> (Accessed: 20 May 2015).

--- (2015b) Available at: <http://www.joomla.org/about-joomla.html> (Accessed: 20 May 2015).

Lembree, D. (2011) *Web Hosting Search* Available at: <http://www.webhostingsearch.com/articles/25-ways-to-make-your-site-more-accessible.php> (Accessed: 18 May 2015).

Mark, J. (2011) *Smashing Magazine* Available at:

<http://www.smashingmagazine.com/2011/11/29/wordpress-cms-crown-drupal-joomla/> (Accessed: 14 May 2015).

MAMP (2015) Available at: <https://www.mamp.info/en/> (Accessed: 13 May 2015).

McKeown, S. (2011) '25 Ways to Make Your WordPress Website More Accessible', *WPMU DEV*, 27 January. Available at: <http://premium.wpmudev.org/blog/25-ways-to-make-your-wordpress-website-more-accessible/> (Accessed: 18 May 2015).

McKinnon, J. (2015) 'Make Your WordPress Site Accessible With These Themes and Plugins', *WPMU DEV*, 01 January. Available at: <http://premium.wpmudev.org/blog/make-your-wordpress-site-accessible/> (Accessed: 18 May 2015).

Mening, R. (2013) *Website Setup* Available at: <http://websitesetup.org/cms-comparison-wordpress-vs-joomla-drupal/> (Accessed: 14 May 2015).

--- (2015) Available at: <http://websitesetup.org/> (Accessed: 14 May 2015).

The New York Botanical Garden (2015) Available at: <http://www.nybg.org/about/120-years-what-is-classical-botanical-garden.php> (Accessed: 29 May 2015).

Open Source Initiative (2015) Available at: <http://opensource.org/> (Accessed: 20 May 2015).

Oxford Dictionaries (2015) Available at: <http://www.oxforddictionaries.com/definition/english/botanic-garden> (Accessed: 29 May 2015).

Rackspace (2015) Available at: http://www.rackspace.com/knowledge_center/article/cms-comparison-drupal-joomla-and-wordpress (Accessed: 20 May 2015).

Rand-Hendriksen, M. (2013) *Lynda.com* Available at: <http://www.lynda.com/WordPress-tutorials/WordPress-Plugins-SEO/140779-2.html> (Accessed: 18 May 2015).

--- (2014) *Lynda.com* Available at: <http://www.lynda.com/WordPress-tutorials/WordPress-Essential-Training/154417-2.html> (Accessed: 13 May 2015).

--- (2015) *Lynda.com* Available at: <http://www.lynda.com/WordPress-tutorials/Installing-Running-WordPress-MAMP/361682-2.html> (Accessed: 13 May 2015).

Royal Botanic Garden Edinburgh (2015a) Available at: <http://www.rbge.org.uk/> (Accessed: 18 May 2015).

--- (2015b) Available at: <http://www.rbge.org.uk/websiteaccessibility> (Accessed: 18 May 2015).

University of Oxford Botanic Garden (2015) Available at: <http://www.botanic-garden.ox.ac.uk/> (Accessed: 18 May 2015).

University of Dundee (2015) Available at: <http://www.dundee.ac.uk/> (Accessed: 05 June 2015).

University of Dundee IT (2013a) Available at:
<http://www.dundee.ac.uk/media/dundeewebsite/webaccessibility/documents/UoDWebAccessibilityBestPracticeAugust2013.pdf> (Accessed: 13 May 2015).

--- (2013b) Available at:
<http://www.dundee.ac.uk/media/dundeewebsite/ics/documents/publications/Web%20Code%20of%20Practice.pdf> (Accessed: 13 May 2015).

--- (2015) Available at: <http://www.dundee.ac.uk/it/services/web/support/wordpress/> (Accessed: 13 May 2015).

W3C (2008a) Available at: URL:<http://www.w3.org/TR/WCAG/> (Accessed: 18 May 2015).

--- (2008b) Available at: <http://www.w3.org/WAI/WCAG20/glance/WCAG2-at-a-Glance-a4.pdf> (Accessed: 18 May 2015).

--- (2014a) Available at: <http://www.w3.org/WAI/> (Accessed: 18 May 2015).

--- (2014b) Available at: <http://www.w3.org/WAI/WCAG20/quickref/> (Accessed: 18 May 2015).

--- (2015) Available at: <http://www.w3.org/standards/> (Accessed: 18 May 2015).

W3Techs - World Wide Web Technology Surveys (2015) Available at:
http://w3techs.com/technologies/overview/content_management/all (Accessed: 20 May 2015).

WAVE Web Accessibility Evaluation Tool (2015) Available at: <http://wave.webaim.org/> (Accessed: 18 May 2015).

WebAIM: Website Accessibility in Mind (2015a) Available at: <http://webaim.org/> (Accessed: 18 May 2015).

--- (2015b) Available at: <http://webaim.org/techniques/acrobat/> (Accessed: 18 May 2015).

WordPress (2015a) Available at: <https://wordpress.org/about/> (Accessed: 18 May 2015).

--- (2015b) Available at: <https://wordpress.org/plugins/all-in-one-seo-pack/> (Accessed: 18 May 2015).

--- (2015c) Available at: <https://wordpress.org/plugins/eu-cookie-law/> (Accessed: 05 June 2015).

--- (2015d) Available at: <https://wordpress.org/about/features/> (Accessed: 18 May 2015).

--- (2015e) Available at: <https://wordpress.org/plugins/jetpack/> (Accessed: 18 May 2015).

--- (2015f) Available at: <https://wordpress.org/plugins/my-calendar/> (Accessed: 18 May 2015).

--- (2015g) Available at: <https://wordpress.org/themes/twentyfourteen/> (Accessed: 18 May 2015).

--- (2015h) Available at: <https://wordpress.org/plugins/wp-accessibility/> (Accessed: 18 May 2015).

--- (2015i) Available at: <https://make.wordpress.org/accessibility/wp-accessibility-plugin/> (Accessed: 18 May 2015).

--- (2015j) Available at: <https://wordpress.org/plugins/wptouch/> (Accessed: 18 May 2015).

York University (2015) Available at:

http://www.yorku.ca/finance/documents/Understanding_Trusts_and_Endowments%20.pdf (Accessed: 01 June 2015).