School of Mechanical, Materials, and Manufacturing Engineering

University of Nottingham
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Development of Web Accessibility Recommendations for CERN

By

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2021

A report presented in part consideration for a
Postgraduate Certificate in Usability and Human Computer Interaction

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Title of Report: Development of Web Accessibility Recommendations for CERN

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Abstract

CERN is the birthplace of the web and a rich source of scientific information, ideas and discoveries. Yet access to the Web and its valuable resources are difficult for many people, with overwhelming evidence of digital barriers in place. This study examines the current status of Web Accessibility at CERN, identifies areas for improvement, discusses factors that may be driving the situation, and finally offers recommendations and guidelines to provide, and promote, an environment where CERN's science can be available to all, both within CERN's communities and the general public.

1 Introduction

This study was conceived after the author carried out a heuristic usability evaluation [1] of "Indico", CERN's online event management tool which is in public use at 314 institutions worldwide [2]. More than half of the 31 usability issues found were scored as a major usability problem, and this raised a further research question about the tool's accessibility for people with impairments.

The original intention for this study was to follow up on this question and carry out an in-depth web accessibility evaluation of Indico in order to provide targeted recommendations for compliance with recommended accessibility guidelines. However, while researching what web accessibility guidelines provided or recommended by CERN could be applied, it was not immediately evident if there was any formal policy or support on this topic at CERN at all. Consequently, this study has pivoted towards an investigation of Web Accessibility at CERN as a whole.

This study therefore has three main research questions:

RQ1 – What evidence is there of web accessibility considerations at CERN?
RQ2 – What might be driving the situation?
RQ3 – What recommendations for Web Accessibility might be relevant?

First, in order to provide an outline of the contextual and legislative framework, this study reviews the European legislation and guidelines on web accessibility, followed by an investigation into the academic literature on the topic of adoption and implementation.

Second, this study examined what evidence there is of web accessibility considerations at CERN. To do this, a search was carried out of the formal structures or support that may exist for web accessibility at CERN. Then, through open-ended interviews carried out with CERN personnel, underlying perceptions and attitudes towards web accessibility were elicited. Subsequently, through automatic accessibility evaluation of some of the most-used CERN websites, the level of compliance with established international guidelines could be observed.

Thirdly, based on themes from the study data and supported by literature, recommendations are made to provide, or reinforce, an environment where web accessibility is actively supported and encouraged.

2 Background

2.1 CERN

CERN is the European Organization for Nuclear Research, founded in 1954. Its mission is to uncover what the universe is made of and how it works [3]. It has over 16,500 personnel [4], and is governed by 23 mostly-European member states. Moreover, it is engaged in scientific collaborations and agreements with over 70 other countries and other international bodies such as the United Nations and UNESCO [5].

CERN is also where – in 1989 – the web was invented by Sir Tim Berners-Lee. The original aim of the web was to share information between scientists in universities and institutes around the world; as stated in the introduction of the world's first website: "The WorldWideWeb (W3) is a wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents" [6].

2.2 Web accessibility

The literature provides many definitions of web accessibility, with the relationships between accessibility, user-experience and usability causing debatable overlap [7]. Indeed Savva noted there was no agreement on a single definition, as definitions ranged from technical standards to user-centric models [8].

The definition which underpins European legislation comes from the Web Accessibility Initiative (WAI): "Web accessibility means that websites, tools, and technologies are designed and developed so that people with disabilities can use them. More specifically, people can; perceive, understand, navigate, and interact with the Web, [and] contribute to the Web" [9]. This will be used as the assumed definition behind this study.

The objective of the original World Wide Web proposal was to provide "a way to link and access information of various kinds as a web of nodes in which the user can browse at will" for CERN experiments [10]. The design focus in those early years was on the code and resolving conflicts between technologies, strategies and standards [11, 12, 13]. Web Accessibility in the context we might understand now (i.e. for people with impairments) was not an objective at the time; in fact the earliest relevant documentation does not seem to appear until 1995 in the United States [14], two years after the Web was released into the public domain in 1993 [6].

Nowadays, web accessibility is considered a human right, and also described as "a matter of political will and of moral obligation" [15]. It is enshrined in The Convention on the Rights of Persons with Disabilities (UNCRPD) [16], ratified by the United Nations in 2006. This was a landmark convention requiring that "that appropriate measures are taken to ensure access for persons with disabilities, on equal basis with others, to information and communication technologies, including the Internet." [15].

2.3 In practice

In less than 30 years, the world wide web has changed from an "information retrieval initiative" [6] for scientists, to a fundamental part of daily life with over half the human population online, providing economic and social benefits worldwide [17].

However, in the European Union, around 5% of the population do not use the internet due to some form of disability [18]. That is around 22.4 million people in the EU totally excluded from the digital world. Moreover, more than 80 million people are affected by some form of disability [18] - whether audio, visual, motor or cognitive, whether through genetics, ageing or accident.

A quick glance at the 'Accessibility' settings in any modern consumer computing device shows a range of assistive technologies available, helping impaired users interact with the web depending on what is needed. Visual impairments can be compensated for using screen magnifiers, colour adjusters, or voiceover to provide spoken content. Physical and motor impairments are supported by sticky or slow keys (e.g. for those who can't maintain consistent pressure on a key), input devices include head-pointers (for those who can't use a keyboard or mouse) and voice recognition.

However, while assistive technologies can help provide basic access to information, websites are not always designed to allow for these different interaction methods. Sites can often present content that is only accessible by use of a computer mouse or expressed visually only [19]. Lazar et al [20] note top causes of frustration for blind users being poor page layout causing screen-reader confusion, unlabelled forms making it unclear what to fill in where, and no alternative ("alt") text for pictures. Uncertainty, reduced mobility, confusion and cognitive overload are common experiences [21], and impaired users waste on average 37% to 50% of their time due to these frustrations [20].

2.4 Web Content Accessibility Guidelines (WCAG)

The Web Content Accessibility Guidelines [22] - from the W3C Web Accessibility Initiative (WAI) [23] – detail extensive criteria for accessibility conformance. They provide the bedrock of much national and international law, recognised as ISO standard ISO/IEC 40500:2012 [24] and European Union standard EN 301 549 for ICT [25].

The guidelines explain both user-centric issues around text, sound and image, as well as technical aspects of mark-up to provide the necessary support for assistive technologies. They also set compliance objectives with 3 levels, from A (bare minimum) to AAA (top-level), along with validation tools to provide automatic evaluation [26].

2.5 European law

The last ten years has shown strong commitment from the European Commission to promote a 'barrier-free Europe' in the form of the "European Disability Strategy 2010-2020: A Renewed Commitment to a Barrier-Free Europe" [27]. Moreover, since 2016, the Web Accessibility Directive (Directive (EU) 2016/2102) [15] has been in force in European Union law. All members states were obliged to adopt the Directive into national law by 2018.

Unfortunately, there is no recent official EU-wide data available to evaluate the implementation of the 2016 Directive, as this review is not due until June 2022. However, as a 'starting-line' observation, the "Digital Inclusion in the EU" report noted in 2016 that less than 10% of websites in Europe were accessible for people with disabilities [18].

WebAim Million [28] is a web accessibility evaluation of the top one million homepages worldwide. While the sample is drawn from the pool of all sites globally and this study is focussed on Europe, the 2021 data can still provide a useful representation to see how web accessibility compliance may be evolving.

In February 2021, 97.4% of home pages had detectable WCAG failures. There was an average of 51.4 failures (with serious/notable end user impact) per homepage. The most common errors found in homepages were low contrast text (86.4% of homepages), missing alternative text for images (60.6%), missing form input labels (54.4%), empty links (51.3%), missing document language (28.9%) and empty buttons (26.9%).

Alongside this report, even the WHO website was found to be lacking in accessibility over its COVID-19 health content and public communications [29]. Despite the considerable legislation and guidelines in place, disabled people are still being confronted with extensive and persistent barriers to usage of everyday online services and products.

What might be driving this? Academic literature examining web accessibility since 2004 may provide some pointers.

3 Literature Review

From a European perspective, there is a noticeable shift in focus of academic research on Web Accessibility, effectively a 'before' and 'after' of legislation coming into force in 2016.

Prior to 2016, research focused mainly on low adoption and implementation of web accessibility in general, and seeking to understand its drivers [7, 30, 31, 32].

A significant theme which emerged at this time revolves around perceptions of web accessibility and disability. Perceptions range from a collective mindset being predominantly ableist, and therefore inadvertently promoting negative attitudes towards inclusion [33], to the idea that support for inclusion is evident, but difficulties lay in the definition and understanding of web accessibility between different roles and potential stakeholders [7].

Lazar et al [31] created a "Web Accessibility Integration Model", to describe why websites might be inaccessible. They identified several factors, including the need for training, policy, awareness, advocacy, and availability of tools and guidelines to help support implementation. These same factors emerge in studies since (e.g. Harper and Chen [30]), but are also particularly validated and complemented by Velleman et al's work on organisational factors. Two further additions which stand out from this study as the top driver for adoption and implementation are; assigning responsibilities, and commitment from management, which helps promote prioritisation of the issues [32].

Harper and Chen [30] looked extensively into the technology aspects, and concluded that large-scale heterogenous systems, such as the Web, present increasingly complex technologies and interactions which create difficulties in web accessibility. Combined with equally evolving assistive technologies inserted between website and the (impaired) user,

conformance would be difficult to achieve. Yesilada et al [7] and Lazar et al [31] also noted technical barriers being perceived as a challenge in making websites accessible.

Post-2016, after EU legislation came into force, European-based studies have shifted towards examining the state of compliance, notably of government and municipal websites [34, 35, 36]. The main finding is that improvements have been made since 2016, but low compliance is consistently observed in the majority of websites. Contributing factors highlighted are; insufficient expertise or knowledge on the part of the website developers and designers [36, 37], and that web accessibility is still not seen as a priority [34].

The issue of education is still very present. Krol et al [36] notes that regulations for education on accessibility should be introduced for people who design interfaces for every-day use. This would help promote awareness of issues and allow for implementation of appropriate design techniques.

There is minimal mention of negative attitudes towards disability, perhaps indicative of a positive shift in society mindset towards inclusion. Another issue which seems to have faded are the difficulties caused by technological barriers. Kous et al [35] note that a possible reason for accessibility improvements is because popular web frameworks and libraries address accessibility directly, thus avoiding some issues.

Policies, sense of responsibility, and commitment from management – found earlier in Lazar et al [31] and Velleman et al [32] – are still found to be lacking [37]. Moreover, Vollenwyder et al observe that while web developers are felt to be responsible for Web Accessibility, there is an "absence of concern" in non-technical (organisational) roles which may lead to compromising adoption strategies [38]. Given these conditions, it is unrealistic to expect web accessibility to flourish in any organisation.

4 Methodology and Results

No study on web accessibility has been done before at CERN, to the author's knowledge. Therefore this is an exploratory study, and so three different techniques were adopted in order to obtain as wide a picture as possible. These were a) online search on CERN's internal websites for documentation to understand CERN's official approach to web accessibility, b) an open-ended questionnaire and discussion to understand perceptions of web accessibility at CERN; and c) automatic web accessibility evaluation of selected CERN websites to observe the extent of WCAG compliance. The following sections present a description of the method applied, followed by the results obtained, for each technique in turn.

4.1 Document search

This was conducted to understand what strategies, standards and resources CERN has in place to support web accessibility. The main areas examined were; policy, training, guidelines and tools, following strategy areas highlighted by the W3C Web Accessibility Initiative [23] for promoting web accessibility within organisations.

Searches were carried out on CERN internal websites in order to find documentation pertaining to web accessibility. The websites were: Human Resources Department, Diversity

& Inclusion Office, CERN Document Server, CERN Technical Training Catalogue, Information Technology Department and the Education, Communications and Outreach group. Relevant managers within these units were then contacted to confirm findings.

4.2 Document search results

CERN is classified as an International Organisation with diplomatic/legal exemption status with regards the laws of its host states France and Switzerland [39]. CERN is therefore legally responsible for its own policies with regards web accessibility.

CERN's Diversity Policy [40, 41] mentions disability in the form of ensuring diversity principles are applied, to include "meeting the special needs of disabled individuals". It also states that it benchmarks best practices with comparable organisations within CERN's Member States. However, no further information seems to be (publicly) available.

The CERN Diversity & Inclusion Office offers "Support Structures for People with Disabilities" [42], which deals with mobility issues (e.g. building access, parking). The "Disability and Inclusion in the Workplace" guidance [43] refers to aspects such as inclusive terminology, physical mobility and behavioural etiquette. There is no mention of digital inclusion in either instance.

Moving on to CERN's recruitment policy, there is a statement that "the recruitment process should be fully accessible and support candidates who require reasonable adjustments. Adhering to W3C standards for the web interface will ensure colour-blind or people with reading difficulties may still apply" [44]. However, there is no reference to which standards (W3C provides many standards [45], not just on accessibility), and if one assumes they meant WCAG, there is no reference of what compliance level was aimed for or implemented.

With no formal policies in place, the existence of informal 'on the ground' support was then examined. There is extensive web-hosting infrastructure offered at CERN. Drupal is the principal tool offered to people without programming experience to create websites, especially if they are public-facing. There are also specialist platforms (e.g. EOS, Apex Web Hosting) allowing people with programming knowledge to write their own sites. However, there is no central web-building or content management team overseeing the resulting ~14,000 [46] websites. Departments and collaboration teams create and manage their own websites, and thus site-builders are left to self-direct in development, design and content management.

This inevitably fuels inconsistent and unpredictable user experience for impaired and non-impaired users alike across CERN's websites. There are extensive Drupal-specific guidelines and community support available [47] but there is no mention of visual, motor control, audio etc. impairments or of the different methods used to interact with a website. "Guidelines for CERN websites" [48] (part of CERN's Communication Strategy [49]), deal with CERN's branding elements, e.g. header and logo. However, there is zero reference to inclusive design for accessibility.

CERN offers thousands of training courses via its Learning Hub [50] to cater for its scientific and administrative population. Searching on general keywords “accessibility” or “disability” returns zero results. “Inclusive” returns 3 records from interpersonal training on gendered vocabulary and leadership self-development. Clearly, there is no training – whether as an independent course, or modules packaged in with web-building training - relating to inclusive principles for digital interfaces.

CERN Disability Network [51] is an informal, voluntary network within CERN. Its mission is to provide a point of contact, support and discussion for people with disabilities. The Network was contacted for comment, but unfortunately there was no response.

It therefore is reasonable to conclude that no policy or support exists at CERN regarding standards, adoption, implementation, evaluation or statement of Web Accessibility.

4.3 Open-ended questionnaire

An open-ended questionnaire to guide discussion was created by the author and presented to participants, in order to elicit their perceptions of web accessibility, and allowing them to introduce ideas and opinions that they felt were important. The aim was for exploratory sampling of opinions from diverse roles, rather than quantitative sampling from random personnel. Discussions were conducted via email, CERN’s internal online chat service, and video-conferencing.

Participants were CERN employees from a wide range of domains: human resources, communications, procurement, software/website development, and web infrastructure. They were approached because they had a professional role which could be considered relevant to some aspect of web accessibility, such as policy, outreach or web development. As data collection would include human participants, Ethics Approval was granted by the University of Nottingham Faculty of Engineering Ethics Committee (see Appendix 3). Eight participants agreed to be interviewed, and all consented for their answers to be used anonymously for this study.

The questions were:

- What do you understand or perceive as Web Accessibility?
- Do you think CERN as a whole understands web/digital interface accessibility for people with impairments?
    - Have you seen any examples you thought were well done?
    - Have you seen any examples where you thought this might be a problem?
- Do you think CERN provides enough/any support for web accessibility for its site/interface builders?
    - If yes, what have you seen?
    - If not, what do you think could or should be done?

Responses were analysed following an adaption of the theme-based content analysis (TBCA) model proposed by Neale and Nichols [52]. This method was chosen as it allows for quick extraction of dominant themes from generally unstructured qualitative data, and provide pointers for further investigation another time. Both inductive and deductive approaches –

as described Braun and Clarke [53], and Kiger and Varpio [54] - were also used to structure themes; based on both arguments identified in the literature and also to see what other threads arose from the discussion.

The raw data consisted of questionnaire answers and spontaneous comments and opinions. Once collected, extracts were grouped according to primary themes that emerged from the responses. These themes were then in turn summarised into 'higher order themes' where evident, and subsequently presented as a simple table matrix.

4.4 Open-ended questionnaire results

Table 1 below contains the predominant themes which emerged from the 8 discussions relating specifically to CERN. These themes revealed a mix of driving factors ("*driver")* for adoption/implementation, and general perceptions of web accessibility. "Lit." indicates where a theme had already been identified in literature and could be applied, while "New" indicates an unpredicted theme. Sample data can be found in Appendix 1.

Raw data theme	Higher theme	Lit. or New
Lack of awareness or commitment at CERN	Organisational *(driver)*	Lit.
Accessibility driven by individual advocates	Advocates *(driver)*	Lit.
Not enough/no assigned budget	Financial *(driver)*	Lit.
Not a priority, no responsible entity	Responsibility *(driver)*	Lit.
Not enough users with disabilities, not visible	Perception	Lit.
CERN silo effect	Organisational *(driver)*	New
No specialists/can't become a specialist	Support *(driver)*	Lit.
Accessible websites are ugly	Perception	Lit.
Not enough training	Support *(driver)*	Lit.

Table 1: main themes identified from discussions

All themes here - bar one - had been predicted in research literature. However, one new driver theme was identified; that of the "CERN silo effect".

As this is a qualitative summary, the following describes summaries and sample comments from all the questions, notably where respondents summed up particularly well the sentiments observed in other participants.

What do you understand or perceive as Web Accessibility?

Four respondents were able to describe Web Accessibility specifically in terms of types of impairments or disability. The rest were more vague, referring instead to general usability issues such as 'ability to navigate' or 'good visual design', or "everyone being able to access content".

While these four could identify types of impairments, only one specifically mentioned implementation techniques relating to the actual experience of an impaired user (e.g. "colour-blind-friendly palette" and "elderly-friendly buttons").

Do you think CERN as a whole understands web/digital interface accessibility for people with impairments?

All participants felt that CERN lacked commitment and general awareness in this regard, and that web accessibility was not considered a priority.

Sample responses:

- "We speak a fair bit about diversity and inclusion but digital inclusion is never a part of our dialogues […] CERN - and many more organisations - care a lot about wheelchair access but don't realise that people with visual impairment have similar challenges with regard to software."
- "I don't think anyone is aware of that [accessibility] at CERN when they build websites."
- "We'd like to be an inclusive environment, but we don't put […] the manpower or the resource behind it to make it happen."

The majority of participants also noted that web accessibility was driven by individual advocates, rather than being an institution-wide default. Another related point which emerged was around the lack of sharing of ideas and techniques across the organisation. One participant noted the independence of the organisational units at CERN, while another noted 'departmental silos', where if an initiative happens in one silo (e.g. web accessibility drive in HR), it stays there and does not spread to the rest of CERN.

Have you seen any examples you thought were good? Or indeed, any examples / experiences where you thought this might be a problem?

Four participants who had had direct individual contact with an impaired user were able to cite specific examples of problems and their consequences.

Some examples given were:

- A user had to pay for their own live-captioning for conferences as this was not provided by default at CERN.
- Another user was offered a job contract at CERN but refused because of issues around accessibility.
- While accessibility modules are provided in Drupal, they are not integrated into the CERN Drupal infrastructure. Any accessibility module search and activation therefore relied on individual site-builder's awareness that such modules exist.

Two participants specifically noted the impact on impaired users:

- My users used to tell me that they were very frustrated, not that they could not navigate, or that it cost them a lot (of efforts I mean), but that they were really frustrated by the big amount of wasted time, but above all, for feeling completely excluded from society.
- I've encountered many occasions where users had difficulties with our systems but already lost hope that we could provide something that would work for them. They take inaccessible systems for granted and consider it part of their CERN life.

Discussion in all cases raised generally-perceived issues around disability, such as that there were not many users with impairments. Respondents also commented on the lack of training, lack of dedicated budget, and a perception that attractive websites were not compatible with accessible websites.

Do you think CERN provides enough/any support for web accessibility for its site/interface builders? What do you think could/should be done?

All participants felt that CERN provided no support whatsoever. The question on what could/should be done triggered extensive discussion, and so here is a summary of the themes which emerged:

- Make web accessibility compulsory at CERN, require web accessibility statements (like data privacy statements required of CERN services)
- Assign budget to support web accessibility initiatives (e.g. quality live captioning provided as a CERN service).
- Training for anyone creating documents or website interfaces (but without requiring an individual to become a specialist).
- Offer tools and guidelines (e.g., colour guides, evaluation tools, examples)
- Immediate repair-work: hire accessibility professionals to fix CERN's most visible websites.
- Raise awareness on why web accessibility is important and its impact if not implemented, in order to gain and retain expertise in-house.

4.5 Automatic website evaluation

The online evaluator and report-generator WAVE (Web Accessibility Evaluation Tool) [55] was chosen from a list provided by the W3C Web Accessibility Evaluation Tools List [26]. The selection criteria for the tool were that it was free, no personal or contact data was required, browser-based, with evaluation based on WCAG guidelines.

An automatic web accessibility evaluation tool can identify the level of compliance with WCAG and highlight issues to be resolved. It is a quick method allowing a wide and relatively detailed overview, especially if comparing multiple websites. Such tools cannot pick up every single issue (e.g. general usability problems that affect everyone, such as unexpected site or page behaviours), and human evaluation is therefore essential. However, given the time constraints, and the fact this is an exploratory study sampling several websites, using an automatic tool seemed an appropriate option.

WAVE [55] creates automatic reports and groups issues found according to 6 categories. For the sake of simplicity, the first three categories which related directly to WCAG failures and alerts for investigation were selected. The other categories requiring a certain level of specialised coding knowledge (e.g. ARIA, HTML structure) were excluded due to the author's limited experience in coding. The three categories presented in this study are:

1) **Error**. This indicates an issue that will impact certain users and marks a failure to meet WCAG.
2) **Contrast Error**. This is text that does not meet WCAG contrast requirements.

3) **Alert**. This highlights elements which may cause issues and requires manual investigation.

The data was tabulated in Excel (see Appendix 2). Details of the types of error found within each category were also listed, and error-type frequency was ranked from high to low. The sites were then aggregated and ranked by frequency of WCAG failure rate of {Error + Contrast Error}.

This allows observation of the severity of WCAG failure per site, and to gain an approximate idea of how well, and to what standard, web accessibility is implemented at CERN.

Homepages of five CERN websites were chosen. The criteria were:
1) the most-visited public CERN websites.
2) browser-based administrative tools used by the CERN community.
3) sites using different web technologies to minimise bias from individual developer expertise.

The five sites selected, with their underlying web technologies, were:
- CERN's welcome website for the general public: home.cern (Drupal)
- IT Department website: information-technology.web.cern.ch (Drupal)
- Indico: indico.cern.ch (Python/Flask)
- CERN Computer Account Management: account.cern.ch (ASP.NET)
- CERN Service Portal: cern.service-now.com/service-portal/ (AngularJS)

4.6 Automatic website evaluation results

The evaluation results of the five selected CERN websites were aggregated to reveal trends in WCAG fails (or "error") and alerts requiring investigation. Table 2 below shows the actual number of WCAG fails and alerts per website, ranked according to total number of WCAG fails (Fail + Contrast Error).

Site	WCAG Fail	Contrast Error (WCAG Fail)	Alert	Total	Total WCAG Fails
home.cern	39	47	55	141	86
Indico	7	24	4	35	31
CERN Account Management	30	0	103	133	30
IT Department	4	12	7	23	16
ServiceNow	1	0	2	3	1

Table 2 Sampled sites ranked according to total number of WCAG fails.

All sites sampled displayed WCAG fails. The highest failure rate was *home.cern* with 86 WCAG fails, almost three times more than the number compared to the next ranked site Indico (31). CERN Account Management (30) and IT Department (16). The lowest was ServiceNow with just 1 error. However CERN Account Management had the most alerts flagged for investigation (103), followed by *home.cern* (55).

Overall, the top ten most frequently-occurring error and alert types across all websites – out of 24 types found (see Appendix 2) – are summarised in Table 3.

Description	Category	Instances
1. **Very low contrast**	WCAG fail	83
2. **Redundant link**	Alert	57
3. **Layout table**	Alert	37
4. **Empty link**	WCAG fail	34
5. **Linked image missing alternative text**	WCAG fail	30
6. **Device dependent event handler**	Alert	30
7. **Possible heading**	Alert	16
8. **Empty button**	WCAG fail	11
9. **Suspicious link text**	Alert	8
10. **Skipped heading level**	Alert	5

Table 3 Top Ten most frequent types of errors/alerts and number of instances.

A look at the top six high-scorers (based on the clear threshold of >30 instances) shows by far the most frequent error - and top WCAG fail - was very low contrast, where contrast ratios between colours are insufficient and will cause issues for users with low vision. The next major issue, which was an alert for investigation, was a high number of adjacent (redundant) links which went to the same location. This causes extra navigation and repetition for screen-reader users. Layout tables were the next issue; these are used uniquely for visual position on a page, and a screen-reader would have problems decoding the navigation order of the content. Empty links - another WCAG fail - were notable with 34 instances. Device-dependent handlers are the next most common issue, whereby (for example) only a mouse or a keyboard can be used to access navigation or content. Evidently, those using different input devices will be severely hampered in their interaction. Finally, the “alt” text for images - which is a WCAG fail - was missing in 30 instances.

Table 3 also shows that 4 WCAG fail types also identified are located in the top ten of all types found. 8 WCAG fail types were found in total, out of 24 types overall (see Appendix 2 for complete data). This clustering of the half of all WCAG fails in the top ten scorers indicates significant web accessibility awareness issues across all sites sampled.

5 Discussion

Looking at the results of the combined data sets, the research questions, “what evidence is there of web accessibility considerations at CERN?” and “what is driving the situation?” can be addressed. From the interviews and online information available at CERN, there are clear indications that beyond high level verbal commitment, the organisation has taken no concrete steps towards establishing any level of web accessibility beyond unsupported individuals’ own initiatives. Inductions can be made from the data about what is happening and why, and the theoretical models discussed earlier may be applied to support - and complement - what is observed.

On an individual level; while every participant supported the general idea of web accessibility, only half were able to define this with specific reference to disabled users and types of impairment. The other half understood the concepts of disability following an experience with a single direct contact, but subsequently had only vague or uncertain understanding and awareness about what web accessibility barriers may be faced by impaired users. This highlights a lack of access to training or exposure, and raises concerns about future prioritisation of initiatives for digital inclusion.

Further evidence of (lack of) awareness can be seen in the results of WCAG compliance of the sampled sites. The clustering of WCAG failures in the top ten most frequent errors clearly indicate faults in basic knowledge around the types of barriers impaired users might face. This is particularly evident for colour and contrast failures, and for other basic faults such as “alt” text for images.

A good example is CERN’s website targeted at the general public *home.cern*, an entity that one could reasonably expect to be fully WCAG-compliant. It is therefore a surprise to find it scored the highest failure rate out of all the sites sampled, with over double the number of failures compared to the next on the list. Given “The WebAim Million” shows an average of 51.4 failures per home page [28], *home.cern*’s 86 failures indicates investigation is needed both for immediate repair, and for inherent issues surrounding awareness and compliance.

Vollenwyder et al note an “absence of concern” [38] which seems to ring true here. Three participants commented that physical accessibility to buildings seemed to be considered more important than web accessibility. Indeed, this shows in the HR/Diversity online guidance, where the focus is exclusively on issues relating to physical impairment (e.g. wheelchair ramps, parking), interpersonal interactions, and absolutely nothing on web accessibility. In addition, tellingly, there is no training on web accessibility offered, neither as a module within a specific tool or language, nor as a standalone speciality.

It is difficult to pinpoint in the data from where this “absence of concern” [38] originates. Management roles tend to be less involved in accessible web information and services [38], and this often results in web accessibility to be considered less important than other requirements [32]. One participant noted “I don't think it's a question of not wanting to, I don't think it's on the top level of agenda from people […] it’s not a burning platform”. Complementary to this, Velleman et al’s model also notes that managerial commitment and decisions are one of the factors needed to drive adoption and implementation [32]. The commitment issue was noted by another participant who said “[CERN needs] to decide if they really want to change this”. The lack of decision from management, and resulting uncertainty, was also commented on by another; “you have that tension between, you know, do I go for it and I do something, or do I wait for management to agree?”.

Who, or what, is responsible is also noticeably absent from the data. One participant felt instructions should come from the IT Department or the Director General (i.e. a top-down policy). Otherwise, there was only vague reference to “CERN” or “management” being responsible. One participant felt that the CERN’s principle web-building tool should already ideally have accessibility factored in by default (i.e. the responsibility question becomes irrelevant with regards to implementation, because it’s automatically taken care of). The

sense of who or what should be considered responsible is difficult to infer from the data, but it is interesting that there was no strong comment about it. This could be an indicator that, given the general sense of vagueness or concern about web accessibility picked up in the data, it's difficult to assign responsibility.

User advocacy is an important driver of a positive accessibility mindset and implementation within organisations [33, 38]. The qualitative data from discussion indicates that CERN certainly has motivated advocates; two individuals were named specifically regarding initiatives in CERN buildings for people with physical and audio impairments, and two other participants had particularly strong, knowledgeable views on web accessibility. Moreover, one participant noted "It's also a culture in which we've seen individuals push for things and make them happen […] the pressure comes also from individuals I think to put things on the agenda".

However, something might be putting the brakes on these advocates, and here we see a new theme not mentioned in literature. It is significant that two participants mentioned the independence of organisational units at CERN, i.e. the silo-effect. Initiatives or knowledge in one department or group do not appear to seep out into the rest of the organisation. It is difficult to pinpoint proof of this in the data, given there are few (if any) web accessibility initiatives to be able to track across the organisation. Only the HR Recruitment unit specifically (and vaguely) refers to "W3C standards". However, there is no more on the subject to be found outside HR, and it is not visible in any report or website that the author has been able access.

Finally, while this was not picked up in the data, it is significant that CERN has no legal obligation to comply with any regulations on web accessibility. This is likely to be a meaningful driver of lack of adoption or compliance [30, 31]. It should be noted that forcing accessibility to be adopted will not change the general accessibility cultural mindset [56], but at least presenting WCAG-compliant sites will contribute to a tangible strategy of inclusion.

6 Recommendations

The recommendations are structured around policy, awareness and implementation.

6.1 Policy

Given there is currently no policy at all at CERN regarding Web Accessibility, CERN management should consult the policy creation guidance provided by the W3C Web Accessibility Initiative [57]. CERN can also leverage its close ties with the European Commission and contact the Web Accessibility Directive Expert Group (WADEX) [58] who advises on implementation across EU member states. They could provide CERN – a geopolitically independent entity - with particular insight.

6.1.1 Standards

Given the global nature of CERN's reach, internationally-recognised standards should be followed. The WCAG guidelines as described in EN 301 549 for ICT [59] should therefore be set as the CERN standard.

6.1.2 Web accessibility statement

In the same way that CERN has OC11 (based on GDPR) which requires CERN service managers to provide a data privacy statement, there should be a similar obligation with a web accessibility statement for websites. This practice follows EU Directive (EU) 2016/2102 (point #44) [60], and guidance is available from Web Accessibility Initiative [61]. This will not only signal that CERN is taking digital accessibility seriously, but also will help enforce policy and promote good practice and awareness.

6.1.3 Compulsory for new websites

Web accessibility must be made compulsory, with an appropriate 'implementation by' date. Optional compliance should apply initially, while support strategies are instigated during an adjustment period.

Given the potential difficulties (e.g. time, training, feasibility) of retrofitting older websites, the author recommends that this policy only applies to new websites. This is on the assumption that older sites will eventually be obsolete or replaced in time, in which case it is hoped that web accessibility will already be an established design approach.

6.2 Awareness

6.2.1 Guidelines

A section on web accessibility in the CERN Design Guidelines [48] must be included, promoted on top-level similar to the UN "Building UN Websites" [62]. Content should cover general design and requirements principles (e.g. WebAIM's "Web Accessibility for Designers" [63] and "Considering the User Perspective" [64]), as well as simple validation tools and methods (e.g. W3C's "Easy Checks – A First Review of Web Accessibility" [65]).

The aim is to provide self-help guidelines which are easy to apply, not excessively technical, and yet effective. In-depth technical guidance can be referenced for those who require it.

6.3 Implementation

6.3.1 Organisational oversight

A unit consisting of recognised advocates should be created to oversee cross-departmental efforts, with appropriate management support. Tasks would involve:

- Coordinate actions to promote initiatives and expertise CERN-wide.
- Consulting for project managers and procurement, to ensure that accessibility requirements are understood and included in new projects or tenders.
- Source and promote training and awareness.

6.3.2 Training

CERN Learning Hub should offer courses covering different levels, to help everyone from site-builders to policy-makers be aware of needs and of different interaction methods as a standard design approach. Such courses could be:

1) Training to cover general web accessibility principles.

2) Unit on accessibility included within website-building tool training.
3) Training for experienced developers to cover ARIA, and other techniques relevant to various programming languages.

6.3.3 Technical measures

Drupal, being one of the principle web-authoring tools at CERN, is a prime candidate for automatically including accessibility suites to reduce issues. This can be timed to coincide with the release of Drupal 9 this autumn.

Appropriate accessibility modules should be identified on Drupal.org [66], and all new blank Drupal 9 websites should be shipped with a selection of these accessibility modules enabled by default.

6.3.4 Immediate professional evaluation

Professional evaluation providing recommendations should be procured immediately for CERN's outreach websites. *home.cern* in particular should be evaluated and corrected as first priority. Departmental websites and regular-use portals should then be evaluated as the next priority. Appropriate resources must be authorised to support the corrective work required.

7 Limitations & further research

To the author's knowledge no study on this topic has been done before at CERN, and therefore this was an exploratory study.

Consequently, the study methods chosen were lightweight and broad in order to see what could be found, rather than investigations to shape strategies.

For example, the actual number of accessibility issues may be far higher in reality. An automatic evaluation tool approach does not find all accessibility issues; the evaluation for Indico here yielded a surprisingly low incidence rate of issues. However, the author's previous usability study [1] indicated that Indico is awkward even for fully-abled people to use, and so issues found like confusing navigation or unexpected behaviour would be amplified for (e.g.) a blind user. The auto-evaluator could not identify this.

The interview questions were very open-ended, and the author did not insist on each question being expressly answered. This was deliberate in order to encourage free discussion, but also means that the data collected was unstructured. No doubt there are holes or hints which were not picked up on.

8 Conclusion

While the concept of diversity is clearly highly valued at CERN as part of its core commitments, it is clear that web accessibility has had minimal consideration, with notable "absence of concern" [38]. CERN is not unique in this respect; academic studies examining Web Accessibility point to similar situations across Europe, and several contributing factors

observed – such as low awareness or knowledge, and organisational factors such as lack of management commitment - are also in evidence at CERN.

The recommendations suggested here are intended to be a starting point towards an organisation-wide approach, promoting awareness and providing practical support for implementation.

CERN has enormous reach as a global laboratory and possesses a unique founding history with the web. This makes the moral and cultural imperative to provide web accessibility all the stronger. It is hoped CERN can now look to revise its approach in order to remove the digital barriers which hinder access to its science.

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10 Appendices

10.1 Appendix 1

10.1.1 Open-ended questionnaire

10.1.1.1 Sample summary tables

Theme (raw data theme)	Higher order theme	No. comments	Literature or New
CERN-specific/professional environment			
Lack of awareness or commitment at CERN	Organisational/commitment	8	Literature
Accessibility driven by individual advocates	Advocates	5	Literature
Not enough/no assigned budget	Financial	4	Literature
Not a priority, no responsible entity	Responsibility/commitment	4	Literature
Not enough users with disabilities, not visible	Perception	3	Literature
CERN silo effect (initiatives stay inside org-units)	Organisational	2	NEW
No specialists, don't want to be specialist	Perception	2	Literature
Accessible websites ugly, design for the majority	Perception	2	Literature
Not enough training	Support (lack of)	2	Literature
Personal Awareness and experience (open discussion)			
Provide impairment-based definition of web accessibility	Knowledgeable about web accessibility	4	n/a
Provide general usability-based definition of web accessibility	Uncertainty over web accessibility	3	n/a
Impact and adaption observed (disability in personal circle)	Personal factors (direct experience)	3	n/a
Improvement suggestions			
Regulations – make web accessibility compulsory	Regulation	3	Literature
Guidance – offer tools/guides	Individual support	3	Literature

Repair – expert accessibility checks. Pay for expertise, retain it	Repair	3	NEW
Training	Individual support	2	Literature
Raise awareness why it's important	Organisational awareness	2	Literature
Assign budget	Financial	2	Literature

10.1.1.2 Raw sample data

Comment during discussion (with number of comments)	Theme (raw data theme)	Higher order theme
• We speak a fair bit about diversity and inclusion but digital inclusion is never a part of our dialogues (1) • There is no formal policy at CERN regarding requirements, standards, support, adoption, implementation, evaluation or statement of web accessibility (1) • We know we're not very good (1) • I don't think anyone is aware of that [accessibility tools, requirements] at CERN when they build websites. (1) • I've never encountered the term ["web accessibility"] in my working environment, which is focused on infrastructure development. (1) • I don't know if CERN understands web/digital interface accessibility for people with impairments at all, and even I'm not a professional, for sure it's not 100% accessible(1) • We've got so much other stuff to do that it's not a priority, and you can philosophically agree on priorities (1) • when I moved to the US is such a different environment in the US, disabled people are fully integrated in the environments. The woods are laid out for wheelchairs probably thanks to Vietnam, but still, you know […] you have	Lack of awareness or commitment at CERN	Organisational driver

people putting stuff into baggies that are clearly mentally heavily disabled […] you're confronted with disability every single day. Here, we put people in different schools, you know, in different institutions, you don't see wheelchairs, in Geneva is not wheelchair friendly either. (1)		
• I would expect that the IT management and the DG management would give that kind of instructions even more than us. I don't think it's there; I don't think it's a question of not wanting to, I don't think it's on the top level of agenda from people. I don't think there's sympathy, of course, because how can you be not sympathetic to trying to build inclusive things(1) • as long as it doesn't burn is maybe not, you know, if it's not a burning platform.(1) • First, [CERN needs to] decide if they really want to change this(1) • The mindset which [*participant]* already touched upon. And I think this the philosophy that yes, we'd like to be an inclusive environment but we don't put them, the manpower or the resource behind it to make it happen. (1)	Not a priority, no responsible entity	Responsibility/commitment driver
• I think very few people have official tasks to improve things (I expect any efforts to improve services are just because an individual thinks it's important) (1) • there are pockets of greater awareness in some corners, usually among those who are engaged in the field of diversity. (1) • I observe strong efforts and commitment from IT colleagues *[name redacted]* and *[name redacted]* toward captioning of both previous and future events (1)	Accessibility driven by individual advocates	Advocates - driver

• It's also a culture in which we've seen individuals push for things and make them happen. So you have that tension between, you know, I go for it and I do something, or I wait for management to agree (1) • But the pressure comes also from individuals I think to put things on the agenda (1)		
• A consequence of CERN's academic culture is the broad independence of each organizational unit. This manifests on the Web, where the CERN website portfolio amounts 13000 websites! (1) • it doesn't filter across to any other department or just be you're looking at it and we don't see anything coming across (1)	CERN silo effect (initiatives stay inside org-units)	Organisational driver
• we have so few people with disabilities (1) • Accessibility analysis has to be experimental with active probing, since the most impacted visitors are the ones we never met. (1) • it's unless you are personally in touch with these people. Otherwise, they don't exist. (1)	Not enough users with disabilities, not visible	perception
• Trying to interpret general accessibility good practices for our services is probably too large a time investment to get much traction at CERN (1) • CERN website portfolio amounts 13000 websites! Are all of these professionally made? No, most are made by people with little technical expertise in Web technologies (let alone accessibility), who target a circle of close collaborators. (1)	No specialists, don’t want to be specialist	perception
• Is there no, not a sort of an equilibrium to be struck between accessibility and beauty because websites [like] that suck. You start, you know, pulling those things further apart at	Accessible websites ugly, design for the majority	perception

some point it will look really ugly probably and it will piss other users off. (1) • maybe it's a bias but the way I see developers. There are quite young, they're mostly men. And again, I see this as a dynamic environment to build for the most efficient, the most beautiful, and so he wants it to work for 80% of the people. (1)		

10.2 Appendix 2

10.2.1 Automatic evaluation

Sample data from one site

https://wave.webaim.org/report#/home.cern		**Home.cern**
141	**errors and alerts**	
39	Errors	***Meaning – from WAVE reference text***
4	Empty button	A button is empty or has no value text.
34	Empty link	If a link contains no text, the function or purpose of the link will not be presented to the user. This can introduce confusion for keyboard and screen reader users.
1	Broken ARIA reference	An aria-labelledby or aria-describedby reference exists, but the target for the reference does not exist.
47	Contrast Errors	
47	Very low contrast	Very low contrast between text and background colors. Adequate of text is necessary for all users, especially users with low vision.
55	Alerts	
5	Skipped heading level	Headings provide document structure and facilitate keyboard navigation by users of assistive technology. These users may be confused or experience difficulty navigating when heading levels are skipped.
16	Possible heading	Heading elements (<h1>-<h6>) provide important document structure, outlines, and navigation functionality to assistive technology users. If heading text is not a true heading, this information and functionality will not be available for that text.
1	Broken same-page link	A link to another location within the page is present but does not have a corresponding target.
7	Suspicious link text	Links, which are often read out of context, should clearly describe the destination or function of the link. Ambiguous text, text that does not make sense out of context, and extraneous text (such as "click here") can cause confusion and should be avoided.
26	Redundant link	When adjacent links go to the same location (such as a linked product image and an adjacent linked product name that go to the same product page) this results in additional navigation and repetition for keyboard and screen reader users.

Aggregated data tables

Ranking of number of WCAG fails, per site					
Site	Fail	Fail: Contrast Error	Alert	Total	WCAG fail
Home.cern	39	47	55	141	86
Indico	7	24	4	35	31
CERN Account Management	30	0	103	133	30
IT Department	4	12	7	23	16
ServiceNow	1	0	2	3	1

No.	WCAG Fail	Description	Instances	No. sites
1	x	Very low contrast	83	3
2		Redundant link	57	4
3		Layout table	37	2
4	x	Empty link	34	1
5	x	Linked image missing alternative text	30	2
6		Device dependent event handler	30	2
7		Possible heading	16	1
8	x	Empty button	11	3
9		Suspicious link text	8	2
10		Skipped heading level	5	1
11		Redundant alternative text	5	1
12		Link to PDF document	4	2
13	x	Empty heading	2	2

14	x	Language missing or invalid	2	2
15		No page regions	2	2
16	x	Broken ARIA reference	1	1
17	x	Missing form label	1	1
18		Broken same-page link	1	1
19		Unlabeled form control with title	1	1
20		Very small text	1	1
21		Select missing label	1	1
22		Missing fieldset	1	1
23		Noscript element	1	1
24		Missed first level heading	1	1

Faculty of Engineering

Process for approval of research study involving human participants

Introduction

This document describes the process to be followed when planning and obtaining approval for studies involving human participants within the Faculty of Engineering. The process is administered by the Faculty Research Ethics Committee, and managed by the Chair of the Ethics Committee and the Faculty Research Ethics Officer. All queries regarding the process should be initially sent to ez-eng-ethics@nottingham.ac.uk

What is Ethics Approval?

When conducting any study or observation or collecting data about individuals, it is essential that full consideration is given to ethical issues and that steps are taken to ensure participant well-being throughout the study. Participants involved in research studies have a right to:

- Know the goals of the study and who is funding the work
- Make an informed decision about whether or not they wish to participate
- Leave the study at any time if they do not wish to continue
- Know what will happen to them during the study and how long it will take
- Know if they may experience any discomfort
- Know what will happen to the findings
- Privacy of personal information
- Be treated courteously

The University of Nottingham and Faculty of Engineering have an ethics procedure that requires all staff and students to submit an application for ethical approval before conducting any research study involving human participants. Members of the Ethics Committee read through study proposals to check that the researcher has demonstrated that they have given full consideration to ethical issues and that they have provided participants with appropriate and sufficient information.

Who needs Ethics Approval?

ANY member of staff or registered student of the University of Nottingham involved in conducting any study or observation or collecting data about individuals MUST adhere to the University Code of Research Conduct and Research Ethics. Those affiliated with the Faculty of Engineering **MUST ALSO** comply with the Faculty ethical approval process before commencing their study.

Ethics application procedure

The attached document outlines the ethics approval process within the Faculty of Engineering. For all applications required to undergo formal review, applications must be submitted to the **Ethics Administrator**, APM Hub, L4-B03, Faculty of Engineering. The application will then be reviewed by the ethics committee. We aim to return a decision to applicants within three weeks but the procedure may be delayed if the ethics committee require further information. It is the applicant's responsibility to make sure that applications are submitted in good time.

THE STUDY MAY **NOT** START UNTIL ETHICAL APPROVAL HAS BEEN AWARDED

Information you should give to ALL participants

The following list describes the information that should be given to all participants. Normally this should be given in a participant information sheet at the beginning of the study, and participants should be required to confirm that they have understood the nature of the study, and that they are happy to participate.
The following information should be included:

- Details of who will be conducting the study.
- Details about who is sponsoring the study and what the terms of the sponsorship are (i.e. who will 'own' the data and how the data will be used).
- Details about the nature, purpose and duration of the study. (Participants whose first language is NOT English may need further explanation of what is involved as their understanding of some of the terminology may be limited).
- What kinds of procedures will be used and what participant will be asked to do.
- Details about any hazards, inconveniences and risks associated with the study.
- What procedures will be followed if a participant is injured. (only needed if risk of injury has been identified)
- What benefits (payments, expenses etc) are attached to the study.
- What they need to do in order to receive the payments described above.
- What procedures will be employed to maintain confidentiality and anonymity (e.g. removing personal details from data/reports, keeping data in locked files)
- What will happen to the data (how it will be used, how it will be stored, in what form it will be disseminated and if it is likely to be used for further analysis).
- How you will use photographs or video records (data analysis, illustration purposes, displayed to sponsors/ non-public academic audiences, printed in public domain documents etc).
- Details about who to contact if questions or problems arise.
- ALL participants must be told that any involvement in the study is voluntary and they are free to withdraw at any time. You should also explain any consequences for the participant of withdrawing from the study and indicate what will be done with the participant's data if they withdraw.

Faculty of Engineering
Application for approval of research study involving human participants

ALL applicants must provide the following information

The applicant must be the person who will conduct the investigations; each application must be made by one applicant:

- usually the student in the case of taught or research courses,
- usually the researcher (the member of university research or academic staff) who will conduct the study in the case of funded research projects,
- usually the principal investigator in the case of applications for ethics approval in advance of submission of a research proposal

If the applicant is an Undergraduate or Postgraduate taught or research student please complete the information below. The application must be approved by a Supervisor.

Name of student:	Catharine NOBLE	Student No:	20218039
Course of study:	MMME4064 UNUK	Email address:	egxcn1@nottingham.ac.uk
Supervisor:	Dr Sue Cobb	PGR ☐	PGT [x]
		UG ☐	

If the applicant is a member of university research or academic staff, please complete the information below: For research staff, the application must be approved by the Principal Investigator

Name:		Principal Investigator (Budget Holder)	
Email address:		PI Signature: ……	

Title of investigation: **Web Accessibility: Recommendations for CERN**

Planned date for study to begin: ……**11th June 2021**…… Duration of Study ……**4 weeks**……..……

Please state whether this application is:

☐ New ☐ Revised ☐ A renewal ☐ For a continuation study

Selection of review process

Please indicate whether the application is required to go forward to the ethics committee for formal review, or, in the case of projects completed by ***taught undergraduate and postgraduate students only***, whether the application can be approved by the supervisor under the expedited review process*.

☐ Formal review, application will be submitted to ethics committee

■ Expedited review, application is approved by supervisor*

* This option can only be selected if the Supervisor is a member of the Faculty Ethics committee

Approval by supervisor: expedited review

I approve the application as supervisor of this project, under the expedited review procedure.

Name of supervisor……Sue Cobb…… Signature……  … Date……8th June 2021……

Office use only

Date form received:		Date decision returned to applicant:
Passed to reviewers:	1. Name……	Date……
(formal review only)	2. Name……	Date……

Ethical Issues Checklist

The purpose of this Checklist is to facilitate the review process and to identify any ethical issues that may concern the Committee. It is meant to be an aid to both the researcher and the Committee. Listed below are areas which require some justification and attention on your part in specifying your study protocol. Please answer each question honestly, giving full details where required. Answering "YES" to any of the questions will not necessarily lead to a negative response to your application but it will draw issues to your attention and give the reviewers the opportunity to ensure appropriate steps are being taken. In expedited review, supervisors should ensure that for any questions where the answer "YES" has been given, appropriate measures have been taken to maintain ethical compliance.

Applicant's full name ..... **Catharine Alexandra Noble**.....

You must complete ALL of this section before submitting your application

1 Who is the population to be studied?

Opinions will be sought from up to 10 work colleagues at CERN in various roles directly associated with website building, Communications, Human Resources, computing software development and within the informal network 'CERN UX Community'.

2 Please give details of how the participants will be identified, approached and recruited. (Include any relationship between the investigator and participants e.g. instructor-student).

Invite colleagues for a semi-structured discussion via CERN Mattermost (internal chat client) or by email, according to roles as described above, and with respect to CERN's Covid restrictions at time of asking. All colleagues invited will invariably have been working with the applicant as project associates or members of online communities for at least 1 year if not significantly longer, so working relationships are already well established.

The interview will be in the form of a semi-structured discussion, with the following questions asked in order to provide initial structure, while expecting it to morph into free-form conversation to elicit unprompted ideas and perspectives:

1) What do you understand or perceive as Web Accessibility?
2) Do you think CERN as a whole understands web/digital interface accessibility for people with impairments?
   - Have you seen any examples you thought were well done?
   - Have you seen any examples/experiences where you thought this might be a problem?
3) Do you think CERN provides enough/any support for web accessibility for its site/interface builders?
   - If yes, what have you seen?
   - If not, what do you think could or should be done?

3 Will the population studied include any vulnerable members of the public? **YES** ☐ **NO** ☒
Note: for the purpose of ethics approval this includes participants who are under 18, people who are disabled or in poor health, and also those who are non-English speakers and may not be able to understand the consent forms. (If YES, please give further details)

.....

4 Will it be possible to associate specific information in your records with specific participants on the basis of name, position or other identifying information contained in your records? **YES** ☐ **NO** ☒

5 What steps have you taken to ensure confidentiality of personal information and anonymity of data both during the study and in the release of its findings?

- Text-based communications between researcher and participants remain in SSO-secured CERN email between or SSO-secured private direct 'Mattermost' chat, visible only to researcher and participants.
- Where a direct quote or source might be needed, it will be either attributed to the role or attributed to an anonymous participant.
- Participants will shown if their data has been used (whether directly or as part of aggregated data/findings) and will have the opportunity to be identified as a role, or as anonymous, or withdraw their contribution entirely.
- Final report will be marked confidential.

6 Describe what data will be stored, where, for what period of time, the measures that will be put in place to ensure security of the data, who will have access to the data, and the method and timing of disposal of the data.

Paper records should be stored in a locked filing cabinet. Digital data should be stored only on a password-protected computer and/or on a secure server. In accordance with the Data Protection Act, the data needs to be kept securely for seven years following publication kept securely for seven years following publication of results. After this time, electronic files will be deleted and any hard copies will be destroyed.

At the end of a student project, students are responsible for ensuring that all data from the study is passed on to their academic supervisor/s. The supervisors/s will then have responsibility for the storage of that data.

The researcher is a CERN employee, and therefore bound by strict CERN rules regarding conduct, data privacy and data protection:

- CERN Code of Conduct https://cds.cern.ch/record/2240689/files/BrochureCodeofConductEN.pdf
- CERN's Operational Circular 11 (OC11) https://cds.cern.ch/record/2651311?ln=en (CERN equivalent of GDPR)
- CERN Data Privacy Protection Policy (https://home.cern/data-privacy-protection-policy), in particular:
    - "Safeguard confidential information, documents or data, and ensure that such material in our possession is properly protected"; and,
    - "Respect the privacy of others and protect personal information given to us in confidence".

All information provided will be captured electronically, whether via CERN Mattermost or CERN Zoom (audio+transcript), and stored on a password protected accounts (of the participant and of the researcher in the case of Mattermost) and locally on the hard drive of the researcher's CERN-issued computer in a password-protected folder (in the case of CERN Zoom).

As only CERN staff will be interviewed, and as data will be kept on CERN servers or CERN-issued hardware, data will be destroyed in accordance with CERN data storage policy, as described in CERN's OC11.

Participants names (i.e. signature on consent form) will be kept separate from their questionnaire responses. Consent forms will be stored in the researcher's password-protected CERNbox (CERN-hosted online storage) personal account, and a copy sent to the university supervisor as confirmation than consent has been given, as per university Ethics rules.

7 Will persons participating in the study be subjected to physical or psychological discomfort, pain or aversive stimuli which is more than expected from everyday life? (If YES, please give further details)

YES	**NO**
☐	☒

……

8	Will participants engage in strenuous or unaccustomed physical activity? (If YES, please give further details)	**YES** ☐	**NO** x

……

9	Will the investigation use procedures designed to induce participants to act contrary to their wishes? (If YES, please give further details)	**YES** ☐	**NO** x

……

10	Will the investigation use procedures designed to induce embarrassment, humiliation, lowered self esteem, guilt, conflict, anger, discouragement or other emotional reactions? (If YES, please give further details)	**YES** ☐	**NO** x

……

11	Will participants be induced to disclose information of an intimate or otherwise sensitive nature? (If YES, please give further details)	**YES** ☐	**NO** x

……

12	Will participants be deceived or actively misled in any manner? (If YES, please give further details)	**YES** ☐	**NO** x

……

13	Will information be withheld from participants that they might reasonably expect to receive? (If YES, please give further details)	**YES** ☐	**NO** x

……

14	Will the research involve potentially sensitive topics? (If YES, please give further details)	**YES** ☐	**NO** x

……

15	Will data be collected which requires potentially invasive procedures (eg attaching electrodes to the skin) and/or other health-related information to be identified (eg heart rate). If yes please give details	**YES** ☐	**NO** x

……

If you require space for additional information, please add it here and identify the question to which it refers:

Checklist of information to include with your application:
Please tick the boxes below to confirm that you have included the following information with your submission. Failure to include the required information may result in your ethics application and approval for start of your research to be delayed.

[x] A brief description of the study design:
- number and type of participants
- number and duration of activities participants will be involved in
- equipment and procedures to be applied
- information about how participants will be recruited
- whether participants will be paid (state how this will be done)
- plans to ensure participant confidentiality and anonymity
- plans for storage and handling of data
- information about what will happen to the data after the study
- information about how any data and images may be used
- state whether it will be possible to identify any individuals.

[x] Copies of any information sheets to be given to participants (include recruitment information (e.g. adverts, posters, letters, etc)

[x] A copy of the participant consent form

[x] Copies of data collection sheets, questionnaires, etc

I confirm that all of the above is included in the application:

As the applicant I confirm that I have read and understand the Ethical requirements for my study and have read and complied with the University of Nottingham Code of Research Conduct and Research Ethics.

Signature of applicant .....  ..... Date ...8 June 2021.....

As supervisor, I confirm that I have checked the details of this application.

Signature of supervisor .....  ..... Date .....8th June 2021.....

NB The signature of the supervisor on this part of the application DOES NOT indicate supervisor approval for expedited review. If supervisor approval is granted then the front page of the application MUST be signed for approval to be confirmed.

Ethics Committee Reviewer Decision

This form must be completed by each reviewer. Each application will be reviewed by two members of the ethics committee. Reviews may be completed electronically and sent to the Faculty ethics administrator (Donna Astill-Shipman) from a University of Nottingham email address, or may be completed in paper form and delivered to the APM Hub

Applicant full name ……**Catharine Alexandra Noble**……

Reviewed by:

Name ……

Signature (paper based only) ……

Date ……

- [x] Approval awarded - no changes required
- [ ] Approval awarded - subject to required changes (see comments below)
- [ ] Approval pending - further information & resubmission required (see comments)
- [ ] Approval declined – reasons given below

Comments:

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Please note:

1. The approval only covers the participants and trials specified on the form and further approval must be requested for any repetition or extension to the investigation.
2. The approval covers the ethical requirements for the techniques and procedures described in the protocol but does not replace a safety or risk assessment.
3. Approval is not intended to convey any judgement on the quality of the research, experimental design or techniques.
4. Normally, all queries raised by reviewers should be addressed. In the case of conflicting or incomplete views, the ethics committee chair will review the comments and relay these to the applicant via email. All email correspondence related to the application must be copied to the Faculty research ethics administrator.

Any problems which arise during the course of the investigation must be reported to the Faculty Research Ethics Committee