Transforming Swiss Building Regulations: A Holistic UX Overhaul for Seamless User Interaction

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GDO750: Major Project Proposal

MA User Experience Design

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Contents

Abstract

Building regulations are tedious and confusing, but they are essential and form the backbone of architectural projects. By applying a phenomenological research approach, three significant usability issues were discovered with the current state of building regulations. Due to their fragmented nature, professionals need help with using documentation, which makes information hard to find and disrupts workflow.

Therefore, the main goal of this project is to assess and drastically improve the usability of Swiss building regulations for all industry professionals. The secondary goal is to enhance the ease of checking a project for compliance.

The expected outcome is improving user interaction with regulations at all stages: creating, updating and using. The project aims to provide a holistic solution that benefits all users by considering multiple angles.

Keywords | Human-computer interaction; User Experience; Usability; Building Regulations; Switzerland

Acronyms | HCI – Human-computer Interaction; UX – User Experience; BE – Built Environment

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Introduction

To be honest, there is not much interesting about building regulations. They are tedious to read and complex to understand, but they form the backbone of our homes and public spaces. Irritation at the tedium and a background as an architect in Switzerland led this project down the winding path of building regulation usability.

The research found three main problems with user interaction with building regulations in Switzerland. The first and most significant problem is fragmented documentation. Swiss building regulations are hierarchical, and "as a consequence, each canton arranges the building permit procedure independently" (Kourakou and Glassey 2015: 171). Such a siloed system makes regulatory information hard to find leading to inefficiency and mistakes.

Secondly, finding the correct document or section within a document is extremely difficult, causing users to memorise as much as possible, which leads to mistakes. Content discoverability is generally tricky, as regulations cover many topics (Imrie and Street 2011: 2507; Zallio and Clarkson 2021: 1; Soliman-Junior et al. 2022: 123; HM Government 2023). Each topic has its own PDF, with varying language and individual structure, leaving users unsure where to find information.

Optimising workflow is the third critical problem due to the complexity and length of architecture projects (Schiavi et al. 2022). Regulatory documents are published directly on municipal websites leaving professionals to individually track updates across the 26 Cantons and 2131 municipalities (FSO 2024a). Such a decentralised structure leads to users 'starting again' with every project.

Governments have tried improving their online platforms with mixed success and applicability (Stadt Zürich 2021; HM Government 2023). Previous studies have focussed on the usability of eGovernment portals (de Róiste 2013: 447), managing building regulation updates (Thomas-Alvarez and Mahdjoubi 2013: 1), and automated compliance checking (Amor and Dimyadi 2021). However, improving the foundational usability and interaction with the regulations has been consistently overlooked.

Despite research into the usability of government documentation, we need to see more research into solutions to the problems identified with building regulations. This project aims to address the foundational issues surrounding construction compliance, which span the gap between human-computer interaction (HCI), user experience (UX), and building regulations.

This study took a phenomenological approach to understanding the lived experience of built environment (BE) professionals. Semi-structured interviews with architects provided in-depth, descriptive data that explored participants' habits and perspectives. Secondary research focussed on reading literature surrounding usability challenges and the design of eGovernment services.

In summary, building regulations are part of the daily practice of many BE professionals. Therefore, this project aims to address the foundational usability issues with building regulation documentation. By improving the interaction between user and regulations, this project hopes to bring joy to an otherwise infuriating process.

Literature Review

To understand the current state of research in the design of building regulations, we need to first look at electronic government (e-government) services. In recent years, governments have seen the value in focussing "on user experience when designing e-government services. However, e-government services are still prone to poor user experience" (Aldrees and Gračanin 2023: 134). Research into the efficacy of e-government initiatives has shown poor functionality and a focus on technology rather than user needs (Bertot et al. 2008: 1).

The Swiss government has recently digitised VAT returns with 'ePortal', filing personal taxes with 'ZHservices' and receiving energy subsidies (Stadt Zürich 2021; FTA 2024; Kanton Zürich 2024). However, ePortal and ZHservices are focussed on finance, while ZHservices and the energy subsidy portal are only available in Canton Zürich. Despite positive steps, the Swiss portals do not reflect a wider adoption of UX principles in federal online platforms.

On the topic of web portals for building regulations, Thomas-Alvarez and Mahdjoubi identified the need to make current regulations more accessible, especially regarding drastic changes in fuel and power conservation requirements (2013: 1). They identified gaps in how planning authorities update building regulations and how they guide users.

A gap in the literature appears at the crossover of usability in government documents, building regulations and online portals. While existing research connects each area, more information is needed to connect the three areas.

Previous studies on compliance have focused on automating compliance checking at the planning stage to avoid errors and speed the approval process (Beach et al. 2020: 2; Sydora and Stroulia 2020: 1; Amor and Dimyadi 2021: 1; Zhang et al. 2022: 1). However, improving the foundational usability of the regulations to improve their initial implementation has not received the same attention.

Contextual design provides an excellent framework for thinking about usability in building regulations. At the heart of contextual design is "an in-depth understanding of users' tasks, motivations, intents, strategies and detailed steps – as well as an overall grasp of how they go through their days" (Holtzblatt and Beyer 2016: 22). Taking such a user-centric approach is critical to understanding daily challenges experienced by BE professionals. Von Grafenstein et al. further highlighted that user-centred design (UCD) is well suited for applying to legal compliance (2022: 12).

While significant steps have been made towards improving usability in government documentation, a more robust application of user-centric principles is needed. By applying contextual design principles to the problem, there will be a better understanding of the challenges professionals face. Taking such a stance will help bridge the usability/online portal/building regulations gap and lead to a more usable interaction with building regulations.

Swiss Contextual Analysis

For context, building regulations are a set of legal guidelines which outline the required standards for building work (HM Government 2020: 9). BE professionals like architects, contractors and building surveyors are responsible for applying building

regulations to their projects (RIBA 2024). They must stay up to date with local, regional and national variations and track recent updates or face a denial of planning permission.

In Switzerland, regulations follow a hierarchical arrangement that mirrors the government, leading to variations at the local level. The federal government is responsible for the overarching framework, while the county (Canton) and municipality (Gemeinde) focus on planning and implementation (Greater Geneva Bern area 2022).

Die Interkantonale Vereinbarung über die Harmonisierung der Baubegriffe or Intercantonal Agreement on the Harmonisation of Building Terms (IVHB) is an agreement between the Swiss Cantons (IVHB n.d.). Participating Cantons agree to change their building regulations to match the 'harmonising' guidelines set out by the IVHB. However, the IVHB is voluntary and since 2005, only 18 Cantons have joined (BPUK 2023). Additionally, the IVHB aims to standardise *only thirty building terms*, such as 'overall height' (Stadt Zürich 2017), it does not aim to standardise or improve finding or using regulations.

National authorities update regulations often in line with progressing standards. In Switzerland, updates are regular, typically occurring every few years. However, municipalities follow an individual update schedule and do not coordinate with others (Gemeinde Ermatingen 2022a: 1; Stadt Steckborn 2023: 1; Gemeinde Goldach 2024). For example, the most recent regulations from the municipality of Gemeinde Oberriet are from a decade ago (2014) and Ermatingen from 2016 (fig.1).

In the face of staggering complexity, it is the responsibility of the individual professional to keep track of updates and to use the correct edition. However, such an

irregular update schedule makes it exceedingly difficult for professionals to understand the state of regulations for their projects. The methods professionals use to keep up to date are discussed further in the section.

Figure 1 A transitional document from Gemeinde Ermatingen comparing updates to an old version (2022b)

Problem Statement

Councils, the government and professional bodies share control of building regulations in Switzerland. In the current situation, forming a coherent body of Swiss regulations is impossible, leading to government initiatives to tighten up some sectors and leave others fragmented. Documents are challenging to use and inconsistencies in language and representation make them hard to understand.

Focussing on the foundational usability issues in the Swiss building regulations landscape will help develop more robust control over the industry. A stronger foundation will also support future research into automated compliance-checking tools because the regulations will be more coherent.

Due to the chaos, the main goal of this project is to assess and drastically improve the usability of Swiss building regulations for industry professionals. The secondary goal is to enhance the ease of checking a project for compliance. These two goals aim to improve the user interaction with regulations at all stages: creating, updating and using. The project aims to provide a holistic solution that benefits all users by considering multiple angles.

Current Technologies

Market Research

The construction sector plays a significant part in the Swiss economy, with around 10% of the Swiss Gross Domestic Product coming from investments in construction (Swiss Economic Institute 2024). 10% is further significant considering Switzerland's goal to be a carbon-neutral country by 2050 (*Preisbekanntgabeverordnung*: 3).

Additionally, in the Swiss market in 2023, investment in new builds went down, while investment in renovations increased by 4.4% (FSO 2024b: 1). Increased renovations rather than demolitions (and subsequent new builds) indicate the gradual adoption of more climate-friendly construction practices.

Global trends towards increased energy efficiency in construction will naturally lead to more stringent regulations. Therefore, this is a notable opportunity to improve on user-friendly building regulations.

Competitive Analysis

This competitive analysis will focus on three products: Amenti and Luucy, Swiss-made tools specifically for Switzerland, and PlanRadar, a worldwide tool. The goal with this analysis is to more clearly see where the gaps lie between the existing tools on the market (fig.2).

Amenti and Luucy focus on the unique Swiss context, making them perfect picks for this project. Both products aim to speed up a project's feasibility by checking it against local regulations (LUUCY 2022; Amenti 2024). On the other hand, PlanRadar has a much broader focus on the global market and improves the experience of managing compliance during construction (PlanRadar 2024).

Despite being comparable products outwardly, PlanRadar explicitly shifted its focus towards construction management. Its features support documentation management, collaboration and quality assurance tools and enhance compliance management (fig.2).

On the other hand, Amenti and Luucy are remarkably similar but with slight focus shifts. Luucy emphasises its 3D spatial planning platform, digital twin technology and presentation tools. It is trying to become an integral tool to the architectural process by proposing it replace drawing programs commonly used in feasibility stages. Amenti, however, is focussed on generating the most efficient building form option

during feasibility. Users can generate multiple building form options and gain rough costs with the inbuilt project calculator.

While Amenti and Luucy incorporate regulations into their platforms, they emphasise automatically checking compliance with the user's 3D model. However, there is still an opportunity to make the regulations themselves more usable.

Feature Analysis	Amenti	Luucy	PlanRadar
Key	x - has feature	- has feature but not a focus	xx - emphasises feature
3D Spatial Planning Platform		X	
Compliance Emphasis	X		
Building Regulations - Planning	X	-	
Building Regulations - General	X	-	
3D Feasibility Study tool	X	X	
Cost Calculator	X	X	
Option Comparison Tool	X	X	
Switzerland-wide	XX	XX	X
Data Control	X	-	X
Project Reports	X	X	X
Presentation Tools		X	
Documentation Management			X
Collaboration Tool			X
Reporting			X
Quality Assurance and Control			X
Project Oversight			X
Intended Users	Developers, Architects, investors, brokers, Private clients, bankers	Urban Planners, Developers, Architects, Governments, Investors, Environmental Consultants	Construction Managers, Developers, Architects, Engineers, Contractors, Compliance Officers

Figure 2 Feature analysis between Amenti, Luucy and PlanRadar

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Target Audience

The primary user base will be architects in the planning phase, who establish the 'big moves' that influence the rest of the project. The secondary user base is professionals who work in the council and must manage the regulations at a governmental level. The tertiary user base is surveyors and architects working in the construction phase, who check specific, often safety-focused regulations.

Research Design

Considering the variety of experiences, a phenomenological approach was perfect for understanding the phenomenon of building regulations from a professional perspective. The research focused on semi-structured interviews, which provided in-depth, descriptive data that explored participants' habits and perspectives.

Through a general call on various social media channels, participants were found through affiliations with the built environment. The aim was to gain as wide a variety of participants as possible to gain a fuller understanding of the problem area.

All questions followed the guidelines established by Groves et al. (Groves et al. 2011: 242). Thematic analysis with an inductive approach explored emergent themes in the data while affinity mapping was the primary analytical technique for unearthing insights (Braun and Clarke 2021: 86).

Results

Five participants were selected through industry contacts as individuals who work in the built environment. Of those five participants, three were architects, one

architectural drafter, and one Part II Architectural Assistant[1]. Four participants live in Switzerland, and one in the UK. Interviewees will be referred to as P1, P2, etc, to maintain anonymity.

Participants universally described building regulations as "the main horror to deal with" (P1). Participants emphasised the difficulty of navigating and applying building regulations in their everyday practice. Themes in usability, discoverability and consistency highlight the critical problems of interacting with regulations.

Each architectural practice has an individual method for keeping abreast of existing, new and adapting regulations. Some offices had an official method, while others had unofficial methods. Regardless of the method, all participants emphasised the difficulty in ensuring access to up-to-date information. As a result, relying on memory and word-of-mouth were identified as standard practices. Frustration at trusting the filing system was common as regulations are "very defining of all the dimensions of the apartment" (P4).

A primary concern was that specific regulations were hard to find. Most participants had memorised the crucial regulations. However, P4 struggled with memorisation stating, "I always look it up again" (P4). Due to the interconnected nature of buildings, information exists in multiple locations, making content pages almost useless. Poor content organisation leads users to "Control-F for [your] life, because you cannot [find anything]" (P3).

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[1] Part II Architectural Assistant is the job title of a person in the UK who has graduated with a master's degree in architecture but who has not yet completed their Part III professional qualification. In Switzerland, once a person has graduated with a master's degree, they immediately become an architect. An architectural drafter is a distinctly different profession with a different educational track that focusses on technical drawing and building details.

PDFs were identified as the primary method for disseminating regulations, significantly impacting their usability. Text-based regulations are hard to understand, and keyword searching is insufficient, resulting in constant communication with the council. Participants said they must constantly refer back to the documentation but must re-find the information every time. The question of consistency continued within the topic of language. Inconsistently written regulations added to problems with keyword searching, while ambiguous language left "a lot of room for interpretation" (P2).

When asked about improving the interaction between professionals and regulations, participants unanimously wished for a centralised tool to collect all regulations in one place. They viewed a centralised tool as having the combined benefits of quick access and reliability of updates. Consistent language and structure were seen as 'must-haves' to improve content visibility, as were filters and keyword suggestions.

Participants additionally highlighted consistency as necessary in representing examples, with 2D images identified as the minimum and 3D images as "the ultimate fabulous goal" (P1). More detailed examples beyond average situations, such as 'simple', 'medium', and 'complex', were emphasised as essential to improving usability.

At the outset, this research assumed that LiDAR[2] would be a vital feature of this project due to its highly accurate scans and, as such was part of the interviews. Responses were divided between participants. All could see the benefit of 3D scanning in the early and late project stages, but it was almost useless in the middle construction

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[2] Light Detection and Ranging, a 3D scanning technique resulting in point cloud models

stages. However, none of the participants visited their project site during planning, meaning a tool with scanning capabilities will only be usable after a significant behaviour shift in architectural projects.

Personas

The survey data informed the following three personas: Paul, Lilian and Jānis. Paul and Lilian are the primary personas, while Jānis is the secondary persona. Paul is an architect early in his career and fell into a rhythm with projects in the early stages (fig.3). He deals with regulations daily and finds them very frustrating. He would love a tool that tells him precisely which regulations apply to his project based on the location. He especially wants improved search functions so he can find specific regulations quickly.

Figure 3 First primary persona. Photo credit: (Grid Architects n.d.)

Lilian represents the other side of the coin as a compliance officer within the local council (fig.4). Councils must maintain extensive documentation, including current regulations, transition documents, future updates and current, rejected and resubmitted projects. Lilian requires more edge-case examples and a method of tracking questions from her team. More importantly, she needs a reliable method of tracking and publishing updates to the regulations.
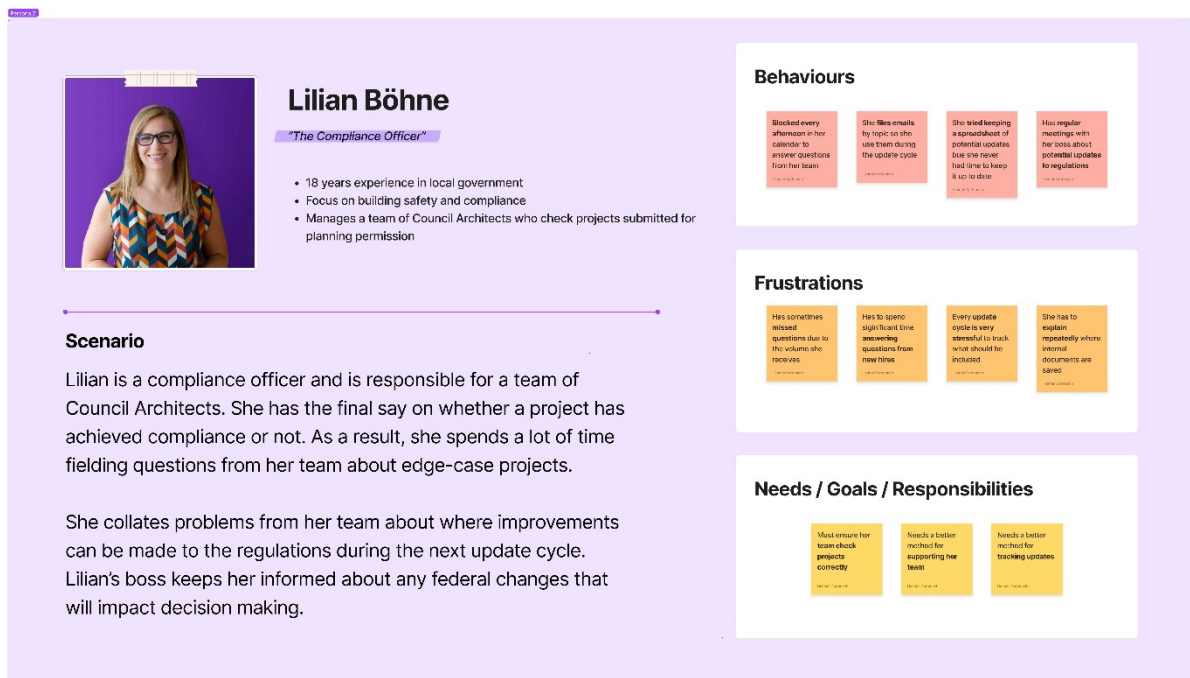
Figure 4 Second primary persona. Photo credit: (Grid Architects n.d.)

While stressful, Jānis graduated recently and enjoyed his time at university (fig.5). He knew about building regulations but had never dealt with them much during his studies. Now, in his first job as an architect, he is suddenly responsible for applying regulations to his designs. No one in the office has time to teach him, so he needs clear and straightforward regulations to bring his work up to scratch.
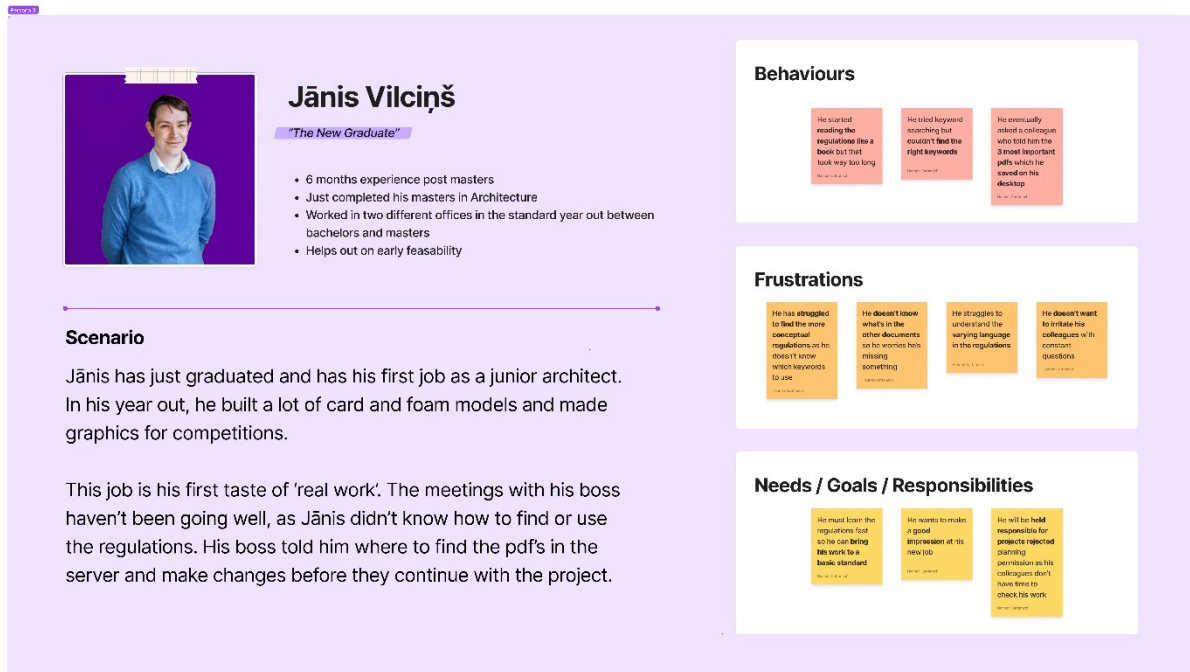
Figure 5 Secondary persona. Photo credit: (Grid Architects n.d.)

Journey Map

The survey data also informed the following user journey of the current situation for users accessing building regulations (fig.6). It is based on Paul's journey, Persona 1, through standard planning permission. The map shows significant areas for improvement in Paul's working day to increase efficiency and reduce stress.
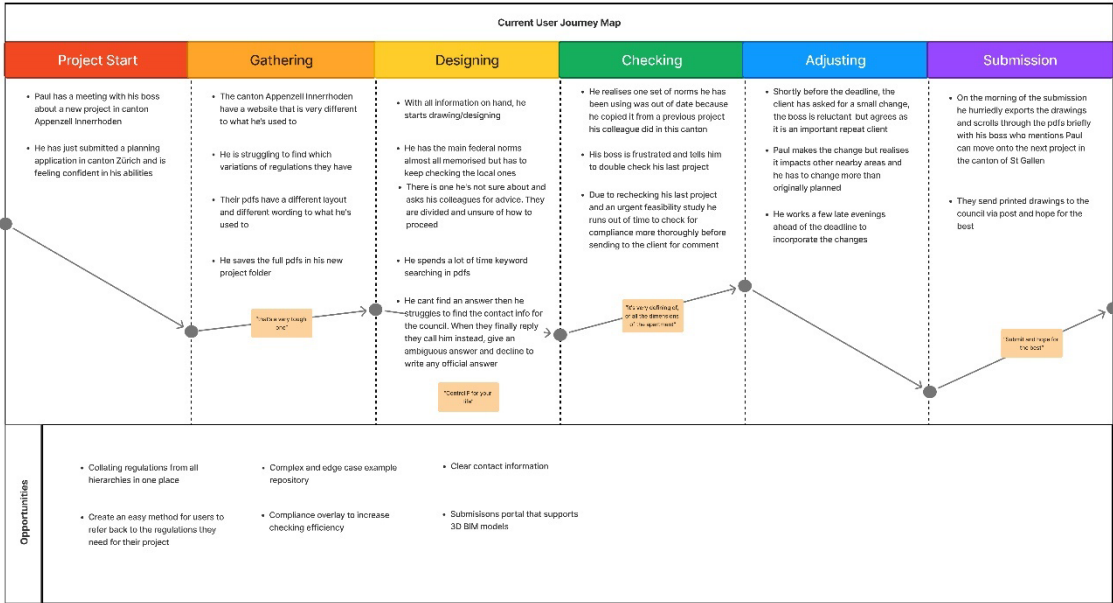
Figure 6 Map of the current user journey based on interview data

Discussion

The interviews revealed critical pain points among users when interacting with building regulations, particularly around usability and consistency. Frustration at the current method for using building regulations was high. Participants were frustrated not only with the format but also with the method for updates, the content, the language, and the ability to refer back to essential sections.

Poor regulation structuring is in direct conflict with Nielsen's heuristic Recognition Rather than Recall, suggesting that improved organisation and search functions could enhance usability (2024: 6). Flexibility and Efficiency of Use will be significantly improved by providing more drawings of varying complexity, allowing advanced users to skip the text (Nielsen 2024: 7). While maps might help locate where specific regulations are applicable, participants did not highlight this as a need. On the

other hand, documentation, contact details, and additional help were identified as musts (Quiñones et al. 2022: 45).

It is common for BE professionals to work to tight deadlines under significant stress. Therefore, streamlining the complex process of accessing regulations should drastically reduce cognitive load reducing mental fatigue and errors (Škola et al. 2024: 1480).

Considering the above points, the research findings suggest that transitioning regulations to an online platform with a streamlined information hierarchy will signify a significant step forward in the user experience. Additionally, improved content discoverability, such as filters, tagging, consistent language/structure, and variable content styles (text with 2D and 3D imagery), will improve interaction with regulations.

By bringing PDF documentation onto an active online platform, councils and BE professionals benefit from better update interactions. The ability to build up complex real-world scenarios will allow the tool to grow in the most critical areas for users.

LiDAR was initially seen as an impactful technology that could scan an area and generate representations of allowable buildings. Despite those initial thoughts, the interviews confirm that usability issues are at the core of this problem area. Morozov suggests placing technology first is solutionism (2013: 1), elevating digital technology "to a position of being the default solution to social problems" (Fass et al. 2021: 67). As much as LiDAR is an impressive technology with an exciting future, it will not be the focus of this project moving forwards.

However, as LiDAR technology's usability improves, its inclusion in a building regulations tool could be a helpful step forward in the data collection stages of built environment projects.

Project Planning

Project Feasibility

User Experience Challenges

There are many different sets of UX heuristics out there, each one developed by the individual experiences of the researcher within their specific context (Nielsen 1993: 5; Arhippainen 2013: 1; Quiñones et al. 2020: 2; Yablonski 2024: vii).

Therefore, this study will use Nielsen's 10 Usability Heuristics because they are the most commonly used and they focus on general usability (Arhippainen 2013: 1; Quiñones et al. 2018: 1; Nielsen 2024). Additionally, the 10 UX heuristics for geoportals, as developed by Quiñones et al., will be great for reference as they overlap with this project (2022: 45). Additionally, attention will be given to adhering to W3C guidelines as a cornerstone of accessibility on the web (2023).

Objectives

The following section outlines the four main project objectives based on the primary and secondary research. The first objective is to turn the scattered web of documentation into one central interactive format accessible by all. By centralising access, individual companies will avoid inventing systems for gathering and managing static PDFs.

A centralised platform will aid the second project objective of streamlining regulatory updates by providing a content management system (CMS) for the government and local councils. Two styles of account will help achieve this goal: one for professionals using the regulations and another for government offices to update them. Updating the regulations in the same location professionals look at to read them will help avoid missing updates if the word-of-mouth grapevine fails.

Lastly, improved information architecture (IA) will increase logic in the information hierarchy, making the information more usable. Better IA will be further enhanced by improved content discoverability. As BE professionals often need specific information, this project must support a robust search tool with advanced filtering to help users find information quickly. This objective will be achieved by developing a logical taxonomy for tagging information and suggesting search terms to support recognition rather than forcing recall.

Proposed User Journey Map

The following diagram outlines the proposed user journey based on the project objectives (fig.7). While architecture projects will remain large and complex, the proposed journey highlights how the interaction with regulations can be significantly improved. A more usable regulations tool will also make project pivots easier to manage by making document management and checking easier.
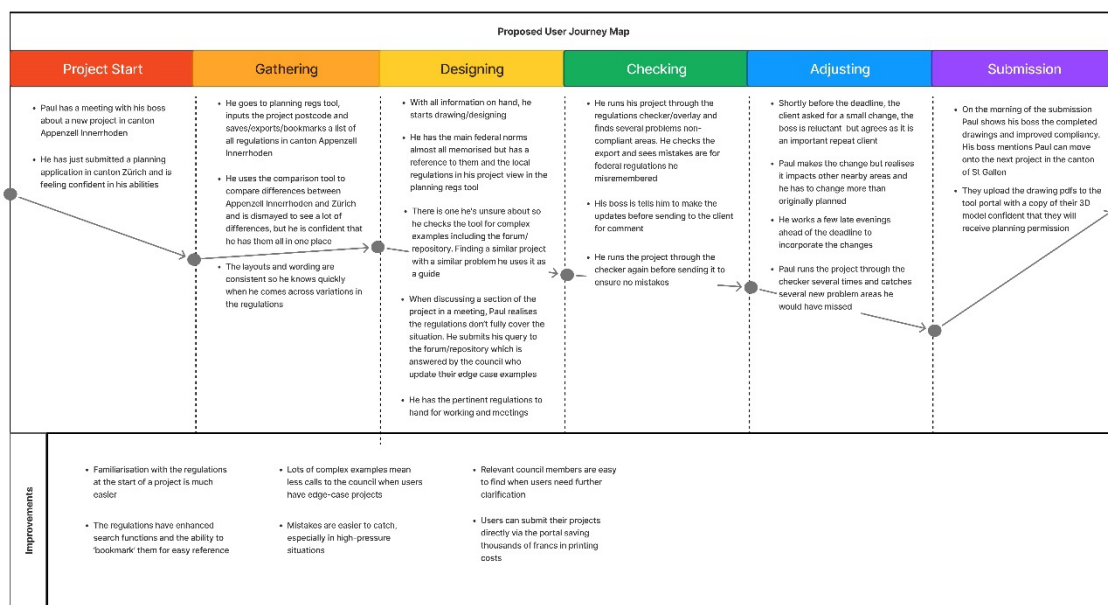
Figure 7 Proposed user journey based on the objectives

Purpose and value

This project aims to enhance the usability of building regulations to increase efficiency and reduce frustration and mistakes in professional environments. By taking a user-centred design approach, this project will improve compliance in architectural projects, further improving efficiency at the planning approval stage.

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The value of this project lies in its potential to significantly improve the workflow of BE professionals by reducing stress and cognitive load. It will provide a powerful resource to empower individuals and their bosses to be confident in their work.

Tools and technology

The initial tools for this project will be pen and paper for low-fidelity prototypes. By sticking with simple tools, usability concerns will remain prominent for as long as possible before progressing to tools with a UI focus.

Figma and Photoshop will provide the backbone for graphics, UI and basic prototyping for early usability tests. Conducting usability tests early and often will help validate the project's logic. Later in the project, ProtoPie will replace Figma for more advanced prototyping (UX Tools 2023). A tool like ProtoPie that supports dynamic input will be invaluable for testing the search function.

As information architecture is a big topic in this project, Lucid Chart will be used to design user flows and IA simply and efficiently. Deliverables created in Lucid Chart will be tested via card sorting with kardSort to refine a logical hierarchy. During usability testing, Maze will help provide quantitative data like heat maps. Bringing quantitative data into usability testing will provide structure to testing the project's usability.

As professional feedback is vital in this project, Miro will be used for collaborative sessions to generate qualitative prototype feedback. Collaborative Miro sessions will focus on UI feedback plus general comments from participants.

Skills audit

Skills audit	Very poor	Poor	Fair	Good	Very good
Sketching					X
Low-fidelity prototyping					X
Photoshop				X	
Figma				X	
ProtoPie	X				
UI Design			X		
Accessibility		X			
Information Architecture			X		

Figure 8 Skills audit
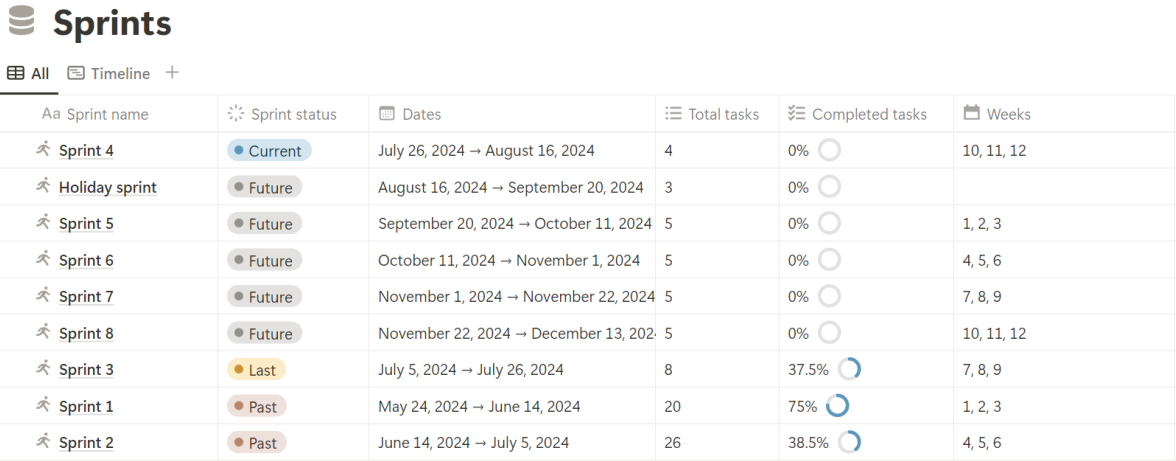
During the module break, refreshing Figma skills will be necessary by revisiting past projects and notes from previous tutorials (*Figma for UX Design* 2021). The 'ProtoPie for UX Design' course on LinkedIn Learning will provide an excellent basis for getting up to speed with the techniques involved in more advanced prototyping (2021). Proficiency in UI design will be maintained through continuous feedback from a small pool of industry professionals during user testing and discussions with peers on this course.

As accessibility is one of the critical drivers of this project, the W3C guidelines will be an integral point of reference before progressing between design iterations to ensure the project remains on track.

To thoroughly understand IA, an e-book copy of Information Architecture: For the Web and Beyond by Louis Rosenfeld, Peter Morville, and Jorge Arango will be a fantastic addition to the project reading list. According to some UX practitioners, this book is a must-read (Yeo 2017).

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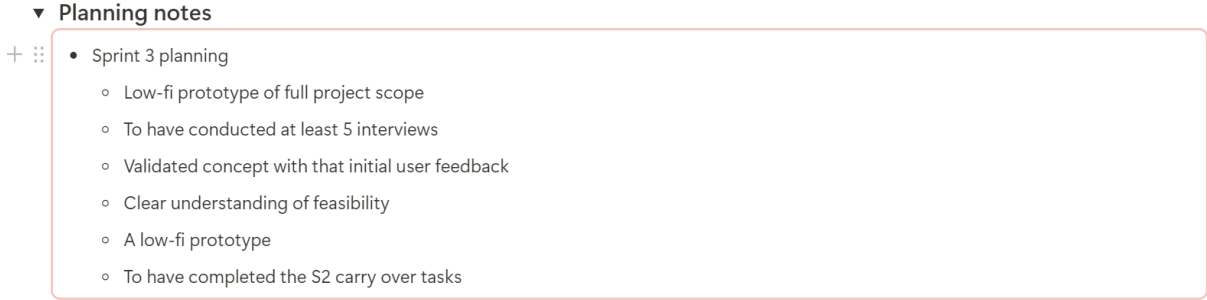
Project Timeline

This project will continue in an agile structure, using three-week sprints ending in a short retrospective that additionally outlines the goals for the coming sprint (fig.9 and 10). Short sprints were highly effective during the proposal stage of this project, as they gave manageable, short-term goals to work towards avoiding project creep/stagnation.

🗄 Sprints

⊞ All   ▭ Timeline   +

Aa Sprint name	Sprint status	📅 Dates	≣ Total tasks	⋛ Completed tasks	📅 Weeks
🏃 Sprint 4	● Current	July 26, 2024 → August 16, 2024	4	0%	10, 11, 12
🏃 Holiday sprint	● Future	August 16, 2024 → September 20, 2024	3	0%	
🏃 Sprint 5	● Future	September 20, 2024 → October 11, 2024	5	0%	1, 2, 3
🏃 Sprint 6	● Future	October 11, 2024 → November 1, 2024	5	0%	4, 5, 6
🏃 Sprint 7	● Future	November 1, 2024 → November 22, 2024	5	0%	7, 8, 9
🏃 Sprint 8	● Future	November 22, 2024 → December 13, 202₄	5	0%	10, 11, 12
🏃 Sprint 3	● Last	July 5, 2024 → July 26, 2024	8	37.5%	7, 8, 9
🏃 Sprint 1	● Past	May 24, 2024 → June 14, 2024	20	75%	1, 2, 3
🏃 Sprint 2	● Past	June 14, 2024 → July 5, 2024	26	38.5%	4, 5, 6

Figure 9 Sprint board outlining past, present and future sprints

▼ **Planning notes**

+ ⋮
- Sprint 3 planning
  - Low-fi prototype of full project scope
  - To have conducted at least 5 interviews
  - Validated concept with that initial user feedback
  - Clear understanding of feasibility
  - A low-fi prototype
  - To have completed the S2 carry over tasks

Figure 10 Each sprint retrospective will continue to outline future sprint goals

A button was created in Notion to automate retrospectives and make them as frictionless as possible. It opens a pre-made template that is automatically filed in the project notes (fig.11 and 12). During the proposal stage, the retrospective button was immensely helpful in conducting retrospectives consistently, so it will remain a key feature in the next stage.

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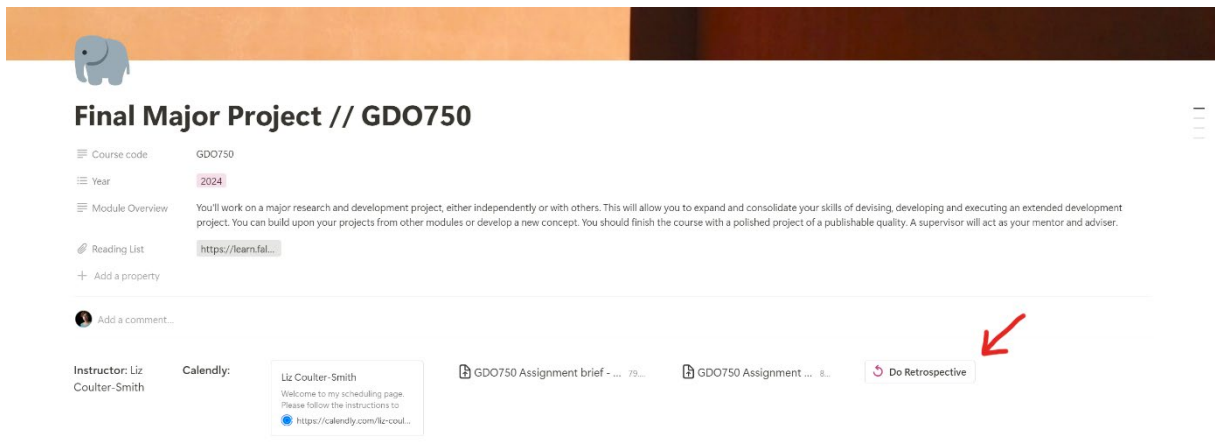
Figure 11 'Do Retrospective' button in the Notion project space
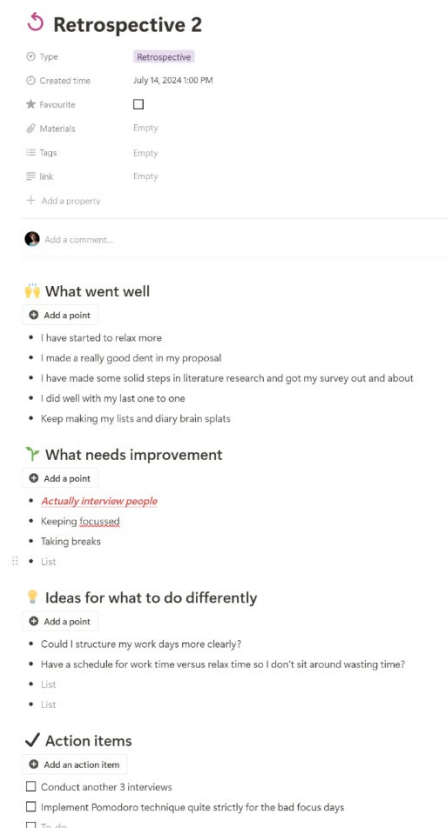
Figure 12 Retrospective template

The coming phase of the project will be based on product iterations and testing according to the following schedule estimation (fig.13 and 14).
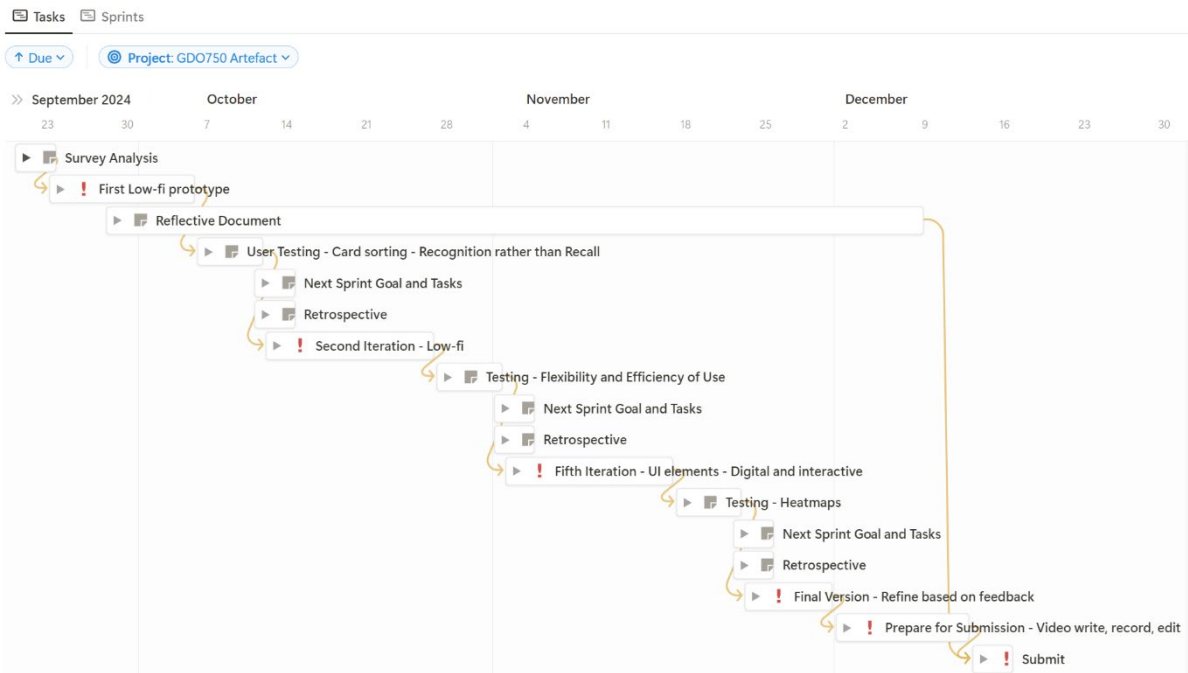
Figure 13 High-level Gantt chart
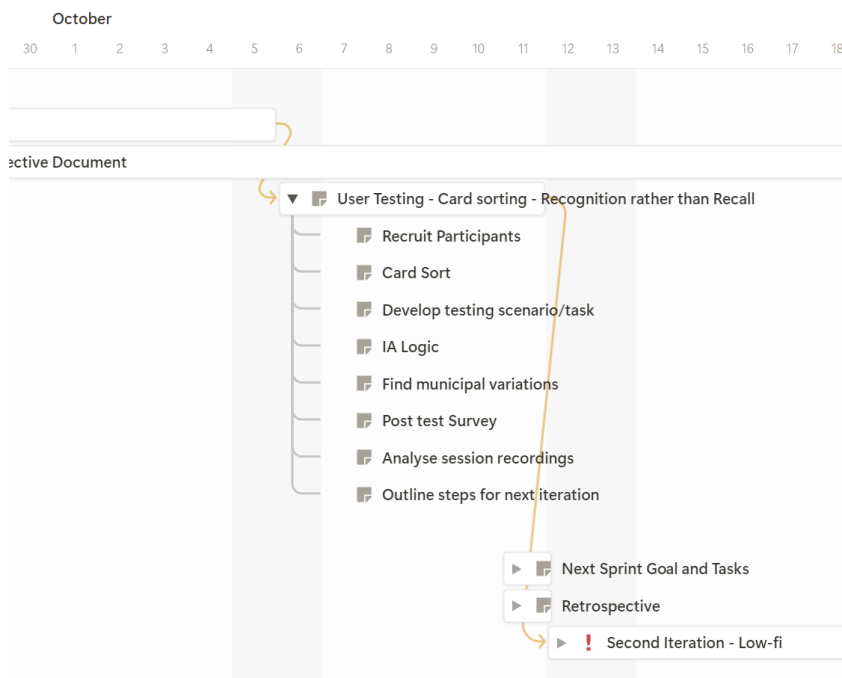
Figure 14 Detailed Gantt chart for one task

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User Research Plan

The goal of user research in the prototype stage will be to receive feedback on two main usability heuristics: Recognition rather than Recall and Flexibility and Efficiency of Use. These two heuristics will form the foundation for the resulting prototype's success. To research the two heuristics, users will participate in in-person and remote usability testing, first-click testing, tree testing and card sorting.

To recruit participants for this testing stage, "Can I contact you for future research?" was a crucial question in the interview and survey stage. Participants who said yes will be recruited via their provided email addresses to be involved in at least one round of testing.

Testing success will be measured via task success rate, time on task and user feedback. Participants' actions will be directly observed while session recordings will allow for analysis from transcripts. Participants will also be asked to fill out a short, post-task survey as a quick glimpse into their thinking.

The qualitative data will be analysed using thematic analysis to uncover related themes, while the quantitative data will be investigated through statistical analysis. The quantitative data will be analysed through descriptive statistics such as mean task completion time, success rate and average satisfaction rating. After each round of testing, a retrospective will be conducted to capture insights from the analysis. The points from the retrospective and user feedback will then be carried forward into the next product iteration via a prioritised product backlog.

Secondary research will continue by reading scholarly papers on user experience and compliance, design principles, usability, and data-heavy interfaces.

Project Wireframes

As with Amenti and Luucy, a tool that imports 3D models and automatically checks them against what is allowable will be essential (fig. 15). The 3D space will display the regulations as 3D representations (green box), highlighting non-compliant areas (red box). It will also include interactive points for when the user wants to read the regulation in more detail. A graphic representation of regulations will optimise workflow by avoiding ambiguous language.
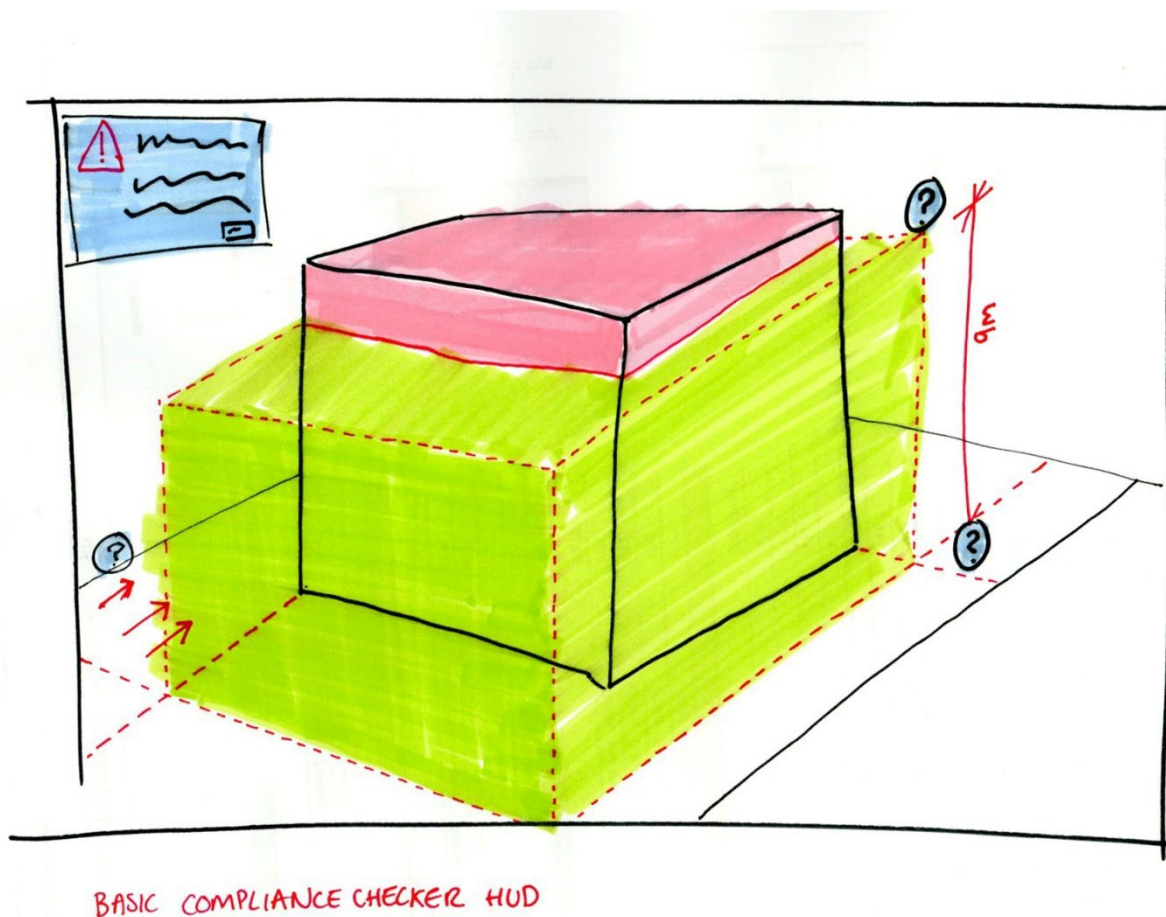
Figure 15 Basic Compliance Checker HUD wireframe

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In interviews, users highlighted the desire for enhanced search functionality with language suggestions (fig.16 and 17). Such functions will be on the product 'homepage' allowing users to search for the topic they have in mind immediately, optimising the workflow.
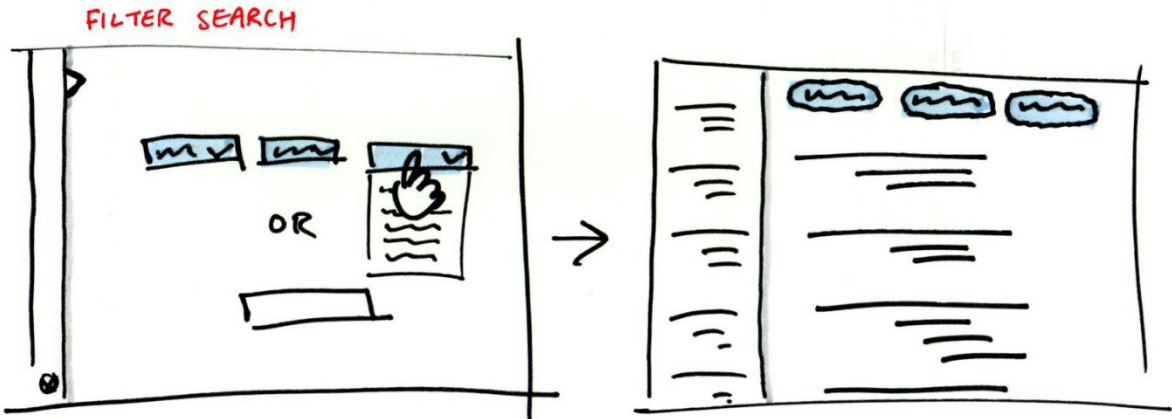
Figure 16 Wireflow of filter search
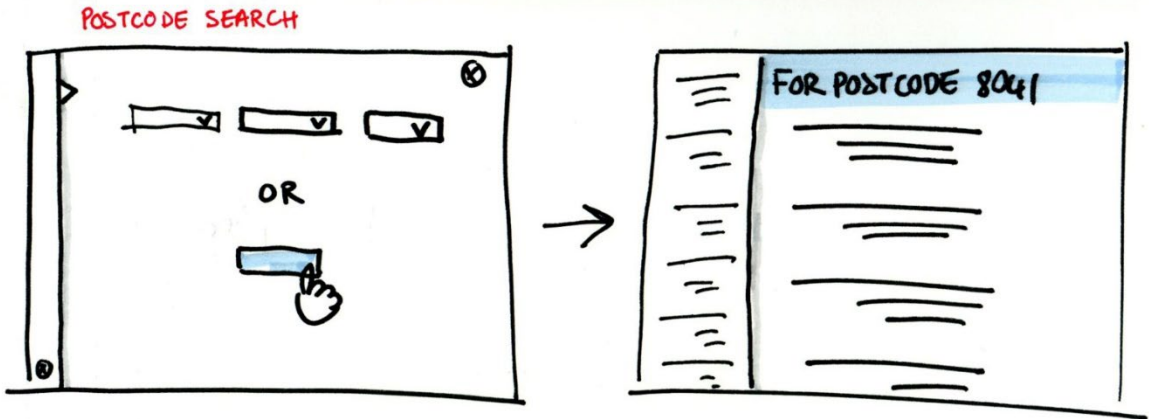
Figure 17 Wireflow of postcode search

The project will explore an enhanced taxonomy (fig. 18) to enable efficient searching and enhanced understanding of the regulatory content. Multiple variations of the taxonomy will be evaluated with tree testing. The taxonomy will also include a hierarchy of example diagrams to enhance the text-based regulation. By creating a standardised taxonomy, content discoverability will be drastically simplified.
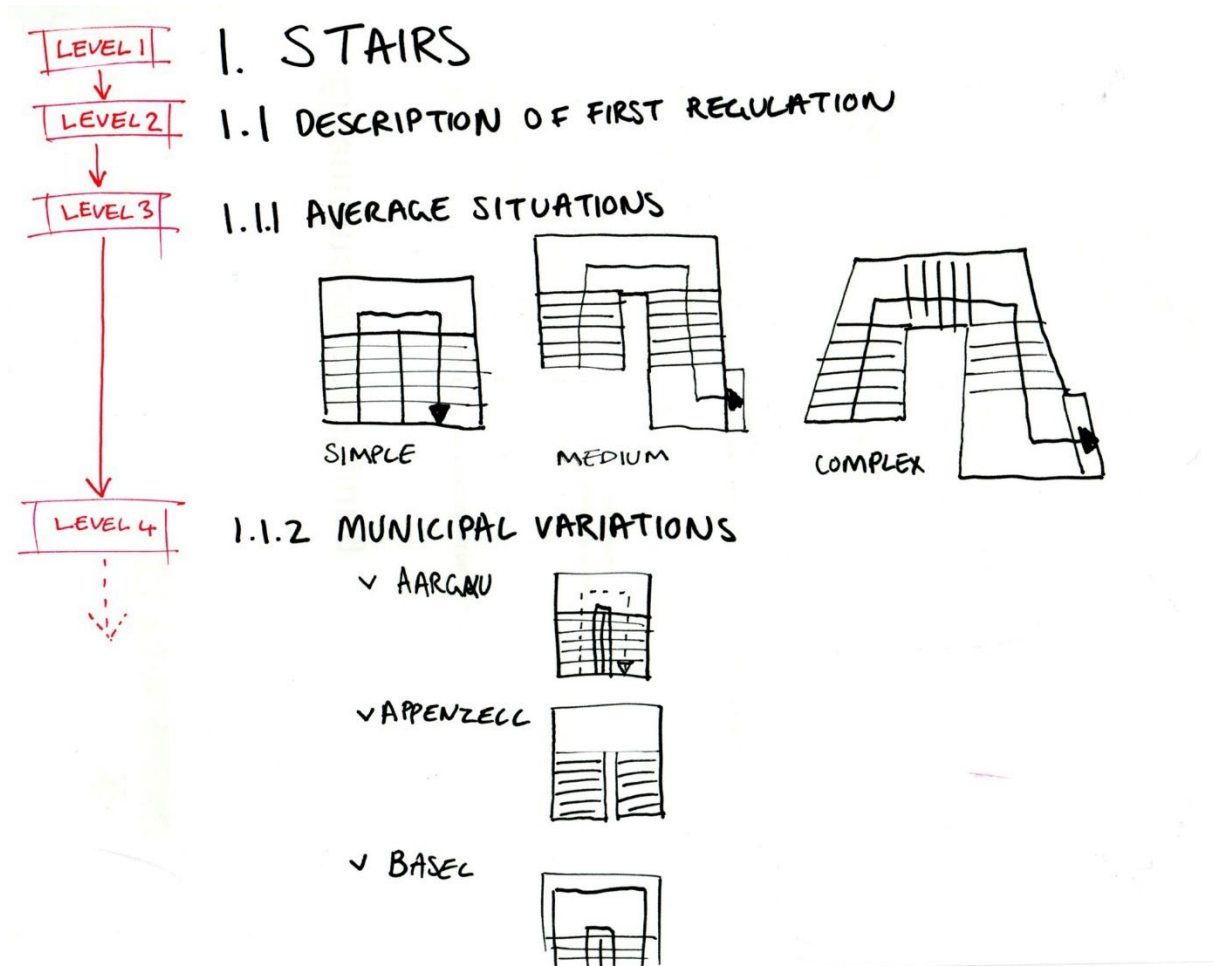
Figure 18 Early thoughts on taxonomy

The taxonomy will form the structure of the principal regulations view (fig.19). The regulations view must be clear and uncluttered while still communicating complex and detailed information. Users must have an overview of the complete documentation (left side bar) and a detailed view of specific criteria in the main screen area. One 'master view' of the regulations will reduce fragmented documentation.
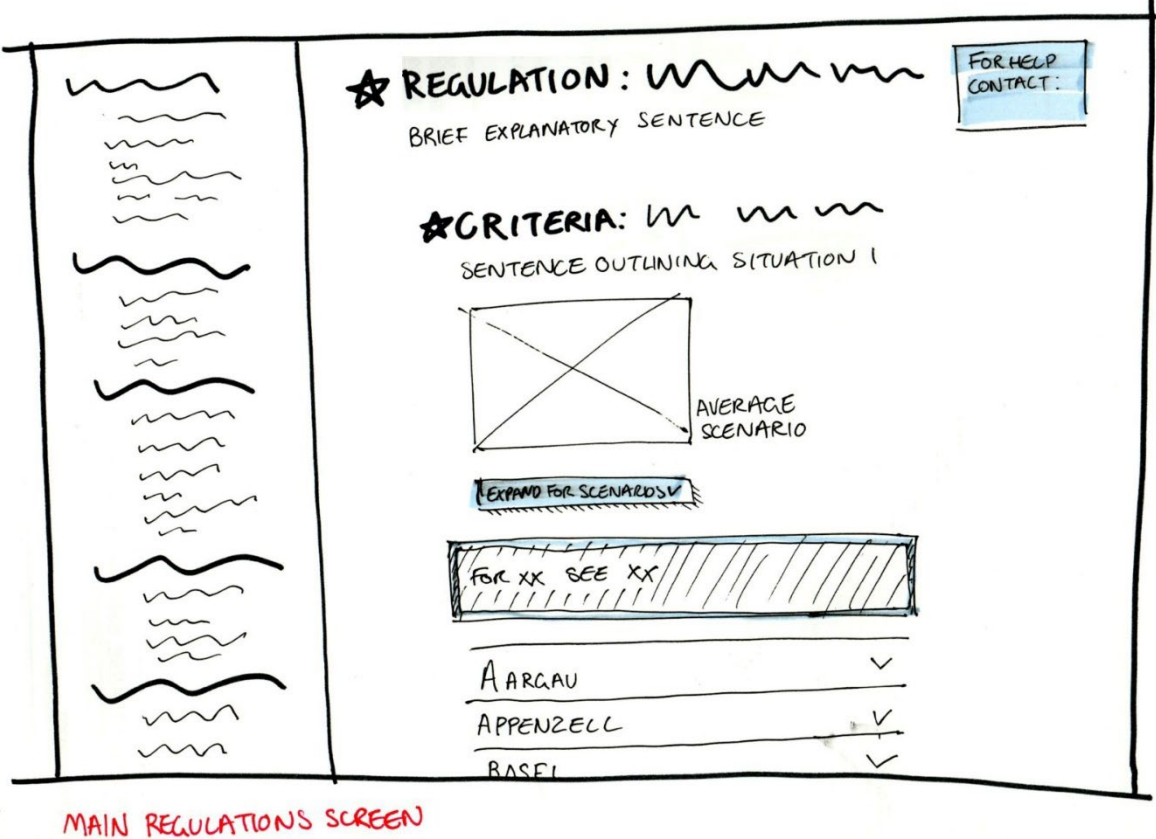
Figure 19 Main regulations view

Tracking updates was highlighted as a critical pain point, so a method highlighting the changes will be essential to assess with users (fig.20). Users can mark or save regulations relevant to their current project. They will be notified of any changes before they submit them for planning.
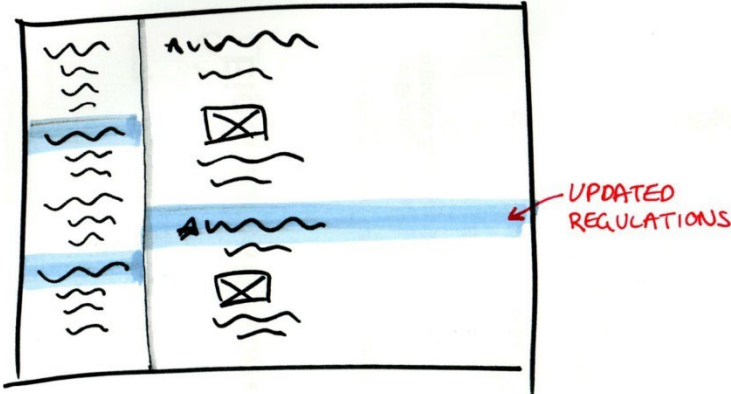
Figure 20 BE Professional view of updates

Councils will have a private view that allows them to save drafts and make regulatory changes easily (fig.21). This view will avoid the need for complex transitional documentation, which requires their own publication and promotion schedule, further optimising the professional workflow.
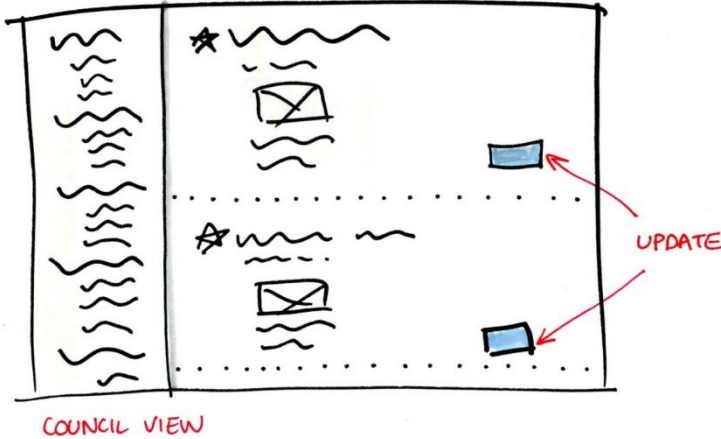
Figure 21 Compliance officer view of updates

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Contextual loading screen animations will be added to the project to inject some fun into an otherwise utilitarian interface (fig.22). As each Canton is highly independent, there will be multiple versions of the loading screen showing a special building from each Canton.
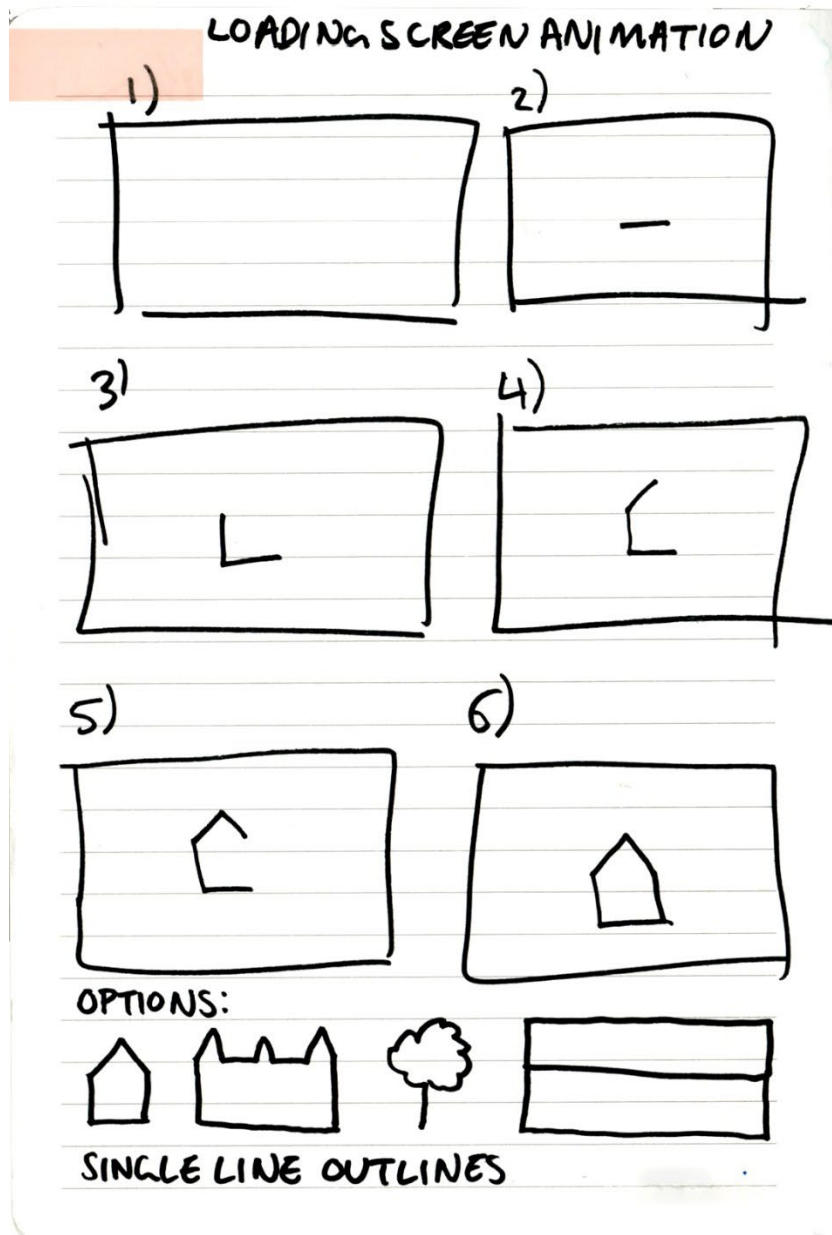
Figure 22 Loading screen animation

Conclusion

The research undertaken for this proposal has highlighted significant user experience problems in interacting with building regulations. Despite being integral to the architectural process, users struggle with ungainly PDFs that are haphazardly saved to company servers. Additionally, due to time pressure, projects are often not checked thoroughly for compliance before being submitted for planning permission, leading to mistakes, rejections, wasted time and wasted money.

This proposal outlines a comprehensive plan to address the foundational usability issues BE professionals face every day. Even though several compliance checkers are already available on the Swiss market, none have improved the usability of the regulations themselves. By studying the foundational layer of the architectural process, this project hopes to improve the interaction with regulations at every stage of a building project's lifecycle.

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Appendices

Appendix A – Ethics Form

FALMOUTH
UNIVERSITY
Ethics Review Form

Project title	"Integrating 3D scanning into everyday architectural practice"
Start date	24th May 2024
End date	13th December 2024
Applicant name	Hannah Jane Cattanach
Module name	Major Project S3S1
Module code	GDO750
Email	hc296443falmouth.ac.uk

Checklist Part 1: HIGH RISK CATEGORIES

Will your project involve clinical trials?	No
Will your project involve the use of human blood or other human tissue?	No
Will your project involve administering any drugs, placebos, food stuffs or drink to participants?	No
Will your project involve the participation of NHS and/or Social Services staff, patients, equipment and/or facilities?	No
Will your project involve participants who are particularly vulnerable? (e.g., refugees, prisoners, victims of violence)	No
Will your project involve participants who are unable to give informed consent? (e.g., children, people with learning disabilities)	No
Will your project risk cause psychological stress or anxiety or other harm or negative consequences beyond that normally encountered by the participants in their life outside research?	No

Will your project involve actively deceiving the participants? (e.g., will participants be deliberately falsely informed, will information be withheld from them, or will they be misled in such a way that they are likely to object or show unease when debriefed about the study)	No
Will your project involve accessing and/or storing data that comes under the Official Secrets Act and/or poses a risk to National security?	No
Is there potential for your project to have unintended harmful consequences (e.g., military use of technology / 'weaponisation' of artificial intelligence)?	No

Checklist Part 2: MEDIUM RISK CATEGORIES

Will your project involve participants?	Yes
Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g., covert observation of people in non-public places)	No
Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?	No
Will your project involve collecting participant data (e.g., personal and/or sensitive data referring to a living individual)?	No
Will your project involve accessing secondary data that is not in the public domain (e.g., personal data collected by another user)?	No
Will your project involve accessing commercially sensitive information?	No
Could your project have negative environmental impacts (e.g., disturbance of natural habitats; damage to, or contamination of, buildings/artefacts/wildlife)	No

Details

Other Researchers/ Co-Investigators (please indicate whether internal or external and where external, please identify partner company/ institution):	Not applicable

Please provide a lay summary of the proposed research, outlining the project's main aims, methods, and primary outputs:	To gain an understanding of how what challenges users face in interpreting building regulations? What are the most common pain points when trying to discover local variations in building regulations online? How can 3D scanning be leveraged to simplify interpreting building regulations for users. How can UX design principles improve utilising LiDAR data for non-specialists? I will conduct interviews and an anonymous survey investigating users' workflows, how they currently access building regulations and its challenges The interviews will be semi-structured and the survey will contain both multiple choice and questions with open ended answers. I will conduct thematic analysis to inform my final proposal and project which I will submit as my final assessment.
Primary locations of research (Country, place):	Scotland, England, Switzerland
Are you able to provide an age range of participants?	Approximately 20 – 50 years
Are any of the participants you are working with likely to come from vulnerable groups such as refugees, those with a physical or intellectual impairment or learning difficulty, victims of crime or abuse or members of marginalised communities?	No

Research Methods, please tick all that apply: ■ Interviews

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☐ Observation

☐ Controlled Trial

☐ Focus Groups

☐ Physiological Data

☐ (Artistic) Practice Research

■ Questionnaires

■ Literature Review

☐ Site Survey

☐ Action Research

☐ Use of Personal Records

☐ Other (please describe in the summary box below)

Please briefly summarise proposed methods:

Answer: This study will employ a mixed-methods research design based on secondary research and primary data from semi-structured interviews and a survey distributed online.

Participants will be recruited through affiliations with architectural bodies, built environment courses and by working at architecture offices.

How and by whom will potential participants or personal records be identified?

Answer: I will be responsible for reaching out initially directly to LinkedIn connections within the built environment. I will also share a link digitally to my survey on more open forums such as Facebook groups and professional forums. Each time I share the survey or request an interview, I will ask for recommendations for further participants within the same field.

Will personal information be gathered as part of the research process?

Answer: Yes

Please outline criteria for inclusion/ exclusion of participants:

Answer: Participants will be selected for the study because of their affiliation with professions within the built environment field.

Have you planned for participants to opt out of taking part in the research before, during or after the research takes place?

Answer: During the interview/survey: participants will be advised they can stop at any time with no repercussions

After the interview: participants will be provided with my email and advised they can request the deletion of their recording.

After the survey: participants will be advised that the survey is anonymous and they will not be able to withdraw their information once it has been submitted, this point will be made clear before the participant begins the survey.

How long will each participant be in the study in total, from when they give informed consent to their last contact with the research team?

Answer: 5-30 minutes approximately depending on the answers participants will provide. Participants will also be asked if they would like to participate in testing prototypes at various stages of development in sessions potentially lasting between 30 minutes and half an hour.

What are the potential risks and burdens for research participants, and how will you minimise them? Describe what steps would be taken to minimise risks and burdens:

Answer: Participants will be advised they may take a break if they feel eye strain or other fatigue in the case of an online interview or digital survey

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Describe the measures you have in place in the event of any unexpected outcomes or adverse effects to participants arising from involvement in the project:

Answer: Participants will be fully informed of the scope of the research project through the 'Participant Information Sheet' to provide transparency and set expectations.
I will provide my university email address and advise on my response times if participants have questions.

Will any aspect of the research include topics that might be sensitive, embarrassing or upsetting, or is it possible that criminal or other disclosures could occur during the study?

Answer: No

Please describe the procedures in place to deal with these issues:

Answer: Not applicable

What are the potential benefits to research participants?

Answer: They gain awareness of the potential benefits of LiDAR3D scanning technology in their daily practice

What are the potential risks to the research team?   Answer: If my university email gets picked up by bots online I may receive spam emails
What are the potential risks to the University? Risks might include damage to reputation, loss or damage of property or negative impact on other University activities: Answer: Based on the nature of my study, there are no identified potential risks to the University
Will research participants receive any payments, reimbursement of expenses, or any other benefits or incentives, for taking part in this research?   Answer: No
Who will data be collected from?   Answer: Data will be collected through acquaintances, online spaces and social media platforms through Microsoft Forms.
Please provide details of the type of personal data to be collected: Answer: I will collect information on user occupation and professional practices.
Please provide details on how and where the data will be stored (Note that all personal data should be stored on a 256-bit encrypted, password-protected device):   Answer: All data will be stored on a password protected server
Have you undertaken University-approved training in compliance with GDPR legislation?   Answer: No, but I am committed to handling any data I collect responsibly, ensuring participant privacy and abiding by data protection regulations to the best of my ability.
Will the results of your research be embargoed for any reason?   Answer: No
How do you intend to disseminate the results of your work?   Answer: I will self-publish my project on my personal website and share the final document on the same platforms where I shared my survey or requested interviews.
Please outline arrangements you have made to share the findings of your work with research participants:

> Answer: The participant may share their contact information at the end of the survey in the event of they wish to see the final project. This however will be emphasised as an entirely optional extra.

Attachments

Please ensure that you have included the following (where relevant), if you are working with participants, including the participant information sheet and consent forms is essential:

■ Participant Information Sheet

■ Participant Consent Form

☐ Covering Letter (where relevant)

■ Examples of Interview questions etc.

☐ Advertising materials or other publicity including URLs

☐ Health and Safety Risk Assessment

☐ Confirmation that project is covered by University Insurance Policy

Researcher Declaration

To be signed by the Main Researcher/ Principal Investigator:

■ I agree to comply and will ensure that all researchers involved with the study comply with all relevant legislation, accepted ethical practice, Falmouth University policies and guidelines, and appropriate professional ethical guidelines during the conduct of this research project.

■ If any significant changes are made to the design of the research, I will notify the Research Integrity & Ethics Committee and understand that further review may be required before changes can be implemented.

■ I agree to notify the Research Integrity & Ethics Committee of any unexpected adverse events that may occur during my research.

■ I agree to notify the Research Integrity & Ethics Committee of any complaints I receive in connection with this research project.

Appendix B – Interview Guide

Ground Rules

- This should only take around 20 minutes

- We're going to talk about how you access building regulations and what might be done to improve that experience.

- I'll be asking you some questions, which will help inform my decisions moving forward with my design project.

- Everything we discuss here is completely confidential, your name and your answers wont be shared anywhere publicly.

- There are no right or wrong answers, I'm looking for what you really think and feel.

- If it's ok with you I'd like to record the audio to help me with note taking later on

Background Information

- Role in built environment?

- How many years of experience do you have in your current role?

Understanding the Problem

- What are your main goals when searching for regulations applicable to your site?

- Can you describe your current process for accessing and using building regulations?

- What are the main challenges you find?

- Have you ever encountered missing or inaccurate data?

- Have you ever used the wrong regulations or interpreted them in the wrong way?

- Tell me about your experiences finding local variations in regulations.

Exploring solutions

- What features would you like to see in a new tool to help you access and use building regulations more easily?

- How do you think a 3D representation of the regulations would change your experience of interpreting building regulations?

- Have you heard of/used LiDAR scanning before?

- How might you use it in your everyday practice?

- How could an integrated 3D scanning and location-based data tool affect your workflow?

Close out

- Lastly, is there anything that you wish I had asked, or anything else you wish to tell me about working with building regulations or working with 3D models or location specific information?

- Thank you
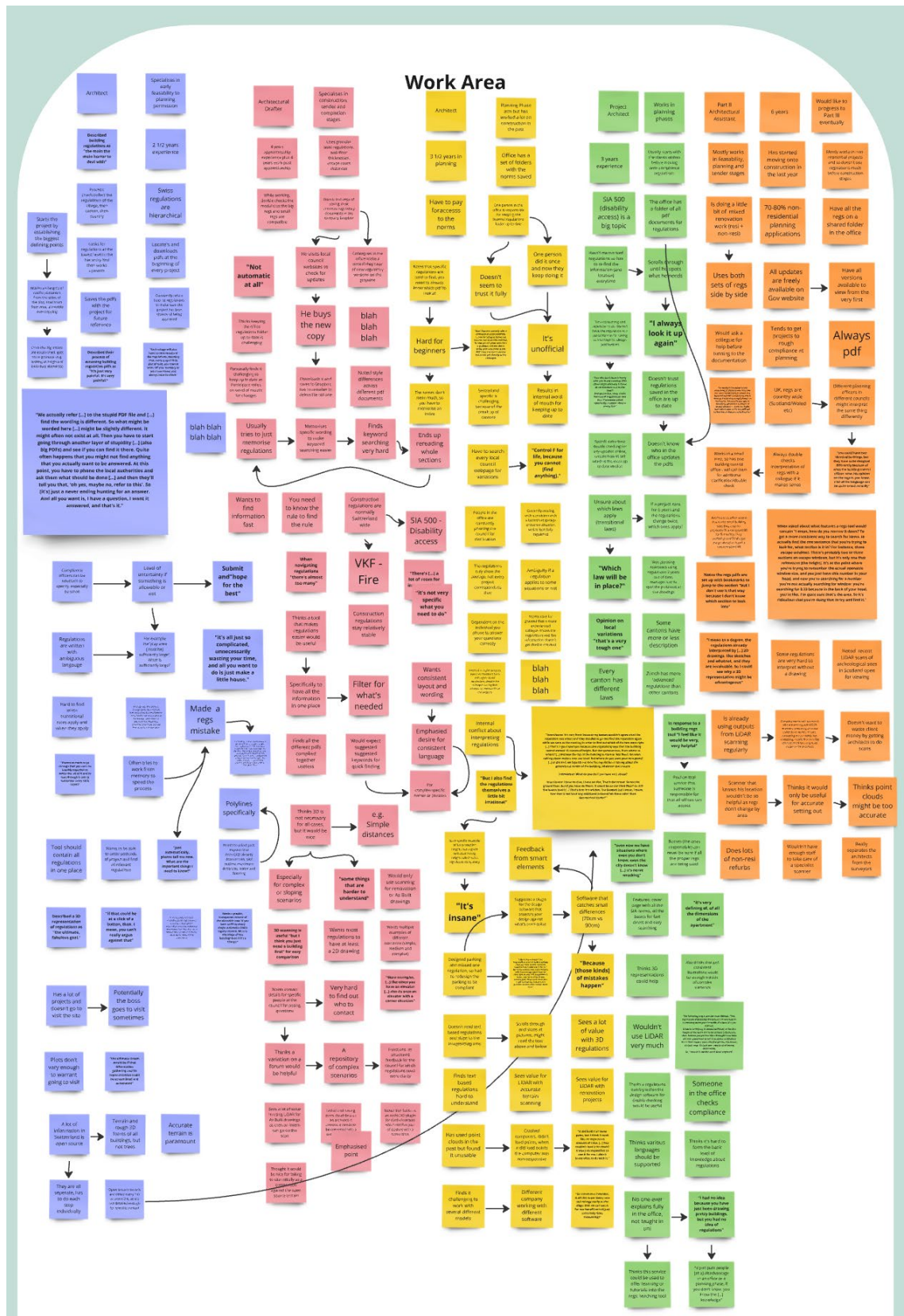
Appendix C – Affinity Map progression

Figure 23 Initial interview data

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Figure 24 Initial theme discovery

Figure 25 Refining themes

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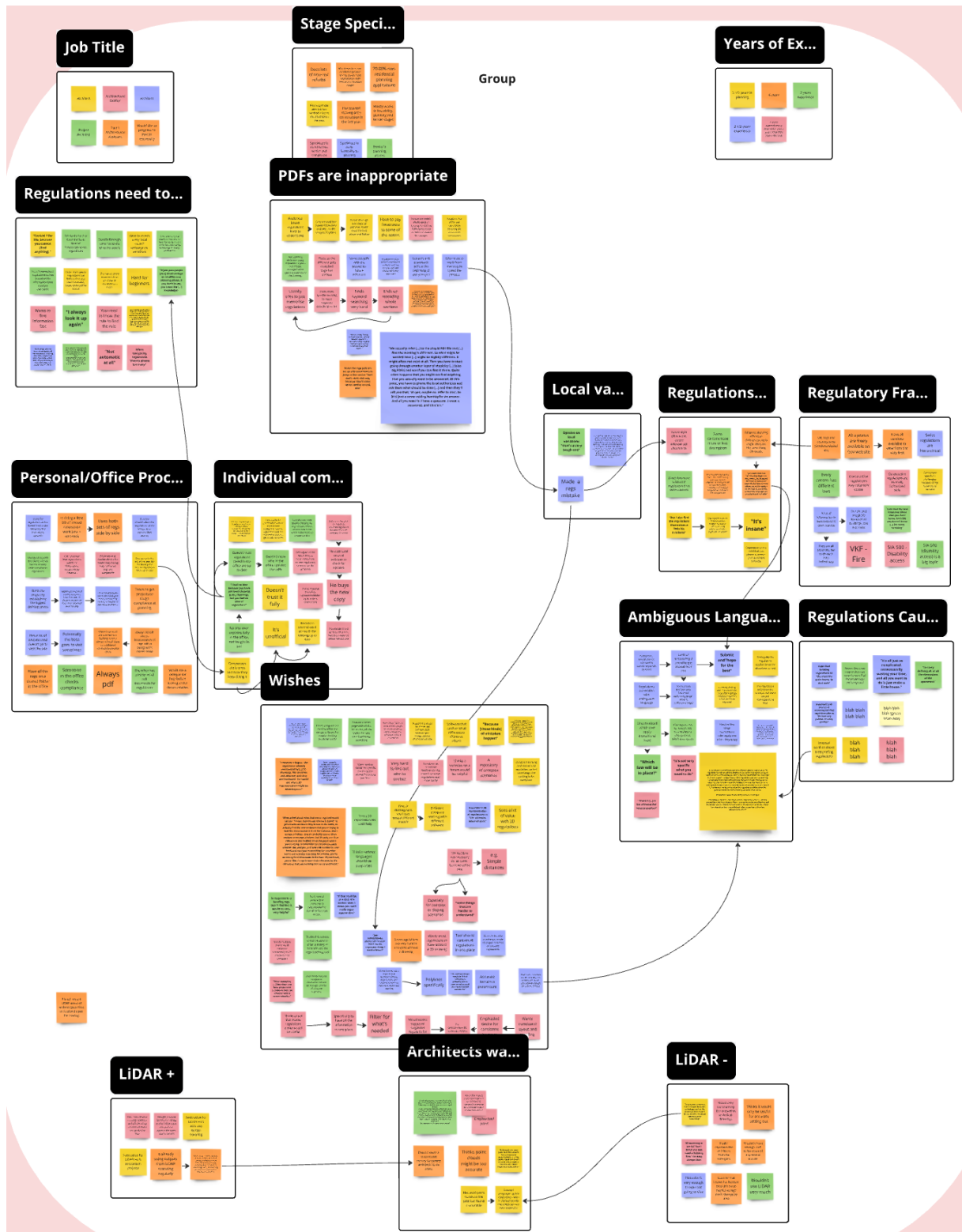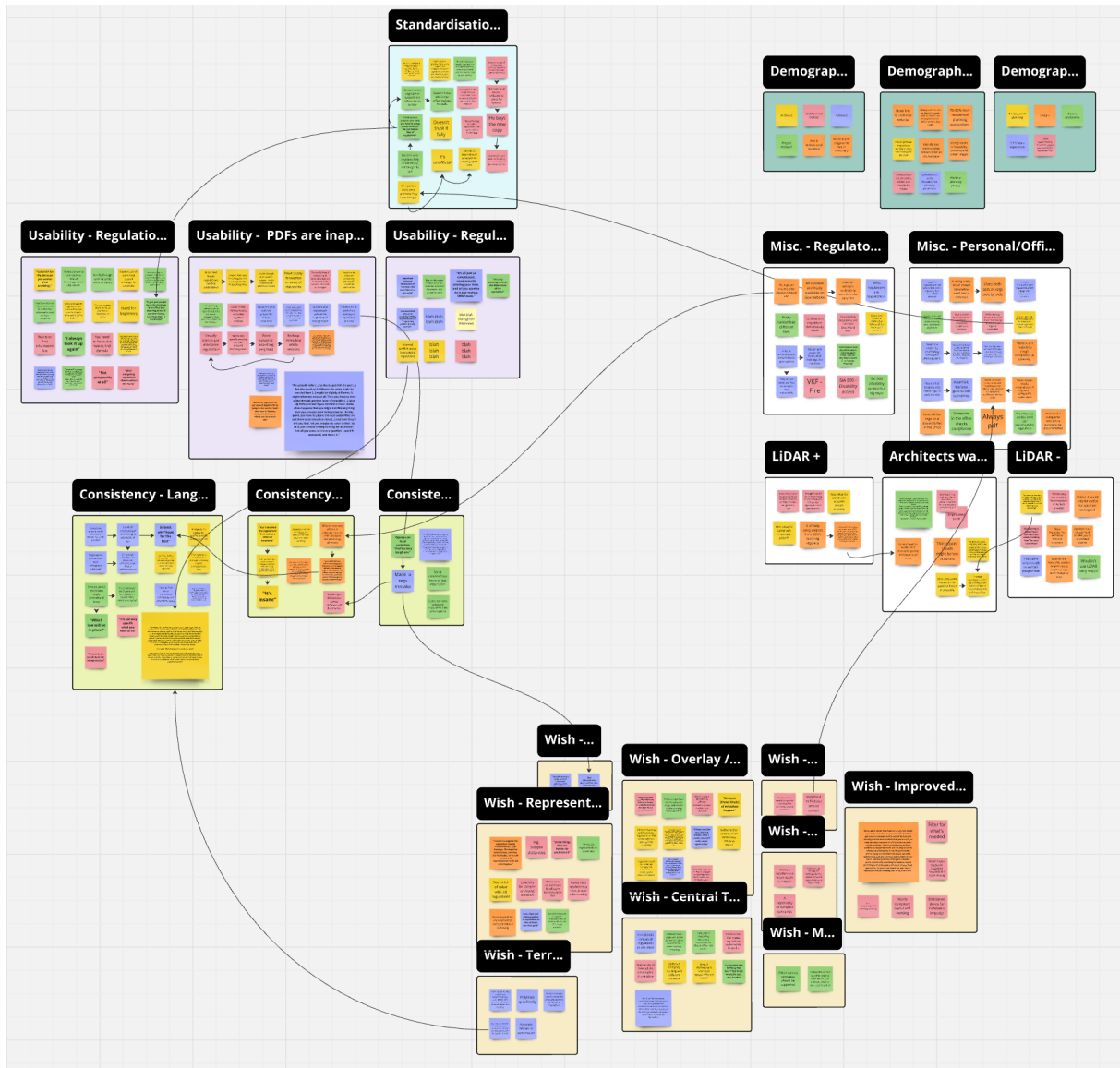*Figure 26 Further refining of themes and data points*

Figure 27 Final map highlighting three key usability issues, three key consistency problems and user wishes