

NAVIGATING BUILDING STANDARDS AND BUILDING WARRANT PROCESSES IN SCOTLAND BUILDING INFORMATION REPOSITORIES

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Abstract

Our paper explores the improvements needed in navigating building standards and workflows for building warrant processes in Scotland. We examine this optimization through the lens of user experience, information and data flow, with the directive of improving the service provided to citizens by the Scottish government. We utilized the development of a web application and a digital process map as vehicles for engagement, developing knowledge for improvements and optimization through qualitative methods. The paper concludes with a discussion and proposals for improving the process, including the use of linked data, BIM, ontologies, and blockchain in an upgrade of the process.

Introduction

Governments establish laws, rules, and regulations relating to the built environment in order to safeguard the well-being and safety of their citizens. In the UK, the multitude and complexity of technical requirements and associated legislation for reviewing construction designs and providing building warrants as well as inspections during construction ensure that the building warrant issued for the structure is constructed according to design (Fauth et al. 2023). Acquiring a building warrant holds significant importance in any construction project, serving as a foundational requirement for its lawful execution. On a global scale, the issuance of construction permits remains a complex and error-prone procedure, often characterised by a substantial time commitment and influenced by subjective judgments (Malsane et al., 2015). One contributing factor to the limited implementation of quick complete automation in public administration is the absence of a comprehensive legislative framework, as well as a lack of societal acceptability. Furthermore, building officers responsible for overseeing building permit processes express reservations about the integration of digitization and the use of digital tools such as Building Information Modelling (BIM) models (Fauth, 2023). Additional reasons might be the lack of comprehensive and commonly agreed-upon standards for the processing of information, the lack of interoperability between data pools and databases, and the need to keep the process accessible to non-experts. For this particular reason, the acquisition of a building warrant holds significant importance in any construction project, serving as a fundamental requirement for the lawful execution of the project.

This research project involves the development of a map for navigating the building standards (BS) and building

warrant (BW) process of the Scottish government, in the auspices of a larger project that aims to improve the digital delivery of the building standards and regulations. We used two vehicles of engagement to enhance our understanding of the building standards and the building warrant process: a prototype of a web application for the BS and a procedural map for the BW. The paper examines the knowledge and output from these two engagement tools.

Background

Building Standards in Scotland and the United Kingdom – relationship between government and local authorities

The digitisation processes of managing data in the Architecture, Engineering, and Construction (AEC) industry have been recently widely encouraged (Hobeika et al. 2022; European Commission 2021). The Building Standards division in Scotland is driving the digital transformation of building standards and the building warrant process. The traditional way of manually handling and assessing the building warrant applications can be prone to error - an activity that requires a high level of effort from all parties from different disciplines involved (Ullah et al. 2022). There has been a need to improve the building warrant completion process recognized, and this research acknowledges the many disjointed data landscapes – i.e fragmentation between the planning process and design, and a lack of orchestration between data pools/data silos needed to create a well-coordinated digitized system that has all the required functions to smoothly handle the process of building permit acquisition – from online submission, review and management of the applications. In 2017, the e-development platform was introduced (and managed by the Scottish Government in partnership with all Scottish local and planning authorities), providing the ability to digitally submit planning and building warrant applications. The portal is a complimentary digital service established by the Scottish Government in collaboration with all Scottish local authorities. It enables users to fill out and submit online building warrant applications, completion certificates and other relevant forms relating to the entire building standards system process. Yet, the current process of applying for approval documents - building warrants and completion certificates, comes with a myriad of complexities associated with the process that involves many stages and stakeholders along the journey. The e-development portal acts as a digital transition point between the applicants and local authorities but comes with its limitations (for example the size of data that can be uploaded onto the portal or communication of the

inspection services) that need to be overcome by using complimentary data transfer options and direct email correspondence between the verifiers and applicants/agents outside the e-development portal.

The building standards as an information repository

This project aimed to create innovative processes for digitising the delivery of building standards information and processes associated with building warrant application, up to obtaining the completion certificate at the end of the permission journey. Additionally, the project focused on understanding the experiences and journeys of various stakeholders as they navigated building regulations and building warrant processes, which involved the provision of inspection services.

To achieve the objective, the research team started with the creation of a persona corresponding to each stakeholder group, which was then prioritised for testing purposes – with a focus on the less technically inclined. A customer journey mapping exercise followed, which determined the measures for success. In the second phase, we developed a minimum viable product (MVP) app and a map of the building warrant processes, using digital frameworks including Figma and WIX.

We focused on creating a web application prototype that will allow a range of stakeholders to navigate the building standards on their mobile phone or laptop/desktop computer in a swift and efficient, manner. The prototype allowed the usability testing of the navigation of the information repository of the Scottish Building Standards while allowing for various types of linkages to be developed following linked data and embedding approaches.

Research Questions

The project sought to answer the following questions to achieve the objective, by conducting a thorough investigation into the requirements of navigating the building standards and the inspection services throughout the building permit journey.

- How can we improve the navigation of the expanded universe of the Scottish Buildings Standards, for all stakeholders, using an application, enhancing the enabling vectors, and minimising restrictions in the day-to-day usage of the building standards?
- How can the building warrant journey and inspection services in Scotland be improved and streamlined?

Methodology

We used a mixed methods approach involving both the development of personas from social sciences but also design science research where we developed a computing prototype and a digital map that we then used as an engagement tool to arrive at recommendations. Our adopted methods for this study were based on a hybrid model of combining the development of digital prototypes - web applications and a digital map of the BW process

with the engagement of a focus group of professionals that would use the app and then respond live to questions and a discussion, and then interviews with lay people who would also use the app and respond to a semi-structured set of questions. Essentially, the process of developing computer prototypes was interwoven with qualitative data collection methods derived from social science and user experience research. The framework diagram (Figure 01) is available on Github [1].

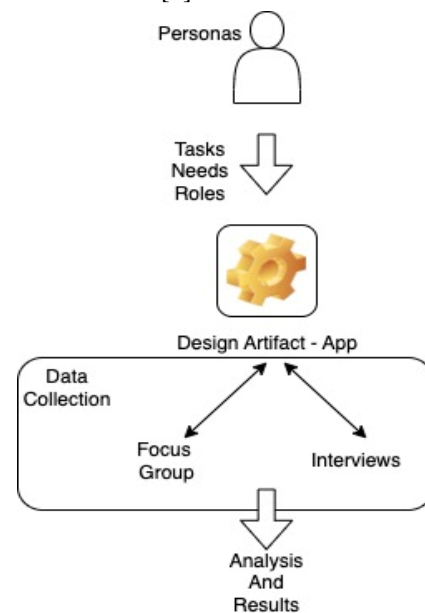


Figure 1: Overall Framework Diagram

Vehicles for research

Personas

Our qualitative methods for this study encompassed various stakeholder engagement activities (focus groups, interviews and, questionnaires) as well as the creation of PERSONAS for each key user group which helped to provide context to [web and mobile] application design for Building Standards navigation and streamline processes involved in the building warrant completion process. The engagement strategy was tailored to pinpoint the specific profile of each user type [for lay people, the general public, and professionals] and their anticipated interaction with the digital tools [web and mobile application] for data management and to develop a series of improved workflows for building warrant completion.

The method of personas creation in user experience research helps to define and understand users' needs, goals, pain points, challenges, and behaviours. The user profiles help make more informed decisions and designs that takes into account diverse user perspectives fostering a user-centred design approach. In this study, through our stakeholder engagement strategy and iterative design processes, we have created different user profiles of professionals: agents [architects, architectural technologists, surveyors, and engineers], verifiers - building officers, consultants [environmental, fire etc] and

the general public in order to tailor the proposed digitisation technology and address the various user behaviours and diverse preferences. During the iterative process of engagement (using various qualitative methods – focus groups, interviews, and questionnaires) the stakeholders were asked about their occupation and objectives related to their work [Context]. They were also requested to provide information on the challenges and obstacles related to the building warrant process [Actions, Motivations, and Pains] as well as best practices and motivations [Values] that could drive the improvements in the process (Figure 2). The information gathered from personas helped to inform the design approach of our engagement tools. Essentially our methods are firmly based on social sciences, using however the design of the web application and the map of the digitised process as design artefacts and engagement tools, with which we build knowledge via the engagement with the participants. Further knowledge building took place through a search through the design space for the web application and the gaps highlighted in the map of the digitised process of the building warrant.



Figure 2: Personas map showing and example of an agent involved in the building warrant process.

Web App

Application Development Stage

Figure 3 showcases the initial web prototype developed in Figma. The proposed mobile application prototype was presented and tested through focus group interviews with professionals in the building construction industry. This prototype was being tested and feedback from different personas was. This prototype was mainly focused on testing the performance of the UI and UX. The structure of the prototype followed the proposed swimlane diagram and the customer journey issued by the Scottish Government: Stage 1 Before you apply for a building warrant; Stage 2 Apply for a building warrant; Stage 3 Local authority assesses your building warrant application; Stage 4 Building warrant is granted by your local authority; Stage 5 Building work (or conversion) starts; Stage 6 Changes to the building warrant design;

Stage 7 Building work (or conversion) is complete; Stage 8 Local authority accepts your completion certificate.

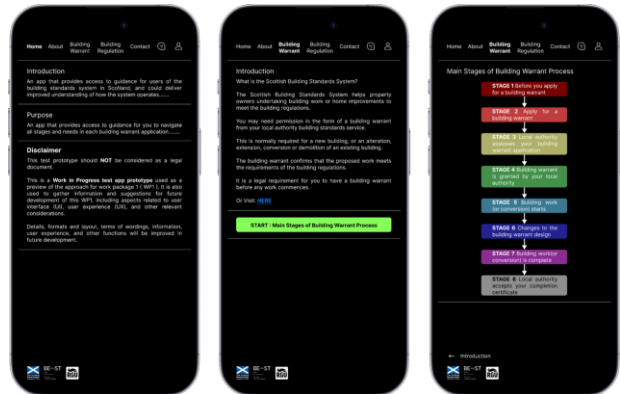


Figure 3: Showcasing Screenshots from Figma Prototype

The feedback from the participants was positive and overall UI and UX were easy to understand and follow. However, there were few participants who pointed out the accessibility of the application. There would be an issue for users to access from the office since they would be mainly accessing from desktops/laptop devices rather than mobile devices. Therefore, based on the feedback, the approach of the development is also considered to improve the accessibility of the prototype.

The Web Application (Web App) was further developed using the wix.com platform, utilized in this project in order to maximise the accessibility for different users from mobile devices, tablets, and desktops that is able to optimize accessibility across various platforms. The web app prototype focused on navigating the building standards for building warrant applications for the general public. The structure of the application is illustrated in Figure 4, while its interface on Figure 5.

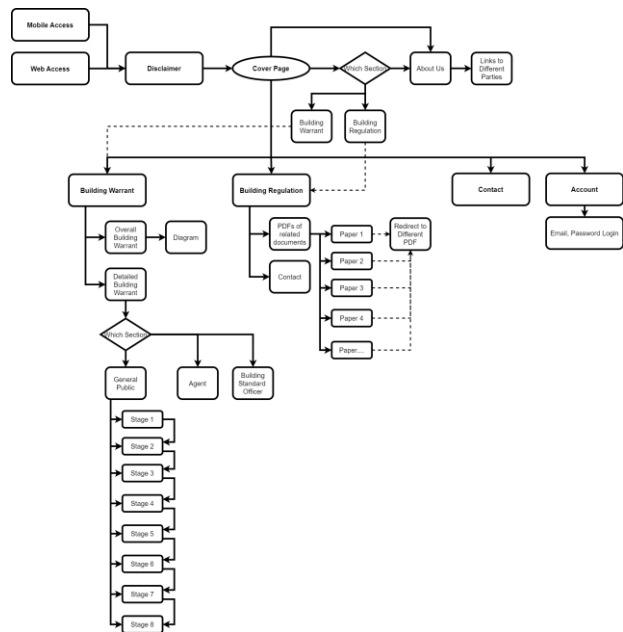


Figure 4: Overall WebApp prototype structure using Wix.com

In order to make the web app more interactive and user-friendly, simplified languages and guidelines of the application, highlighting key actions, and related

building standard documents are being added during the web app development (Figure 5). The web app prototype is available on Wix.com [02].



Figure 5: Showcasing Screenshots (Left: mobile, Right: website) from WebAPP (Wix.com) Prototype

The Building Warrant Process

Investigating and recreating the swimlane diagram helps visualise and explain the whole process of all parties involved in building warrant applications. Figure 6 illustrates the full process of the building warrant application, and Figure 7 showcases an overview process

of building warrant application. Both application processes followed the stages written in the document issued by the Scottish Government, with meetings and discussions with members from the Building Standards Division of the Scottish Government to prepare and finalise the process of building warrant application.

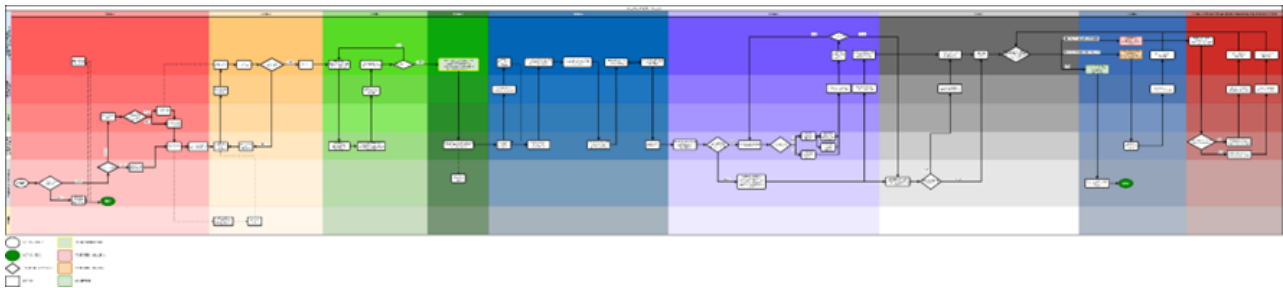


Figure 6: Whole Process of Building Warrant Application

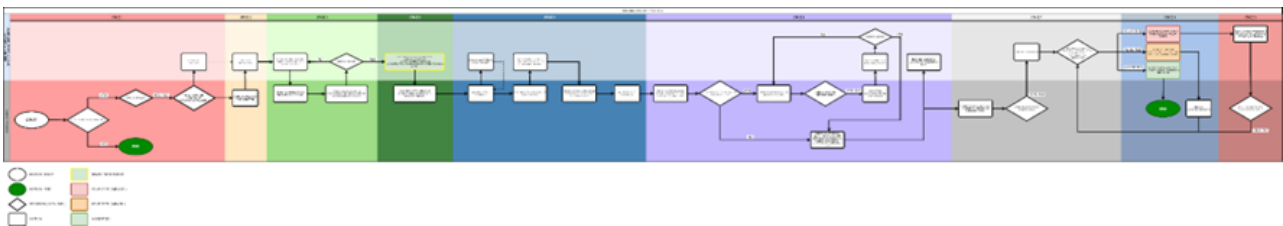


Figure 7: Overview Process of Building Warrant Application

The swimlane diagram uses mainly three shapes to identify the actions for the readers to understand. (1) an Oval shape, representing the starting and ending action, (2) a Diamond shape, representing the decision needed to be made, and (3) a Square, Action happened.

Figures 6, and 7 illustrate the whole process of building warrant application, the process was divided into 8 + 1 stages:

1. Before you apply for a building warrant.
2. Apply for a building warrant.
3. Local authority assesses your building warrant application.
4. A building warrant is granted by your local authority.

5. Building work (or conversion) starts.
6. Changes to the building warrant design.
7. Building work (or conversion) is complete.
8. Local authority accepts your completion certificate.
9. Local authority rejects your completion certificate.

Moreover, the swimlane diagram includes all sections carried by all parties being involved in the process, from a top darker colour to bottom lighter colour: (1) Building standard officer/ Local authority; (2) eDevelopment Scotland; (3) Agent, a professional who handles the application on behalf of the client; (4) Shared action (Agent/ General public), actions are similar on both parties; (5) Member of the public; and (6) Other, Specialist that involved during the application.

Through several structured dialogues with members from the Digital Strategy and the Building Standards Division, our team analysed the BW process and developed a swimlane diagram of it. While analysing the process of building warrant applications, it was essential to identify all actions (being carried out by different parties), and stakeholders being involved in the application process. Despite the rich documentation published by the Scottish government, none of it was comprehensive and integrated, confusing and misleading its users. Furthermore, the application varies between different councils in Scotland, each council has a slightly different set of explanations and technical requirements. Moreover, eDevelopment Scotland mainly acts as a digital mailbox between applicants and councils, i.e there is no central storage of the data. eDevelopment lacked connections between both platforms and applicants and may lead to a slower process of applications, as the applicants submit to eDevelopment, but receive answers from each particular council which is responsible for their application. Furthermore, building regulations may be interpreted subjectively by different building standard officers, leading to inconsistent application of rules. This creates confusion and unfairness for the applicants.

Data collection and analysis

Focus Group

The initial data collection was conducted through an open invitation online focus group that was distributed through social media channels (LinkedIn and Eventbrite). The focus group participants that signed up for the workshop involved an expert group representing the built environment industry including architects, technologists, quantity surveyors, building physicists, building inspectors, and sustainability consultants working on a variety of project types and scales (interiors, existing buildings, retrospective works, or large-scale education projects) offering full design services throughout all RIBA stage (Figure 8).

What is your occupation?



Figure 8: Focus group participants

Questionnaire

The questionnaire was issued in the advanced phase of developing the engagement tools timeline which allowed the research team to refine the questions and gather valuable feedback for both work packages. The questionnaire respondents were asked to review the streamline diagram embedded into the survey. The majority of respondents were aware of the overall process

of getting a building warrant permission, however only 60% were familiar with the official documents explaining the process. This suggests that an online platform or indeed an interactive diagram with embedded links/images/explanatory documents and videos could be a future useful improvement in making the customer journey through the building warrant process more approachable and easier to understand when asked about the challenges associated with the permission process the participants indicated 'Contacting officers to discuss points raised ' and 'Technical innovation / alternative approaches', timescales - 'lengthy process', individual interpretation of technical observations and general interaction with the local authority as issues contributing to the complexity of the process. The direct impressions from the diagram indicated that the simplification could be considered as one of the participants commented: 'Far too complex, much simpler in practice/not needed to be explained in that much detail'. Additional comment was raised about the wording of certain stages in the process not adhering to the RIBA Plan of Work Stages. This, however, was predetermined in the official document released by the Scottish Government - 'Making a quality building warrant application - what you need to know' gov.scot (www.gov.scot).

The issues of acceptability and potential client-agent relation issues were also raised due to the possibility of progress tracking ability and potential liability of delays in the process being shifted to the agents: 'Any direct involvement from the client in this process would likely only result in further client-agent relation issues. [...] I feel it only opens the chance for a client/BCO to be able to lay blame on the agent unnecessarily. This whole idea could result in overconfident homeowners not appointing an agent.'

However, the overall functionality, clarity, and usefulness of the building warrant timeline were positively rated noting that the relevant information was included within the diagram and that the schematic was relatively easy to follow with legible content. Most of the participants were also in agreement that the best practice to move forward in the process would be an online platform to comprehensively process the application with improved liaison with the building inspector (and local authority prior to submitting the application); reminder of scheduled inspection, automated reporting on the status of the application with the ability to track progress and be aware of the 'next steps' in the application. The mobile [web] application was also mentioned together with notification of the required actions and responsibilities for those involved in the process as useful features that could be embedded in future digitisation of the customer journey diagram (Figure 9).

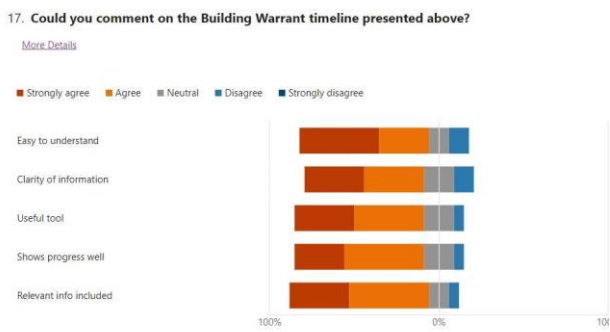


Figure 9: Extract from the survey with participants' comments on the diagram

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18. What would be the best practice for you when dealing with building warrant process?

[More Details](#)

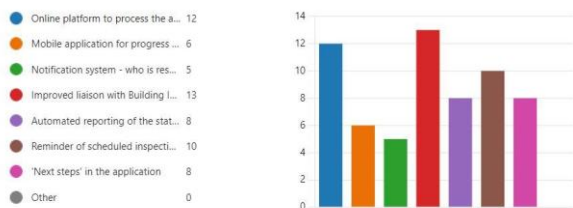


Figure 10: Results from the questionnaire pointing to the best practice

Results and Discussion

In this project, we designed and published a web app prototype focused on providing a platform for the general public to navigate the Scottish building warrant application processes and other related documents of the Scottish building regulation. The prototype streamlined the application process and made the application process more accessible and interactive for members of the public. Through prototype testing and a series of interviews, it shows the potential of web application prototypes to enhance the accessibility and user-friendliness of the navigation process of Building Standards and Building Warrants for the general public. The outcomes of this phase of the prototype show a huge potential for further exploration and development for impact. Through the interviews, we have observed that by simplifying the content of the building standard and building warrant application into illustrations and or plain language we can help a broader audience (members of the public and professionals) to understand easier, without requiring

professional high level skills. These enhanced by interactive elements in the app provide clarity to the user experience.

The proposed web app prototype would be beneficial for users to navigate and understand the process of the building warrant applications and other building standards. However, for this project, we recognize that the approach of the research has the following limitations. The navigating framework mainly focused on the members of public access. The needs and usage habits of professionals such as: architects, architectural technologists, building standards authorities, etc. will be different compared to lay people. This prototype used a no-coding platform as the approach of the framework, thus not allowing full customization of all parameters as a full-from the ground -up application would provide.

Beyond the limitations presented here, the proposed web application prototype and interviews show the potential of developing a building standards hub or platform for different stakeholders to navigate the Scottish building regulations integrated with the process of building warrant application. There is different research (Kim, et al, 2020., Zhong, et al, 2018., Zentgraf, et al, 2023) showing that the frameworks are available to fill the gap and to develop a more effective navigation platform for building standards.

We summarise here the directions that this platform could encapsulate: Personalised user profiles where one can save searches, encourage users to revisit topics, easily picking up their trail from a previous visit, along with bookmarking frequently used documents or sections of the documents. Additionally the use of linked data approaches between the text of the regulation and building standard and real examples or guidelines of application would enhance the experience of the user and reduce ambiguity in the regulations. Further, a focus on navigation on building types could be developed. At the moment, when navigating the standards, the user has to choose between domestic or non-domestic regulations and there are cases where categories span both texts. Any platform of course would have to Consider mobile and web applications (user dependent). In order to maximise the flexibility of this application, both mobile and web applications for navigating Scottish building regulations and warrant content enhance the accessibility in the building environment community. Mobile applications such as smartphones, or tablets allow users to access the navigation app in different locations; websites otherwise were designed aimed at office users. Cross-platform allows users to choose their preferred platform and enhance accessibility. Although this prototype has not explored the potential of a Progressive Web App (PWA), such an approach allows offline access in the mobile background that benefits users offshore, and in highland, areas that have no internet connections; Installing the app into the mobile devices, PWA also allow users to

download the app and access the content even when there are no internet connections (web. dev, 2023).

Finally, Design compliance tracking tools. Implementing tracking tools in the future development of the web app enables monitoring updates of building regulations and responses from building standard officers. For example, questions on clarifying unclear sections of action during applications or anticipating results of the submission of applications. Furthermore, a direct mailbox as a single point of contact between the user and the authorities, helps individuals to keep track of all actions that have been taken. Additionally, automated alerts are another potential feature that would help guide the applicants to stay on track and generate alerts when deviations are being detected. Such features may help to minimise errors during application.

Conclusions

Within this research study, we analysed the navigation of the building standards of the Scottish government and identified the actions and stakeholders involved during the application process of a building warrant in Scotland. We used a web application and a digital schematic diagram appropriately developed. Our work produced a number of key critical inflection points in the building warrant application and developed a set of guidelines for improving the navigation of the building standardfs.

Further work could include holistic implementation of thorough digitization and standardisation process in the planning process, ie starting from planning permission to the building warrant, a journey that should include a set of newer technologies such as building information modelling, linked data and potentially the use of blockchain for the data that need it.

In this context, different potential digital applications may assist and improve the technological barriers during building warrant application processes. Blockchain and Ontology offer a different approach for future improvement, in improving the quality of the application processes, and user-friendly experience. Blockchain offers a secure and shared system for storing information (Dounas, 2022). Ontology helps to organise and standardise information and data management (Zentgraf, 2023). These approaches provide a huge potential in improving the current system of building warrant applications, improving the application processes, and the security of the data.

Authorship & acknowledgements

HMY and DB wrote most of the report and the present paper, DB developed the engagement methods -personas, focus group, interviews, and the questionnaire, conducted data analysis and provided recommendations; HMY build the engagement tools – web & mobile application and streamline diagram; conducted analysis of the engagement tools and provided recommendations; JY developed the outline of the process for the building

warrant in WP2 and contributed to the personas, questionnaire and data analysis, TD conceived, organised and directed the research, determined the structure of outputs and their quality and contributed to the authorship of the report and papers. HMY and DB can both claim first authorship of this paper.

References

- Building Standards (2016) The customer journey. [online] Available from: [the+customer+journey.pdf](https://www.gov.scot/the+customer+journey.pdf) (www.gov.scot)
- Dounas, T., Lombardi, D. 2022. Blockchain for Construction. Blockchain Technologies. Springer.
- European Commission. 2021. The EU in 2021. General report on the activities of the European Union. Published in accordance with Article 249(2) of the Treaty on the Functioning of the European Union, <https://op.europa.eu/webpub/com/general-report-2021/en/>
- Hobeika, N., Liempt, J, V., Noardo, F., Ohori, K, A. 2022. Geobim Information To Check Digital Building Permit Regulations. The International Archives of the Photogrammetry Remote Sensing and Spatial Information Sciences XLIII-B4-2022:529-535, DOI:10.5194/isprs-archives-XLIII-B4-2022-529-2022
- Judith Fauth, Gabriele Pasetti Monizza & Giada Malacarne (2023) Understanding processes on digital building permits – a case study in South Tyrol, Building Research & Information, 51:5, 518-532, DOI: 10.1080/09613218.2023.2178372
- Kim, I., Choi, J., Teo, E. A. L., Sun, H. 2020. Development of K-BIM e-Submission prototypical system for the openBIM-based building permit framework. Republic of Korea. Journal of Civil Engineering and Management. Available at: <https://journals.vilniustech.lt/index.php/JCEM/article/view/13756>
- Malsane, S., Matthews, J., Lockley, S., Love, P. E. & Greenwood, D. 2015. Development of an object model for automated compliance checking. Automation in Construction, 49(PA), 51-58.
- Ullah, K., Witt, E., Lill, I. 2022. The BIM-Based Building Permit Process: Factors Affecting Adoption. Advancing Digitalisation in Construction: Responding to New and Emerging Drivers and Changes, DOI:10.3390/buildings12010045
- Web.dev. 2023. Progressive Web Apps. Available at: <https://web.dev/explore/progressive-web-apps>
- Zentgraf, S. et al. 2023. OntoBPR: Ontology-based workflow and concept for building permit reviews. 30th EG-ICE: International Conference on Intelligent Computing in Engineering. Available at: https://www.researchgate.net/publication/372252159_OntoBPR_Ontology-based_workflow_and_concept_for_building_permit_reviews

Zhong, B., Chen, G., Luo, H., Xing, X. 2018. Ontology-based framework for building environmental monitoring and compliance checking under BIM environment. China. Building and Environment Volume 141, Pages 127-142. Available at: <https://www.sciencedirect.com/science/article/abs/pii/S0360132318303123>

[01] Github. Overall Framework Diagram. Available at: <https://github.com/arlav/ScottishBuildingStandardsWP0102>

[02] Wix.com Web App prototype. Scottish Building Standards HUB. Available at: <https://scotbwpp0102rgu.wixsite.com/webapp>