Applying Personalisation to Enable eGovernment Service Delivery for Citizens

Sohail Sarwar

A thesis submitted in partial fulfilment of the requirements of the University of Sunderland for the degree of Doctor of Philosophy

April 2021

Abstract

With the increasing use of the Internet, there has been considerable global growth in the development and use of e-government services. Citizen expectations based on everyday use of personalised, quick and easy to use advanced e-commerce and streaming services, bring a recognised need to improve the user experience of e-government services. Governments are increasingly looking to innovate, personalise and automate the delivery of public e-services to improve citizen experience.

Unlike e-commerce, the role and characteristics of public authorities of serving the entire population of citizens with a diverse range of public e-services required and constrained by regulations make the design of e-government more challenging. Existing technical approaches and design methods to personalise services focus on personalisation and recommendation techniques aimed to increase consumption or engagement. There is little consideration of the challenges for personalising public e-services for citizens who are occasional users, only accessing needed services when required.

This research seeks to answer the research question, “How can personalisation be applied to enable e-government service delivery for citizens?”. To answer this, an illustrative case study of a UK local government authority was used with a multimethod research approach to explore citizen and system requirements for personalising e-government services. Using data analytics, focus group and interviews, citizens’ experiences and perceptions of e-government were explored. An innovative task-based user segmentation design approach was developed where personalisation was related to task fulfilment with user segments represented as personas. eGovernment specific personalised heuristics for the delivery of personalised e-government services were identified, developed and applied, providing a novel approach for the design and evaluation of e-government services.

The integration of the techniques and methods applied to personalise e-government resulted in a new design method called PeGS (Personalisation of eGovernment Services), which is aimed at the developers of e-government to enable the delivery of personalised e-government services according to citizen needs and expectations. PeGS validation was

performed through involving e-government experts highlighting its strengths and limitations, and there was a consensus among the experts on its feasibility and viability.

The design of personalised e-government is under-investigated. Personalisation is often considered as a set of recommendation and filtering techniques with no major focus on user involvement in its design. This research provides a significant contribution providing an approach for personalising e-government and improving the citizen experience.

Acknowledgements

I thank Allah Almighty for giving me strength, knowledge and ability to complete this study.

This is dedicated to my lovely family, Zebunnisa, Amna, Ahmad and Saleh Muhammad, thank you for your unfaltering support and love whilst I worked during family time or needed to let off steam. And thank you to my late father Muhammad Sarwar and mother Sham-o-Seher, for their support in everything I do in life. Love you all.

A very big thank you to my knowledgeable, extremely supportive and dedicated Director of Studies, Professor Lynne Hall and Co-Supervisor, Dr Kate MacFarlane for everything you have done to get me to this stage; your guidance and encouragement has been invaluable (and at times entertaining!). And my utmost thanks to my colleagues who have provided significant support and guidance, Lee Spraggon, Paul Stevens, Andrew Webber, Brian Dougherty and many others. And thanks to many other university staff and students that have helped and supported me along the way, including, Dr Mark Proctor, Deborah Whittle and the Graduate Research Support team. And of course, thanks to all the participants that have taken part in this research - without you, this wouldn't have happened.

Sohail Sarwar, April 2021

Table of Contents

List of Figures

List of Tables

1 INTRODUCTION

The increase in global internet usage has resulted in approximately half of the world's population having access to and continue using the internet (United Nations, 2018, p.67). Similar to other organisations, governments are increasingly looking to the internet as a way to provide services to citizens (Organisation of Economic Co-operation and Development, 2016). eGovernment is the use of Internet Communication Technology (ICT) by a government body to enhance access and delivery of government services to benefit its citizens, business partners and employees (Mahajan, 2015).

There has been a positive trend in the global growth and use of e-government represented by the EGDI (E-government Development Index) calculated based on the online transactional service delivery, Open Government Data, mobile government services and public engagement (United Nations, 2018). The average EGDI of United Nations member states has increased from 0.47 in 2014 to 0.55 in 2018. A similar positive trend in the growth of e-government has been found across the European Union (EU) member states (European Commission, 2018, p.28). Comparing the annual Digital Economy and Society Index (DESI) reports (European Commission, 2019c) for the last three years reveal that e-government users who submitted forms to the public administration increased from 34% in 2016 to 64% in 2018. In addition, the extent to which already known data is presented in prefilled forms has increased from 49% in 2016 to 58% in 2018. In the UK, 49% of citizens submit completed forms on public authorities' websites, 41% obtained information and 39% downloaded official forms (Office for National Statistics, 2019).

Although an increasing number of e-government services and information are going online, there are significant opportunities for improvement. A demand-side citizens survey polled a representative sample of 28,000 European citizens across 32 EU countries highlighted that among the 46% of European citizens who used various e-government services, only 47% fully got what they wanted from public administration, 46% partially received what they were looking for and 5% did not get what they wanted at all (European Commission, 2013). Notably, a significant portion of e-government users (29%) were at risk of dropping out after their less than excellent experience. It was also reported in the same study that public e-services are

falling behind commercial e-services and government e-services must be designed and delivered in a citizen-centric manner. The dimensions of the public value of e-government include improved public services, improved administration and improved social value (Twizeyimana and Andersson, 2019). Factors related to the improved public services include the provision of personalised services for the disabled, services providing online advice, language support for the minorities etc.

Today's citizens demand interactive, personalised and real-time service delivery, with 67% of 5000 citizens across five countries (Australia, Germany, Singapore, UK and US) identifying ease of interaction as being the most important when accessing government services online (Accenture, 2019a; Accenture, 2019b). The same research indicated a strong demand for personalised e-government services addressing individual preferences with more than half (56%) favouring proactive content from those services. Citizens expectations from governments have changed through the experience of using online retailers such as Amazon, eBay etc. and demand personalised, quick and easy to access e-government services (Eggers and Hurst, 2017). Citizens are increasingly used to personalised experiences, with providers such as Amazon, eBay and Facebook offering a tailored, personalised experience. The provider's goal to further engage the user, for example, with Amazon reported as generating an extra 10- 30% business revenue in response to buying suggestions (Srihari, 2015).

Governments are exploring emerging technologies to innovate, personalise and automate services delivery (Government Digital Service, 2018). The use of advanced technologies such as Artificial Intelligence (Agbozo and Spassov, 2018) and Artificial Intelligence powered personalisation (Dodd and Cordella, 2019) to improve citizen interactions with e-government service may significantly add value for the citizens. Some governments are looking to devise proactive service delivery strategies to citizens. For example, Taiwan's fourth e-government strategy includes a notable commitment to proactive service and information delivery, which is aimed to flip the service delivery model from traditional 'Pull' approach, where citizens seek out services to 'Push' approach, where governments proactively and seamlessly deliver services to their citizens based on citizens' needs, preferences, circumstances and location (Linders et al., 2015). Scholta et al. (2019) also proposed a more proactive service delivery model of no-shop stop beyond the centralized integrated one-stop shop e-government,

where governments would be able to deliver appropriate services to the citizens without citizens initiating those services.

Despite the governments' enthusiasm to use the most innovative technologies, these new generation technologies have not achieved the transformative power emphasised in governments initiatives (Liu et al., 2019). This is due to a misleading assumption that 'government is a service industry', without going into the details of government policy instruments bound by laws and more reliance on ICT to transform e-government (Waller and Weerakkody, 2016). Instead of finding a solution to a problem in what technology can achieve, the focus should be achieving the policy instrument goals with the help of ICT. Successfully implementing government policies to deliver user centric services require a well-defined design approach and method to understand complex public e-services.

This study investigates a design approach with a focus on the users and tasks to design and personalise e-government services. Personalisation has the ability to improve e-government service delivery that may lead to higher user satisfaction. According to Adomavicius and Tuzhilin (2005, cited in Al-Hassan, 2014, pp. 23-24), "*personalisation tailors certain offerings (e.g., content, services, product recommendations, communications, and e-Commerce interactions) by providers (e.g., e-Commerce/eGovernment Web sites) to the consumers of these offerings (e.g., customers, visitors, users, etc.) based on knowledge about them with certain goal(s) in mind*". Although, targetisation referred to personalisation has been described as a next stage in the sophisticated delivery of e-government services (European Commission, 2010, p.244), personalisation has not yet been widely applied in e-government. Rekand (2014)'s study of existing personalised e-government state portals of European countries including Denmark, Norway, Austria and Estonia concluded that each state portal implemented personalisation differently with no standard approach to personalisation.

The existing methods to design and personalise e-government (Abdrabbah et al., 2016; Al-hassan et al., 2009; Lu et al., 2009), e-commerce (Lokhande and Meshram, 2015) or both (Kaneko et al., 2018; Van Velsen et al., 2010) focus more on the technical ability of personalisation and recommendation techniques to personalise services. These existing approaches are not much different from each other and centred around user interactions of a targeted user group with a specific service or product type. Unlike e-commerce, e-government serves a large group of citizens with a variety of services strictly bound by laws

and regulations. These peculiar features of e-government services make their design more challenging. In response, this research aims to investigate and to propose a method that enables the supply-side to create personalised e-government services. This research study focuses on the design and potential of a service delivery method that enables suppliers to provide personalised services to citizens according to their needs and to deliver tailored services and information.

1.1 Research Questions, Objectives and Conceptual Framework

The research will answer the overarching research question:

How can personalisation be applied to enable e-government service delivery for citizens?

Based on the overarching aim, this study has the following research questions.

1- How to develop a design approach to personalise e-government services?

2- What are the techniques and methods that can be used in the design approach to personalise e-government?

These questions were explored through the following objectives:

1- To highlight issues with the use of e-government services and the potential of personalising these services from a citizen perspective.

2- An overview of citizen behaviour and use of e-government services by analysing relevant secondary data.

3- In-depth analysis of e-government services usage context and factors affecting the use of various services.

4- To propose a design method to personalise e-government services that would facilitate the implementation of e-government personalisation and an overview of various steps of the proposed design method.

5- Validate the proposed design method and highlight potential issues if any.

The research questions and objectives as discussed above were used to develop a conceptual framework for this research. Conceptual framework is defined as a network of concepts and constructs that provide a comprehensive understanding of a phenomenon (Jabareen, 2009). To understand how this study was conducted, a six-phase conceptual framework was defined including the concepts, methods and techniques used at each phase that inform this research. This is shown in Figure 1.1.1.

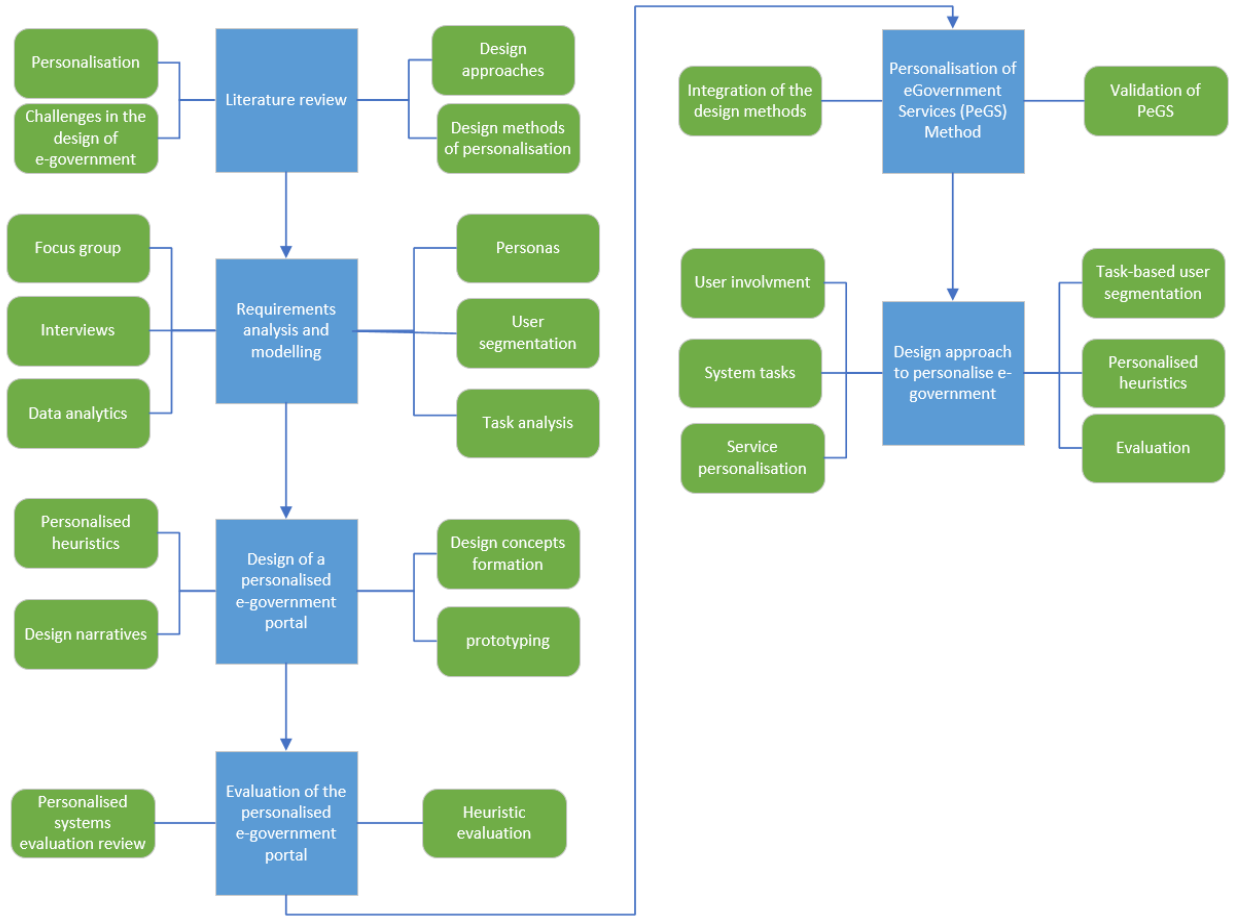


Figure 1.1.1 *The conceptual model developed for this study*

The details of each phase of the conceptual framework are listed below.

1. **Literature Review**

In this phase a literature review was conducted to explore concepts and topics related to personalisation, commonly used design approaches with focus on user involvement and tasks, challenges in the design of personalised e-government, and existing methods of personalising e-commerce and e-government. Literature review revealed that none of the reviewed methods of personalising e-government cater for the challenges in the design of personalised e-government. These challenges include delivering a variety of services to the entire population, impact of regulations and policies on the design etc. as explained in section 2.3. Chapter 2 explains the outcome of the literature review phase as shown in Table 1.1.1. Requirements analysis and modelling was used as a starting point for developing the design approach to personalise e-government. This is explained in the next phase.

Phase	**Chapters**
Literature review	Chapter 2 – Literature Review
Requirements analysis and modelling	Chapter 4- Understanding the User Context: Results from Stage 2
Design of a personalised e-government portal	Chapter 5 - Personalised Heuristics and Prototype Design: Results from Stage 3
Evaluation of the personalised e-government portal	Chapter 6 - Evaluation of Personalised Systems and Prototype: Results from Stage 4
Personalisation of eGovernment Services (PeGS) Method	Chapter 7 - Personalisation of eGovernment Services (PeGS) Methodology Development: Results from Stage 5
Design approach to personalise e-government	All chapters including Chapter 8 – Discussion and Chapter 9 – Conclusions

Table 1.1.1 *Chapters explaining various phases of the conceptual model*

2. Requirements analysis and modelling

In this phase, analysis and modelling of system and user requirements were performed. User research was conducted by direct communication with users employing methods such as focus group and interviews. Data from Google analytics were reviewed to identify the most commonly used public e-services and their usage factors. Relating public e-services to their usage factors representing their context of use provide opportunities to personalise those services. Personas were built for the target user segments, which represent descriptive models of archetypal users representing multiple people who share similar goals, motivations and behaviours. Finally, advanced task analysis was performed to understand, automate and personalise tasks for the target user segments. Chapter 4 presents the details of the data collected and analysed at this phase as shown in Table 1.1.1. The information produced at this phase provided the basis for the design of a personalised e-government portal as discussed in the next phase.

3- Design of a personalised e-government portal

Based on the user and system requirements collected in the previous phase, a personalised e-government prototype was built as a proof of concept to demonstrate how the design concepts for a personalised e-government system could be implemented. The design concepts were formed from various sources including features of the existing personalised systems, task analysis of the public services, personalised heuristics etc. The design concepts for the personalised e-government portal were then visualised by creating an experimental prototype. Medium-fidelity and hi-fidelity mockups were built to demonstrate salient features of a personalised e-government portal. Chapter 5 explains the process of building a personalised e-government prototype and heuristics developed for the design of e-government portal as shown in Table 1.1.1. The prototype built at this phase was evaluated in the next phase as discussed in the next section.

4- Evaluation of the personalised e-government portal

The evaluation of personalised systems is inherently complex and different from the evaluation of non-personalised systems. This is because the output of a personalised system is different for different users. In this phase, the existing methods to evaluate personalised systems were reviewed and the personalised e-government prototype built in the previous phase was evaluated. The prototype was evaluated with experts in heuristic evaluation. Heuristic evaluation is a quick and inexpensive method in which a system is evaluated against a set of usability features or heuristics. The personalised e-government prototype was a proof of concept aimed at showing how personalised e-government system could be built, evaluating the prototype with non-expert users could hardly reveal usability issues specific to personalised systems. The review of the existing methods to evaluate personalised systems and the heuristic evaluation results are given in Chapter 6 as listed in Table 1.1.1.

5- Personalisation of eGovernment Services (PeGS) method

As discussed in phase 1, the existing methods to personalise e-government services do not cater for the challenges in the design of e-government. In this phase, a new design method was developed to personalise e-government by integrating the design methods and techniques applied in the previous phases. This new design method is called Personalisation of eGovernment Services (PeGS). The peculiar features of PeGS include focus on the requirements of target user groups, user participation, focus on tasks enabled by the e-government, personalised heuristics, prototyping etc. Finally, PeGS was validated with experts to highlight its strengths and limitations. The details of how PeGS was developed and validated are given in Chapter 7 as shown in Table 1.1.1.

6- Design approach to personalise e-government

The final phase of this study concluded that a design approach with focus on users and tasks enabled by the government authorities can be used to personalise e-government. User involvement early in the design process explores usability issues. For e-government, where services are bound by laws and regulations, focusing too much on target users' needs may go against those rules and regulations. Therefore, the design approach to personalise e-government needs to focus not only on users but also on the activities and tasks enabled by the government authorities to make e-government service requests. Other principles of this design approach include finding service usage factors to personalise specific public e-services (section 4.2), segmenting users based on task fulfilment (section 4.6.2), developing personalised heuristics (section 5.2) and system evaluation (Chapter 6) early in the design process.

1.2 Motivation for Research

Several interests, work-related and personal came together to motivate this study. My work-related interests were built by work experience in the local government sector for over ten years as a Senior ICT Officer, which provided me opportunities for involvement in the requirements collection, design, development and testing of various e-government projects. My ambition was to try an innovative solution for the delivery of e-government services to improve user interaction with local e-government.

As discussed at the beginning of this chapter, there is a clear need to improve e-government service delivery due to growing citizen demands stimulated by e-commerce. Personalisation has the ability to tailor services according to user needs and improve service delivery by automation, reusability and customisation. The use of personalisation in the e-government domain to improve citizen interaction with the use of innovative technology inspired and motivated me for this PhD research. Hopefully, this study will have a positive impact on the

lives of citizens using the digital medium to interact with the government and help the government to achieve its vision of quality service delivery to its citizens.

1.3 Thesis Structure

This doctoral thesis is structured as follows:

Chapter 2 – Literature Review: This chapter presents the literature review of the main topics related to this study including personalisation, design approaches, challenges in the design of e-government services, user participation in the design process and existing methods to personalise services. The chapter aims to discuss the concepts around the design and personalisation of e-government and identify the literature gaps.

More importantly, this chapter reviews the existing design approaches and methods to personalise e-government/ e-commerce and discusses the strengths & weaknesses of these in relation to personalising e-government. The existing design methods are further explored for their suitability for e-government.

Chapter 3 – Methodology: This chapter outlines the philosophical position that underpins the methodological approach and explains the selection of methods used in this research. The five-stage research design applied in this research, using multimethod research approach, is detailed exploring how various methods were used to design and personalise services in a local e-government context using Durham County Council (DCC) services as a case study.

Chapter 4- Understanding the User Context: Results from Stage 2: This chapter presents the results of the methods used in Stage 2 'Understanding the User Context' of the research design. Results from the methods applied at this stage are explained in the research context with methods and techniques including data analysis, focus group, interviews, building personas and task analysis.

This chapter is aimed to explore user experiences, expectations and their perspective on personalising e-government. Results from the user research methods contributed to and informed the design of a personalised prototype for e-government services.

Chapter 5 - Personalised Heuristics and Prototype Design: Results from Stage 3: This chapter discusses the results of the methods used in Stage 3 'Personalised heuristics and prototype design' of the research design. The heuristics developed for the personalised systems are explained that inform the design and evaluation of the personalised e-government prototype.

Prototyping activities required to build the personalised e-government prototype are discussed including building design concepts from various sources, visualisation of those design concepts and building a hi-fidelity personalised e-government prototype.

Chapter 6 - Evaluation of Personalised Systems and Prototype: Results from Stage 4: This chapter presents a review of the evaluation methods specialised for adaptive or personalised systems. The results of the heuristic evaluation method in Stage 4 'Prototype Heuristic Evaluation' of the research design is also presented. The heuristic evaluation method was used for the evaluation of a personalised e-government prototype against a list of domain-specific heuristics developed for the personalised systems.

Chapter 7 - Personalisation of eGovernment Services (PeGS) Methodology Development: Results from Stage 5: An overview of the integration of design approaches and techniques applied in this research to design and personalise e-government services resulted in the development of a new design methodology called PeGS (Personalisation of eGovernment Services). This chapter discusses how the PeGS method was developed, its steps and presents its results as planned in Stage 5 'PeGS Methodology Development' of the research design.

Finally, results from the validation of the PeGS method with experts are discussed to highlight its strengths and limitations to personalise e-government.

Chapter 8 – Discussion: This chapter provides a synthesis of the research presented in this thesis with a discussion of the various constructs and methods that contributed to the design of the research presented. Originality, contributions to knowledge, limitations, future work and personal reflection relating to this research are discussed.

Chapter 9 – Conclusions: The final chapter of the thesis presents the main conclusions drawn from this research.

2 LITERATURE REVIEW

The focus of this research is to investigate the design of personalised e-government. This chapter reviews, analyses, interprets and critically evaluates various design methods, personalisation, e-government and the relationship between these. The sections in this chapter include:

2.1 Personalisation: This section presents an overview of personalisation and its importance across multiple domains for the users. Various recommendation techniques are also discussed to understand how personalised systems work.

2.2 User Participation in eGovernment Development: This section reviews the strategic importance of involving users in public e-service development and highlights its importance. The challenges in user participation are also discussed.

2.3 Challenges in the Design of Personalised eGovernment Services: This section briefly discusses the attributes of e-government systems that makes the design of personalised e-government services challenging.

2.4 Selecting a Design Approach for eGovernment Services: This section presents an overview of various existing design approaches and their stages. The suitability of these approaches to design public e-services is also discussed. The literature review of the existing design methods indicates that there is a need for an alternative design approach to meet the challenges in the design of personalised e-government services as discussed in the previous section.

2.5 Design Methods for Personalisation: This section discusses various existing methods and their limitations to personalise public e-services. The literature review in this section concludes with the need for a new design method to personalise e-government services. The details of the steps required in the new design method are given in this section.

2.6 Summary and Key Findings: This section summarises the literature review conducted in this chapter and highlights the main findings.

2.1 Personalisation

The idea to build personalised tools, products and to provide personalised services is as old as human society. Personalisation techniques such as recommender systems, adaptive hypertext, information retrieval and filtering have been used in various research fields such as Artificial Intelligence (AI), Machine Learning (ML), Human Computer Interaction (HCI), Industrial research, Cognitive Science etc. (Zanker et al., 2019). The use of the Internet has enabled the implementation of personalisation opportunities on a broader scale. With the enormous growth in data creation estimated 2.5 quintillion bytes of data per day as estimated by IBM (Germanakos and Belk, 2016, p.3), the idea of personalisation is even more recognisable which provides a solution to tailor information according to user needs and goals. Initially used to resolve the issue of information overload (Santos et al., 2014), recommender systems offering personalised services and products have become strategically important for many giant online companies such as Amazon, Netflix and many others (Zhang and Sundar, 2019).

Governments are also aware of the importance of personalisation as highlighted in the 'Tallinn Declaration' signed by European Union member states in October 2017, which emphasised the European vision of e-government: "the overall vision remains to strive to be open, efficient and inclusive, providing borderless, interoperable, personalised, user-friendly, end-to-end digital public services to all citizens and businesses – at all levels of public administration" (European Commission, 2019a). The next phase in public sector digital transformation is the delivery of highly personalised services to citizens (Microsoft, 2017).

Organisations increasingly see personalisation as a strategic tool to improve their relationship with customers. This is revealed by a recent survey conducted by Researchscape International and Evergage Inc. from 314 marketing professionals across the world where 70% claimed that personalisation has a strong impact on the business delivering better customer experiences (88%), increasing loyalty (59%) and generating measurable lift/ROI (50%) as top motivating factors (Researchscape International and Evergage Inc., 2019). The organisational strategy for designing and using the recommender systems depends on factors such as centricity (user or business centricity), dimensions (recommendation techniques) and delivery of the recommendation output to the target users (Gorgoglione et al., 2019). Organisations are

selective in the use of recommender systems for their business gains and the selection strategy may change to what fits best to the business needs. For example, companies can use recommender systems to recommend and promote new products to target users irrespective of their previous purchase history.

A large portion of the existing research on personalisation and personalised systems focuses on the effective use of recommendation techniques, concerns with the use of user personal data, improving system usability in relation to using personalisation and the impact of personalisation on user cognitive processes (Zanker et al., 2019).

To facilitate the personalised design process, it is a requirement to understand the architecture of a personalised system, its components and interaction between those components to produce personalised recommendations. Benyon and Murray (1993; cited in Weibelzahl, 2002) presented an early model of the adaptive system architecture that includes a user model, a domain model and an interaction model. Al-Hassan (2014) proposed a conceptual domain-specific personalised e-government framework called Intelligent Personalised e-government (IPe-Gov) framework containing user interface, user data collector, data repository and intelligent recommendation engine as main components (See Figure 2.1.1). A similar framework in the field of Government to Business (G2B) e-government has been proposed by Lu et al. (2009), which constitutes major components including user interface through e-government portal, data collector, database builder and recommendation engine. The proposed framework is called Intelligent Business Partner Locator (IBPL) framework and is shown in Figure 2.1.2.

The literature review in section 2.5 discusses the existing studies, which suggest the design methods to personalise systems in different domains. The existing studies listed in Table 2.5.1 and a more detailed review conducted by Gao et al. (2010) shows three core elements of a personalised system including user profiles, content modelling and filtering techniques.

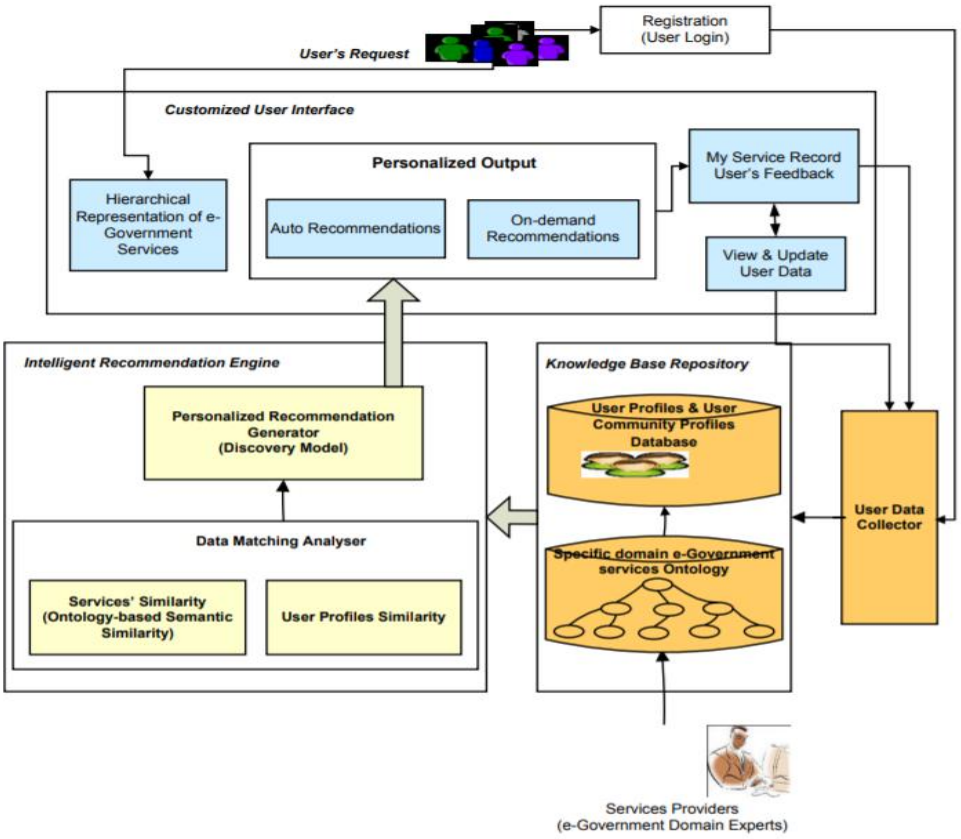


Figure 2.1.1 *Intelligent Personalised e-Government (IPe-Gov) framework (Al-Hassan, 2014, p.68)*

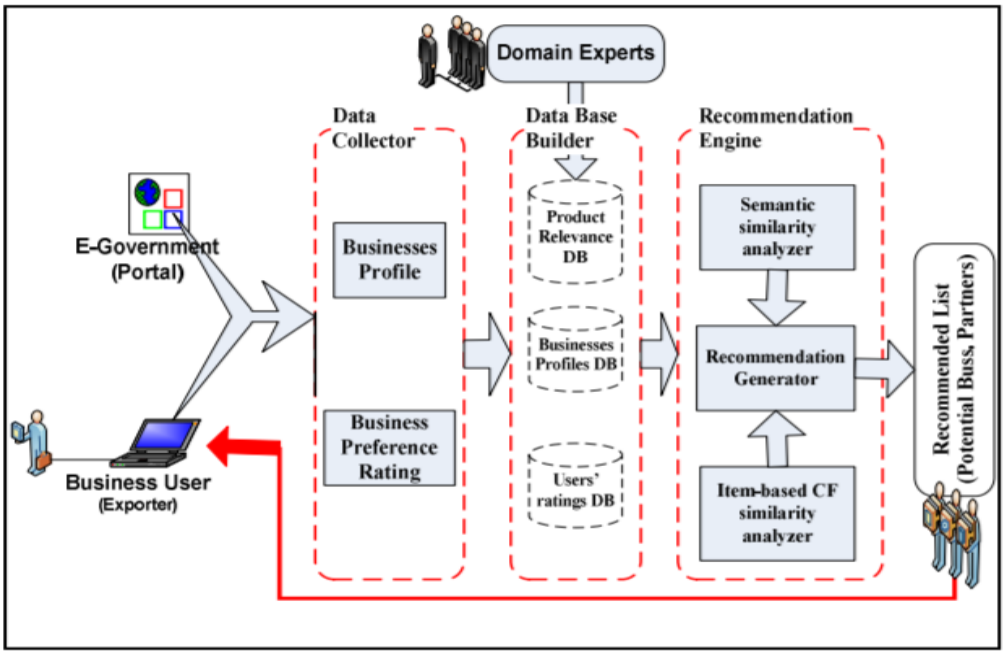


Figure 2.1.2 *The Intelligent Business Partner Locator (IBPL) System framework (Lu et al., 2009)*

A user profile is a set of information that contains user basic information (such as age, gender, address etc.), usage behaviour and interests. User profile can be built explicitly, implicitly or by a combination of both implicit and explicit data collection methods (Cufoglu, 2014). Explicitly, the user can provide profile information to the system. Implicitly, the system can collect user data by monitoring user interactions with the system. Complete and comprehensive data that reflect customer interactions provide the basis for effective personalisation (Issa, 2014).

Content modelling includes the classification of data and services based on the analysis approaches (Gao et al., 2010). Content modelling also called content/item profiling, facilitates the filtering of content by comparing user profile with the description of the content. Content analysis techniques such as Association Rules and Decision Tree are used for content classification. Association Rules is a data mining technique that unveils the relationships and associations between data extracted from transactions (Jooa et al., 2016). For example, a customer who paid for school meals may also be interested in school closure service i.e. a service that displays information if a school is closed due to unforeseen circumstances such as building damage, heavy snowfall etc. Decision Tree is another data mining technique, where a limited set of rules are discovered by analysing historic interactions between user and content/services for a pre-determined target on the system (Gao et al., 2010).

Once user profiles and content modelling are in place, the filtering techniques filter and recommend the right content to the right users. The most common filtering techniques include rule-based, content-based, collaborative and hybrid filtering techniques (Renjith et al., 2019; Yusof et al., 2014).

In rule-based filtering, a set of predetermined rules are created by domain experts that filter the specified group of content to the users based on user information such as demographics from the static user profile. In a content-based technique, filtering is based on comparing user profile information and item descriptions (Thorat et al., 2015). User profile information contains user interaction histories such as previous rated or preferred items based on certain item attributes. Collaborative filtering attempts to find similarities between users from the same preference group (Choenaksorn and Maneeroj, 2018). This approach makes recommendations by finding correlations among likes and dislikes of users. This technique predicts the interest of an active user by collecting rating information from other similar users.

The discussion about personalised recommendation techniques and their impact on system usability is important. However, a strategy to implement personalisation is required for the effective use of personalisation techniques. To devise a personalisation strategy in the public sector, Kieboom (2017) suggests understanding citizen needs, to assess the status of digitization of government services, be transparent and secure, undertake a risk-cost-benefit analysis and choose the best technological solution for the desired level of personalisation. Homburg et al. (2014) investigated the diffusion of personalised e-services in the 10 selected Netherlands municipalities from 2006-2009 and found that horizontal and vertical channels of persuasion and human agency (internal technical and non-technical staff, knowledge brokers) rather than the technological opportunity and rational cost-benefit considerations, were the main factors in the adoption and diffusion of innovative personalisation.

The effective use of personalisation and to scale up the usability of personalised systems, it is required to engage users in the development of personalised systems. The key for successful personalised design is basing the personalised design tools and features on creating value for the end user (Kramer et al., 2000). For governments offering a diverse range of services to the diverse populations of citizens, applying personalisation that focuses on creating value for the end user comes with design challenges. These design challenges include profiling diverse populations of citizens with different attributes and, choosing and applying suitable recommendation techniques to offer personalised public e-services to the relevant target users. In addition to these inherent challenges, there are organisational obstacles that impede the implementation of personalised public services including process-based, financial, governance-based, legal and technical obstacles (Pieterson et al., 2007).

eGovernment developers need to consider the design challenges for the effective implementation of personalisation in e-government. Although, the existing user centric design approaches and methods (see sections 2.4 and 2.5) emphasised user participation and the collection of user data to personalise services, the challenges in the design of personalised e-government are not effectively addressed. The next sections present an overview of user participation and challenges in the design of personalised e-government services.

2.2 User Participation in eGovernment Development

Realising the full potential of innovative technologies is not only a challenge for the government authorities as it places new demands and expectations from users on the public services but also provides potential to supply services in line with user needs (European Commission, 2019a). This has led governments to focus on the integration of user preferences and technology in their digital strategies. In digital strategy recommendations to its member states, the Organisation of Economic Co-operation and Development (OECD) recommends engagement and participation of public, private and civic society stakeholders in policymaking, public e-services design and delivery (Organisation of Economic Co-operation and Development, 2014). According to the United Nations (2014, p.61), e-participation is defined as "the process of engaging citizens through ICTs in policy and decision-making in order to make public administration participatory, inclusive, collaborative and deliberative for intrinsic and instrumental ends".

Although there have been some research studies highlighting the importance, challenges and roles of user participation in the development of e-government, most of the studies have not discussed at which stages of the design process user participation is required. To find the extent of user's willingness to participate in the development of public e-services, Holgersson and Karlsson (2014) conducted semi-structured interviews from 99 users and found that users with little experience of public services were more willing to participate in User Centred Design (UCD) than Participatory Design (PD) and User Innovation (UI) design methods. Users with experience of public services were more interested in the PD design, where user knowledge of public services is required. However, users were not interested in the time extensive UI design method, which requires user time and knowledge. This implies that ordinary citizens are more likely to participate if the UCD method is used to design public e-services The UCD and PD design methods are explained in section 2.4.

Despite the user willingness to participate in the design of public e-services, the participatory design process face challenges such as forming and retaining the participants in the design group over a period of time, performing needs analysis and joint participatory design activities and lack of formal methodology to engage and involve large heterogeneous stakeholder groups (Pilemalm, 2018). Participant engagement is not the only challenge, but there are also

organisational challenges such as skills and method gap between UCD practitioners and government decision-makers, teams such as business analysts and designers working in isolation and mismatch between government and user goals (Hamilton et al., 2011).

Despite the challenges in user participation, government services are increasingly moving online as revealed by the most recent EU e-government benchmarking report reporting that online availability of public e-services increased from 72% in 2013 to 85% in 2019 (European Commission, 2019a, p.16). Although the e-government services are increasingly moving online, the number of personalised and proactively delivered services stagnated for years in a row (European Commission, 2018, pp.51–52). This indicates the need for a new design approach that not only address the challenges faced by user participation in the design process, but also other challenges specific to e-government as discussed in the next section.

2.3 Challenges in the Design of Personalised eGovernment Services

eCommerce has greatly benefited by providing personalised experiences with targeted front end services provided to identified consumer segments with the goal of repeat business. eGovernment has different characteristics to e-commerce that impact on personalisation (Lee and Rao, 2009; Scholl et al., 2009; Van Dijk et al., 2015). These include:

1. **A diverse range of services provided to the entire population:** Unlike e-commerce, where selective users can be targeted to offer products or services, e-government must be able to serve all the users in a geographical location under the jurisdiction of a government authority. Organisations offering e-commerce services are usually limited to a specific type of services such as commercial, financial etc. Not all but most government authorities such as local municipalities or councils usually provide a variety of e-government services such as the collection of local taxes, waste collection, maintenance of roads and streets, planning permissions for construction projects etc. Considering the needs of all e-government users and designing a variety of services for those users, make the design process complicated.

2. **Laws and regulations bound services:** eGovernment services are bound by laws and regulations from the government. Usually, service rules are complicated and have many details and exceptions for particular groups of citizens. The design method needs to cater for both the user needs and the laws.

3. **Occasional use:** Most e-government services are occasionally used, while commercial services such as shopping, or internet banking are used more frequently by the users. This makes e-government services far more difficult to learn and remember by the users. Improving the usability of e-government services is therefore an important factor in designing e-government services.

4. **Integrated Services:** Unlike e-commerce services usually provided by a single company, e-government services are provided by a chain of government departments. This has motivated the idea of an integrated one-stop shop web portal.

5. **Limited or no choice to use alternative services:** In most cases, users of the e-government services have limited or no choice to use services from alternative providers. There are choices for alternative channels such as telephone or personal visits, however, users may continue to interact with government through online channels to save time and avoid other costs regardless of the fact that e-government services fail to meet their expectations (Nishant et al., 2019). This provides opportunities to improve the cost-effective digital channel shift.

Due to these peculiar characteristics of e-government services, the design of personalised e-government services is more challenging than the design of e-commerce. This research aims to find a suitable design approach to personalise e-government services by exploring and applying various design options as explained in the next section.

2.4 Selecting a Design Approach for eGovernment Services

Literature was reviewed to select an appropriate design methodology for e-government services. Common design approaches used by researchers and designers were reviewed to assess their suitability for the design of personalised user centred e-government services.

2.4.1 User Centred Design

User Centred Design also referred to as Universal Design (Wilkinson and De Angeli, 2014), is a design process with a focus on user needs and tasks. The system design considers user goals and expectations, with explicit user involvement in each stage of the design process.

The term “User Centred Design” was first originated in the 1980s from the Donald Norman laboratory at the University of California San Diego (Kaygin and Demir, 2017). According to International Standard Organisation (2019), in ISO (International Standards Organisation) 9241-210:2019 edition, User Centred Design (UCD) process also called Human Centred Design (HCD) process is defined as an “approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques”. Although the terms User Centred Design and Human Centred Design are synonyms and can be used interchangeably, there is a subtle difference between them. Originally UCD was supposed to focus on the end users only, which was later changed to HCD with focus on all system stakeholders - individuals or organizations having a right, share, claim or interest in a system or in its possession of characteristics that meet their needs and expectations (International Standard Organisation, 2019).

UCD approach can be used in a variety of system development methodologies. ISO standards have not provided details of any specific methods or techniques to carry out UCD but instead defined a set of principles on which various methods and techniques should be based. No matter what design and development methodology is used, a UCD approach should be based on the following principles. (Kotamraju and Van der Geest, 2012; W3C Web Accessibility Initiative, 2008).

1. Focus on users and tasks
2. Active user participation throughout the design process
3. Early prototyping to develop and evaluate design with users
4. Iterative design with continuous iterations of design, user evaluation and redesign based on the evaluation

With the basic principles in mind, a UCD process can have several variations and can be applied using a variety or combination of methods (Maguire, 2001). A typical UCD process for designing web-based applications has Analysis, Design, Evaluation (iterate back to design), Implementation and Deployment phases (W3C Web Accessibility Initiative, 2008). Smaradottir and Fensli (2016) explored that steps for a UCD process used in a health information technology system development include Field Study, User Workshops, Design and Development Phase, User Evaluations, Field Trial and Final Development. To design a usable Human Machine Interface for air traffic control, König et al. (2012) used a four-step UCD approach with steps including understanding the context of use, specify the user requirements, produce design solutions and evaluation. According to Magain (2013), every UCD process consists of the same high-level phases including Strategy, Research, Analysis, Design and Implementation. These UCD phases and methods that can be applied at each phase are summarised below.

1- Strategy

A project strategy is required in the beginning to outline what would be required to carry out the rest of the activities, set out goals and objectives of the project and do preliminary investigation how to achieve the desired product.

2- Research

In this stage, user and system research is performed. A user group of targeted demographics is selected at a time. Data is collected by a variety of techniques such as web analytics/system usage data review, contextual review, surveys to gather user feedback from the current system users, interviews to collect data about user tasks etc.

3- **Analysis**

The data collected in the previous stage is further analysed to gain deep insights into the system under development. User personas are created, scenarios are built, and task analysis is performed. This stage provides a blueprint to the designers to start design in the next stage.

4- **Design & evaluation**

In this stage, low to high fidelity prototypes are built based on the user requirements from previous stages. The prototypes are further evaluated by the users, feedback is gathered, and prototypes are further refined. Extensive communication is required between analysts, designers and users at this stage. This process iterates until the design is refined to a more stable state. The iteration may go back to the previous stages if required.

5- **Implementation & deployment**

Once the design is finalised in the previous stage, the fully functional system is built and deployed. Regular user feedback should be collected post system launch and the system should be updated into new planned releases.

There are some concerns with the use of Human Centred Design, initially highlighted by Donald Norman, much of whose life's work is rooted in research and advocacy for User Centred Design. According to Norman (2005), focus upon individual people (or groups) might improve design for them but worsen it for others and distract designers from the support of tasks and activities. Norman (2008) later clarified that focusing too much on modelling individuals by building their high-level scenarios and personas are not as useful as focusing on the tasks and activities. Recently some researchers proposed ideas to move beyond the anthropocentricity (an inclination to evaluate reality exclusively in terms of human values) of the HCD approach and consider incorporating environmental ecosystems, animals and other objects (Pasanen, 2019; Thomas, Remy and Bates, 2017).

There are many misconceptions around the UCD process and the goal is not always clear to many designers, therefore, it is worthwhile to understand the design concepts which cannot be classified as User Centred Design.

1- UCD does not mean to ask users what they want and then giving it to them (Endsley and Jones, 2011, p.7). This is because users have limited knowledge about what can be better for them and most systems have a diverse base of users. Different users may have conflicting ideas about the same feature of a product. This approach is costly in terms of implementation.
2- UCD does not mean to present users with just the information they need at any given moment in time (Endsley and Jones, 2011, p.8). This can be ideal, but it has proven to be very difficult for the system to always detect what information user exactly wants at a given moment in time and users cannot easily keep up with the pace of information changes on the system.
3- UCD does not mean designing systems that make decisions for the users because systems that make ambiguous decisions leave users with reduced decision-making quality. If the system advice is wrong, then the user will more likely take a wrong decision (Smith et al., 1995; cited in Endsley and Jones, 2011).
4- UCD does not mean doing things for the users automatically (Endsley and Jones, 2011, p.9). This keeps users out of the loop and the system enforces its actions upon the users.

2.4.2 Goal Directed Design

Goal Directed Design (GDD) is defined by a leading software programmer and designer Alan Cooper as a design methodology with a primary focus on user goals and translating those goals into user tasks and activities (Dalrymple, 2014). GDD methodology is laid out in Alan's book 'About Face – The essentials of interaction design' (Cooper et al., 2014) with the following stages shown in Figure 2.4.2.1.

1. **Research:** In this stage, qualitative data about users or potential users is collected through field studies and interviews. The output of this stage is a set of instructions reflecting how users could use the product.

2. **Modelling:** Based on the data collected in the previous stage, user and domain modelling is carried out at this stage. User modelling is performed by defining user

personas for the target user groups that embody users' behaviour and goals. Domain modelling is performed by building workflow patterns.

3. **Requirements definition:** This stage connects user models with the domain models. Context scenarios (stories of user interaction with the system) are defined for the target personas. New design ideas not revealed before can be generated at this stage.

4. **Design framework:** The overall framework representing the structure of user interaction with the system is defined at this stage. Design visuals or prototypes are created to validate scenarios.

5. **Design refinement:** This stage is focused on the details and refinement of the design visuals and related design ideas.

6. **Design support:** Finally, constraints affecting the design are highlighted at this stage and any adjustments made. These constraints include technological, budgetary and timeline concerns.

Comparing User Centred Design with Goal Directed Design, Wei and Xing (2010) proposed that GDD should be used as an overall design process while UCD should be used as a guiding principle in the research stage of GDD. Abidin et al. (2018), who used the GDD method to develop a user interface on reproductive health learning media for a Senior High School, found that GDD has increased the average usability percentage to more than 85% as compared to its previous counterpart with less satisfied feedback from students.

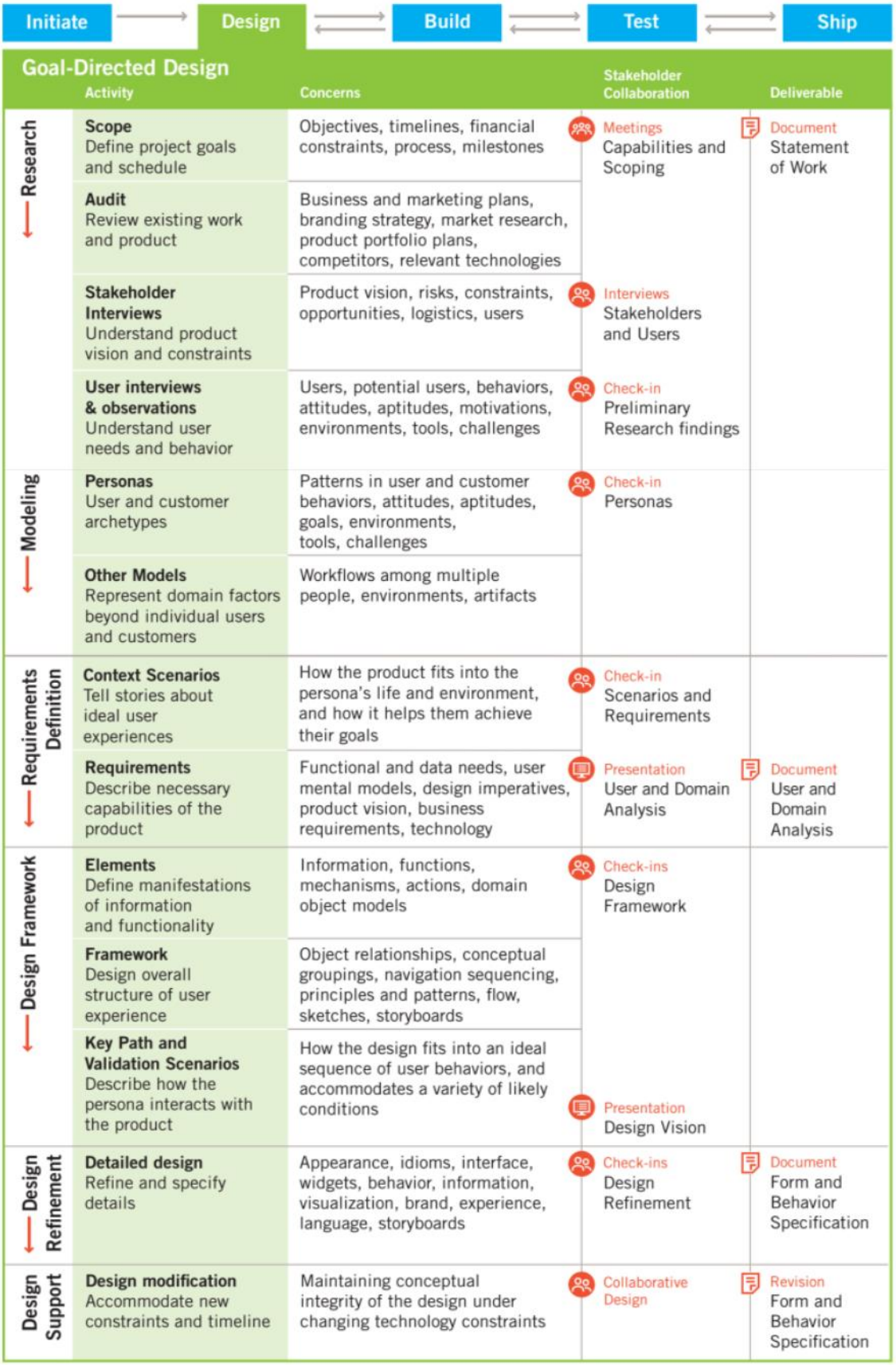


Figure 2.4.2.1 *A more detailed look at the Goal-Directed Design process (Cooper et al., 2014, p.25)*

2.4.3 Participatory Design

Participatory Design (PD) is a collaborative design approach, where designers team up with other stakeholders such as partners, end users, citizens etc. to exchange design ideas and generate design concepts (Kang et al., 2015). PD is a vigorous process that requires user involvement at different levels and in a variety of ways. Barcellini et al. (2015) defined a set of roles for the users and designers in the Participatory Design process based on the structure of interactions during design meetings including interacting role, group-oriented, task-oriented and production role characterised by contributing in the design discussion, group co-ordination, participation in the considered task and direct actions on the considered artefact respectively. PD can be implemented using a variety of ways such as workshops, ethnography, cooperative prototyping, mock-ups etc.

Participatory Design has several advantages and challenges in its use. The main advantages include increased understanding of users and context of use, ownership, higher user satisfaction, provide opportunities to develop increased self-esteem and confidence for certain groups of users such as children, collaboration, communication, alter social attitudes and generation of new design ideas (Constantin et al., 2019). The challenges in the use of PD include attracting and retaining participants, extracting design information from PD activities, managing resources etc.

2.4.4 Design Thinking

Design Thinking (DT) is a design approach where designers, based on their knowledge of users and domain, ideate and implement a service more suitable for the users. Tim Brown, CEO of leading international design and consulting firm IDEO, who proposed a transformed version of DT method for designing services defined Design Thinking as “a discipline that uses the designer’s sensibility and methods to match people’s needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity” (Brown, 2008). One of the key features of DT is to visualise the design idea before it becomes tangible and accepted early in the design process (Pereira and Russo,

2018). Companies such as Apple and Nintendo are using DT as a part of their design methodologies (Pasman and Wieringa, 2011).

A typical Design Thinking process has three to five main stages. The three-stage DT process provides similar stages as the five-stage process with a higher level of abstraction and includes inspiration, ideation and implementation phases (Mahmoud-Jouini et al., 2019). The inspiration stage involves understanding the role of empathy to collect and gain deep insights into user and system data. The ideation stage focuses on the generation of design ideas from the data collected and analysed in the previous stage. In the implementation stage, the design ideas are presented in a prototype and improvements made. In the five-stage DT process the high-level stages are refined into Empathise, Define (defining insights), Ideate, Prototype and Test stages (Chon and Sim, 2019).

2.4.5 Activity Centred Design

In Activity Centred Design (ACD), organisations use their understanding of the activities to build a service or product (Norman, 2005). Activity is a well-defined integrated and coordinated set of tasks. A set of activities are required to perform an action that operates a product or service. Williams (2009) discussed that no definitive text exists in the literature that profiles the processes, methods and deliverables to be used by ACD practitioners.

Unlike User Centred Design, which focuses on users and their tasks in an environment to use the system, ACD focuses on the activities and tasks enabled by the system or application (Porter, 2008). In the case of e-government, ACD looks more promising for certain activities which are bound by laws, and government authorities simply cannot change those rules. For example, the noise complaint service request offered by Durham County Council cannot be investigated anonymously unless the complainant provides contact details. However, ignoring the voice of the citizens altogether not only go against the government commitment to provide citizen centric services but also undermines the democratic rights of the citizens.

2.4.6 Summary

The review of the design approaches as discussed in the previous sections is summarised in Table 2.4.6.1. User Centred Design and similar design approaches (Goal Directed Design, Participatory Design and Design Thinking) with focus on a target user group work well for e-commerce, where certain user groups can be omitted from the design process and companies can evolve around the user needs. Unlike in e-commerce domain, where organisations are free to choose their target users and evolve around user needs, government authorities are bound to provide services to all the citizens and must work following laws and regulations.

Design approach	**Scope**	**Pros and Cons**
User Centred Design (Dell'Era and Landoni, 2014)	Focus on users and their tasks, a design approach with user as a subject	Gain insights into user needs by asking or observing users, focus on the requirements of a large and diverse user base is difficult to achieve.
Goal Directed Design (Duan et al., 2020)	Focus on user goals	Converting user goals to user activities and tasks, user modelling with personas
Participatory Design (Barcellini et al., 2015; Dell'Era and Landoni, 2014)	User participation in the design process	User acts as a partner in decision making, user participation and user retention in the design process are time consuming and incur cost, user knowledge of services is required.
Design Thinking (Chon and Sim, 2019)	Design ideation and creativity	Ideation and creation of design concepts based on user knowledge.
Activity Centred Design (Porter, 2008)	Activities and tasks enabled by the system	Public e-services compliant with laws and regulations can be designed without much user involvement.

Table 2.4.6. 1 *Summary of the design approaches with their scope, pros and cons*

To meet these challenges in the design of e-government, fourth generation of UCD development methods are required (Pilemalm et al., 2015), which are more practically relevant and methodologically correct, provide suitable design tools and techniques, bring know-how and experience from cross-sector collaboration and e-government projects, and work under constrained resources.

None of the reviewed design approaches alone can meet the challenges in the design of e-government. A new design approach is needed, which not only benefits from the user centric design approaches but also employs Activity Centred Design approach to design public e-services bound by laws and regulations. The next section reviews the existing design methods of personalisation.

2.5 Design Methods for personalisation

As stated in Chapter 1, governments across the EU have made improvements in the user centricity of the public services referring to the online availability, mobile friendliness and usability (in terms of online support and feedback) of those services; however, the existing research suggests that quality of the existing public e-services needs further improvement (European Commission, 2019b; United Nations, 2018).

High service quality can be achieved by involving users in each step of the service design and development method. Designers tend to design system based on their knowledge ignoring the user interests. The leading design consultant Norman argued that a problem with many designers and engineers is that they are too logical and logic does not always describe the real behaviour of end users, how they use the object (gqpzhang, 2013). This raises the need for user involvement in various stages of the product or service design. However, for e-government where services and the associated tasks are usually bound by regulations, the services must be designed to comply with those regulations. This implies that UCD should be used in a balanced way considering user needs, analysis of the activities that accomplish the task, our prior knowledge and experience about the product (Norman, 2005).

Personalisation provides a wide range of features aimed for better user experience with the product or application. Designers use personalisation to design personalised features and

often forget if these features would provide any value to the end user. A user focused approach to personalisation should be devised to better assess the value provided by personalisation to the end user. In an extensive literature review, Iivari and Iivari (2011) discussed that system personalisation is a dimension of user centeredness that can be used to evaluate systems development methods and approaches as to what extent and in what sense they adhere to the ideas of user centeredness. Other dimensions of user centeredness include user focus, work centeredness and user involvement.

Existing methodologies for personalising e-commerce services (Kaneko et al., 2018; Kramer et al., 2000; Lokhande and Meshram, 2015; Van Velsen et al., 2010) with their focus on regular user interactions are not applicable for the personalisation of e-government services. Similarly, existing methodologies for personalising e-government services (Abdrabbah et al., 2016; Al-hassan et al., 2009; Lu et al., 2009) are based on conceptual semantic technology and have limited real world relevance. Table 2.5.1 provides an overview of these methodologies with the pros and cons of each method.

Methodology	**Steps, stages or main elements**	**Pros**	**Cons**
Personalised design method based on engineering products and services, by Kaneko et al. (2018)	Read out (User requirements), Goal setting (System specs), Solution (recommendation engine), Production and realization (personalised product)	User feedback at each step, Suitable for both products and services	A General method with no details on how to perform each step, e-government services not discussed
A Dynamic Community-Based Personalisation for e-Government Services, by Abdrabbah et al. (2016)	User data collection from user service ratings or user interaction data, Semantic communities (groups) of static/dynamic e-government services, recommender system	Conceptual dynamic method to capture users' behaviour from their system interaction	User ratings for e-government services not clearly explained, Semantic internet technology (still not implemented)
Analysis and Design of Web Personalisation Systems for E-Commerce, by Lokhande and Meshram (2015)	Input data from the web usage logs, transaction database & user profiles, knowledge discovery by data mining, product recommendation	Highlighted the use of existing web usage data sources, use of applied	No emphasis on direct user involvement in the system design

	engine using Collaborative Filtering	personalisation techniques	
A Framework for Delivering Personalised e-Government Services from a Citizen-Centric Approach, by Al-hassan et al. (2009)	Implicit/explicit user data collection, User profiling, Domain-specific semantic e-government services ontology, Intelligent recommendation engine (Data matching analyser and recommendation generator)	User involvement, a conceptual framework with clearly defined components	Based on semantic web technology (still not implemented)
Recommendation Technique-based Government-to-Business Personalised e-Services, by Lu et al. (2009)	Data collector collecting data from business profiles and business user preferences, Database builder to build user profiles, product relevance and user rating databases, recommendation engine using CF (Collaborative Filtering) fuzzy & semantic similarity and recommendation generator	A framework suitable for Government-to-Business services, clearly defined framework components	No details of direct business user involvement mentioned
A layered approach to design personalised systems, by Van Velsen et al. (2010)	Identify target user groups, User data collection, data interpretation to design recommendations, users assess recommendations to form adaptations, Implementation of adaptations	User involvement in multiple stages	Lacking details of how to interpret user data and design adaptations
User Centred Design approach to personalisation, by Kramer et al. (2000)	Identify target user segment and profiling, Task analysis, Blue-sky exercise of Task analysis (personalised version), User domain modelling, Stepping through each task flow, Prototyping, Evaluation and Implementation	A suitable method for e-commerce, User involvement, Emphasis on tasks, Participatory design	No details to design e-government services on a single web portal

Table 2.5.1 *Existing methodologies to personalise e-commerce and e-government services*

The reviewed studies focus on personalising a specific product or service for a targeted segment of users. The approaches used in the reviewed studies are more technology centred with a focus on implementing recommendation techniques, which may work for specific types of applications. These studies suggested the steps to personalise e-services; however, not many details of how to perform those steps were given. For personalising e-government, none of the studies considered the challenges in the design of e-government as discussed in section 2.3.

From the literature review of the existing design approaches and methodologies, this study used a best fit design method initially used to personalise a set of public e-services of Durham County Council – a UK local government authority, with a set of methods and techniques selected from different design approaches used at different stages. These stages reflect a typical Software Development Life Cycle (SDLC) method including project selection & planning (specification), analysis, design and implementation stages (Costa et al., 2014). The methods used at different stages were further optimised to personalise services for the target users. A synopsis of the stages and methods used are as follows.

1- User research

The design method was started with the user research stage to focus on stakeholder needs. The methods used at this stage include Participatory Design (PD) methods such as citizens' focus group and interviews. User secondary data in relation to using public e-services was also selected at this stage.

2- Analysis

Analysis of the data collected in the previous stage was performed at this stage. Analysis of the focus group data provided information about the user's desired system features. Personas, a method from Goal Directed Design, were built from the data analysis of the data collected from the user interviews. Task analysis of the user activities to make a service request is performed considering user and organisation needs. The focus on organisation needs to design activities and tasks is a core concept from Activity Centred Design.

3- Design

In this stage, design concepts were generated from various sources including Design Thinking methods such as design ideations and visualisation (Pereira and Russo, 2018). Finally, a personalised e-government prototype was built.

4- Evaluation

In this stage, the heuristic evaluation of the personalised e-government prototype was performed by experts.

The next chapters discuss these stages in further detail and explain what and how various methods were used at these stages to personalise e-government services.

2.6 Summary and key findings

This chapter reviewed the main areas of focus in this research including personalisation, user participation in e-government development, challenges in the design of personalised e-government, various existing design approaches, the suitability of design approaches to design public e-services and finally existing methods to personalise e-government and e-commerce. This review identified that the User Centred Design approach alone is not sufficient to design public e-services because of the complex nature of e-government. A mixed design approach is proposed where methods of other design approaches such as Goal Directed Design, Participatory Design, Design Thinking and Activity Centred Design are combined and modified for the best use.

The review of the existing methods to personalise e-government and e-commerce found that these methods focused on the recommendation techniques to personalise services without considering the challenges in the design of e-government such as diversity of public e-services offered to a large user base, laws impacting the design of public e-services etc. Therefore, a need for a new design method was identified to personalise e-government. The next chapters

discuss the stages of the mixed design approach and explain the methods used in these stages to personalise Durham County Council public e-services.

3 METHODOLOGY

This chapter outlines the research paradigm underpinning the research methods used by this study and explains how the research methods were configured to produce effective research output. The chapter is structured with the following main sections.

3.1 Research Paradigm: In this section, a brief overview of the philosophical position that underpins the methodological approach used in this research, is presented.

3.2 Selection of Methods: This section explores the research methods used in this research. The importance of the methods used in the research context is also discussed.

3.3 Research Design: This section discusses the research design outlining how various research methods were configured for the effective outcome of this research. A five-stage research process was designed that explains the activities and methods from the beginning of this study until the outcome was achieved.

3.4 Ethics and Consent: This section briefly discusses the ethical requirements for this research.

3.1 Research Paradigm

According to Schwandt (2001; cited in Chilisa and Kawulich, 2012), "A paradigm is a shared world view that represents the beliefs and values in a discipline and that guides how problems are solved". A research paradigm is a way to describe world views informed by philosophical assumptions about the nature of reality (ontology), how the knowledge is known (epistemology) and what is valued (axiology) in the research (Creswell and Poth, 2016, pp.19–22; Thanh and Thanh, 2015).

To the best of author's knowledge, this research takes the philosophical approach of pragmatism. The word 'Pragmatism' has derived from the Greek word 'Pragma', which means action and is the central concept of pragmatism (Pansiri, 2005). Pragmatism is the philosophy of common sense with a strong emphasis on human inquiry that acknowledges human experience as problematic situations emerge and are recognised (Shields, 1998). John Dewey,

who promoted pragmatism explained human experience in terms of two inseparable components of human beliefs and action (Morgan, 2014). The origins of our beliefs arise from our prior actions and the outcomes of our actions are found in our beliefs.

Unlike other distinctive research paradigms such as the positivist paradigm based on objective world reality (Ryan, 2018) and the constructivist paradigm based on participants' subjective views (Hesse-Biber et al., 2015, p.4), the pragmatic paradigm rejects these distinctions and focuses more on the inquiry of the research to define its own world of research - different contexts with different feelings about and different standards for the nature of inquiry (Morgan, 2014). Pragmatism is based on the proposition that researchers should use the philosophical and/or methodological approach that works best for the particular research problem that is being investigated (Tashakkori and Teddlie, 1998, pp.20–29). According to Saunders et al. (2009, p.128), pragmatism holds that the most important determinant of ontology, epistemology and axiology is the research question.

Morgan (2014) argued that pragmatism can be used as a research paradigm, regardless of whether that research uses qualitative, quantitative, or mixed methods. However, pragmatism underpins mostly the multimethod or mixed methods research with a view that the best research methods are those that help to most effectively answer the research question or inquiry of the research (Kaushik and Walsh, 2019).

This research focused on the research question, "How can personalisation be applied to enable e-government service delivery for citizens?" and used a variety of methods to answer this research question. Due to the inquiry-focused nature of this research to personalise e-government services using a variety of qualitative methods (a multimethod research approach), this research takes the philosophical approach of pragmatism.

3.2 Selection of Methods

In general, a case study is a preferred method when a) the research has to answer "how" or "why" questions and b) the focus is on a contemporary phenomenon within a real-life context (Yin, 2009, p.2). In a case study approach, while defining the research questions, it is required to determine a case and bind that case to a preferred context (Baxter and Jack, 2008).

To answer the research question (see in the previous section), this study used an illustrative case study approach to illustrate the process to analyse and personalise e-government services in a government organisation. In an illustrative case study, key cases (a limited set, not a wide range) are chosen because the researcher has a particular interest in or circumstances around them (Crossman, 2019; Hayes et al., 2015). The case was defined to analyse services of Durham County Council (DCC) - a UK local government organisation and determine how these services could be personalised, see 'Appendix A: About Durham County Council' for the information about DCC.

DCC also provided access to secondary data. Secondary data refers to the data, which was not collected for the research hypothesis being tested (Trinh, 2018). Secondary data analysis involves the analysis of the existing data to address new research questions, extend previous findings, measure new constructs and longitudinal designs without much effort and resources required (Greenhoot and Dowsett, 2012).

The availability of Open Government Data provides greater opportunities for researchers to use government data. Open Government Data is government-related data that is opened to the public to support and enable the grand democratic purposes of open government (Kučera et al., 2013). As of the 1st November 2017, the UK government portal (https://data.gov.uk/) that publishes open government datasets contained 42,991 secondary data sets published by various government organisations (Wang and Shepherd, 2020). There are several other sources to collect data about e-government services such as the government web portal where links to the services are published, Customer Relationship Management (CRM) system where data about customer service requests are captured and processed, other third-party systems used by government organisations for specific tasks etc.

Data analytics tools are used to retrieve data from the data sources, analyse and present it in a meaningful way. Google Analytics is one of the best tools to analyse web analytics data, which provides several indicators such as pageview tracking, traffic analysis, behaviour analysis etc. (Walker, 2018). These analytics and traffic indicators can be used to predict user demand for the services and develop forecasts which enhance managerial decisions (Gunter and Önder, 2016). As detailed in section 3.3.2.1, this research mainly used Google Analytics tool to analyse the pageviews tracking of those pages of the Durham County Council website where the services were published.

As discussed in the following sections, this research used qualitative and user-centred research methods. In any User Centred Design approach, the system is designed based on the user views, expectations and needs. According to Hammarberg et al. (2016), “qualitative methods are used to answer questions about experience, meaning and perspective, most often from the standpoint of the participant”.

3.2.1 Qualitative Methods

Conducting qualitative research is more challenging as the role of a researcher is to attempt to access the thoughts and feelings of the study participants (Sutton and Austin, 2015). This is not always an easy task, which may involve asking people personal questions which they are reluctant to openly discuss, recent experience participants may not have explored or reliving past experiences which might be difficult. Unlike quantitative research, which tends to focus on the frequency, intensity or duration of a behaviour, qualitative research explores the beliefs, values and motives that explain why the behaviour occurs (Castleberry and Nolen, 2018).

Qualitative research places the researcher at the centre of data gathering phase and the researcher is an instrument by which information is collected (Roller and Lavrakas, 2015, pp.5–6). The researcher needs to have skills such as good communication and interaction, active listening and systematic content analysis skills for conducting effecting qualitative research (Braune, 2018).

In this research, focus group and individual interviews were used to find and collect data about user views and perceptions of using their local e-government services. As detailed below, qualitative data was analysed using thematic analysis.

3.2.1.1 Focus Group

According to Krueger and Casey (2014, p.2), a focus group is a “special type of group in terms of purpose, size, composition and procedures. The purpose of a focus group is to listen and

gather information. It is a way to better understand how people feel or think about an issue, product, or service. Focus groups are used to gather opinions". Focus group provides carefully planned discussions aiming to obtain personal perceptions of the participants in a defined research area (Bräuer et al., 2018).

An exploratory focus group was conducted in this research with citizens of a target user group to find their behaviour of using e-government services, needs and expectations from e-government. The focus group was aimed to find citizens who exhibit similar behaviour (i.e. used a similar set of services). This usage behaviour analysis aimed to provide valuable information to personalise and display a similar set of services to all the citizens who belong to the target group.

The focus group method was used as it draws upon participants' attitudes, feelings, interactions in a way which would not be feasible using other methods such as observation, one-to-one interviews or questionnaire survey (Gibbs, 1997). Unlike one-to-one interviews or questionnaire survey, a focus group elicits a multiplicity of views within a group context.

The steps followed to conduct the focus group include defining objectives, recruiting participants (4-15) with the homogenous composition (gender, education, language etc), identifying a suitable location for conducting focus group, pre-session preparation (preparing script, seating, equipment preparation, recording discussion etc.), facilitation during the meeting, data analysis and reporting results (Nyumba et al., 2018; Winke, 2017).

Using the focus group method has several benefits such as being faster, easier and cheaper to assemble, generating ideas built on one another's responses and developing deeper insights into the participant's own words (Pretorius and Calitz, 2011). Although a focus group can be a powerful method to collect subjective data about user needs and preferences in system development, a focus group may not produce accurate data as the data is based on what customers say they do – not how they do it (Nielsen, 1997).

The focus group as detailed in section 3.3.2.2 was conducted early in the design process, with the aim of gaining user input to develop this research further and ensure it focused on user requirements and needs.

3.2.1.2 Interviews

An interview is a primary qualitative data collection method that provides the most direct, research-focused interaction between researcher and participant (Kazmer and Xie, 2008, p.258). Interviews can be structured or unstructured (Austin and Sutton, 2014). Structured interviews rely upon predetermined questions which guide interviewers during the interviews and facilitate consistency between participants. Unstructured or semi-structured interviews may begin with some predefined questions, but the interviewer has considerable latitude to adapt questions to the specific direction of responses. This may lead to more intuitive and natural conversations between researchers and participants.

Interviews are more interactive, where interviewers can seek for complete, clear answers and probe into emerging topics (Alshenqeeti, 2014). Interviews, therefore, are expected to broaden the understanding of an investigated phenomena. Interviews have several benefits such as in-depth data collection and comprehensive understanding, the interviewer can probe for explanations of responses, stimulus material and visual aids can be used to support the interviews, interviewers are not influenced by others in the group, ambiguities can be clarified and incomplete answers followed up etc. (Marshall, 2016).

In this research, interviews (section 3.3.2.3) were conducted from the target citizens to further explore their experience with e-government services, pain points, their behaviour of using e-government services, needs and expectations. These interviews were aimed to create user personas for the target users. With some common themes, interviews were also used to triangulate the focus group method and produce rich citizens data.

3.2.1.3 Qualitative Data Analysis Approach

The open-ended nature of data from qualitative research is a challenge as textual data is often difficult to reduce and identify patterns than numbers as data (Castleberry and Nolen, 2018). Examples of qualitative data include interviews or focus group transcripts, survey questionnaire responses, direct field observations, videos, images etc. Thematic analysis (TA), a commonly used approach across all qualitative designs, is an analysis method for

systematically identifying, organising and offering insight into patterns of meaning (themes) across the dataset (Mortensen, 2019; Roulston, 2014, p.305).

Thematic analysis was used to analyse the focus group and interviews data. A common deductive thematic analysis of the focus group data was performed with steps including data familiarisation, coding, generating themes, reviewing themes, defining and naming themes and producing a report (Braun and Clarke, 2012; Caulfield, 2019). Unlike Inductive thematic analysis, which does not come with preconceived themes, in deductive thematic analysis researcher brings to the data a series of concepts, ideas or topics that they use to code and interpret the data (Braun and Clarke, 2012). The focus group and interviews were conducted with preconceived themes of finding target users experience, pain points, expectations, their behaviour of using e-government services and perceptions of personalising e-government.

3.2.2 Task Analysis

Task analysis is the process of learning about ordinary users by observing them in action (Hackos and Reddish, 1998 cited in Arnowitz et al., 2000). Task analysis is a qualitative method to identify, understand and optimise user tasks to achieve user goals and improve system design (Annett, 2003). Task analysis helps in identifying and understanding user tasks, which further facilitates and formalises usability requirements (Liu et al., 2017).

Task information includes task specification, how users perform the task, information about the data sources and other third-party systems where interaction is required to perform that task. Task analysis can be time-consuming if performed with a higher degree of details and may lead to analysis paralysis (Gaddy and Marcus, 2006). Therefore, task analysis should start with a review of current user activities at a higher level instead of fine-grained details. Although it is preferred to observe customers performing tasks or get access to user data, government institutions have strict policies to allow access to user confidential data. However, according to GDPR recital 26, anonymous data not directly linked to user identification can be accessed and may contain useful information to improve task design (Mourby et al., 2018).

The use of task analysis is equally important in both e-commerce and e-government. Unlike e-commerce, e-government is designed to support a vast variety of services take on different roles and serve a large base of users. The e-government business process model is based on the laws, statutes and regulations to service users, which does not always evolve along with the user needs (Lee and Rao, 2009; Scholl et al., 2009; Van Dijk, Ebbers and Wijngaert, 2015). Therefore, task analysis must consider these obligations. Furthermore, most e-government services are occasionally used, while commercial services such as buying or internet banking are used more frequently by users. The occasional use of e-government services makes them far more difficult to learn and remember by the users. Therefore, task analysis should initially focus on user activities and further extended to automate tasks wherever possible.

Due to the complexity of e-government, tasks required to make service requests need to be decomposed into subtasks for effective design. In this study, Hierarchical Task Analysis (HTA) was used that involved task decomposition into subtasks at multiple levels of complexity and representation of information flow in terms of decision points and actions (Kulahcioglu et al., 2017; Stanton, 2006).

Originally developed as a means of determining training requirements, Hierarchical Task Analysis (HTA) has been used for a range of applications such as interface design and evaluation, allocation of function, job aid design, error prediction, and workload assessment (Stanton, 2006).

Decision points are critical points requiring knowledge by the users, which helps in task optimization and automation by the system providing the user knowledge instead of the direct user input (Marine, 2014). The extended HTA analysis method was applied to design and create service adaptations of e-government services for the target users based on the information in the user profile. This method is further discussed in section 4.6.

3.2.3 Personas

Persona, a user profile and a User Centred Design tool, is a descriptive model of archetypal users representing multiple people who share similar goals, motivations and behaviours

(Marshall et al., 2015). Personas are user presentation tools that help designers to understand users and adopt their perspectives (Marsden and Pröbster, 2019). This presentation is meant to decrease designers' reliance on their egocentric perspective when reasoning about other people's thoughts, feelings, and other subjective experiences.

In the design process, personas are created based on the user study that helps designers focus on user needs (Chang et al., 2008). Personas offer a more realistic portrait of users and are used in the design process when feature decisions need to be made (Quintana et al., 2017). In any marketing strategy, a persona can be used as a powerful tool to understand target customer needs and serve as a first step to achieve personalisation (McIlveen, 2017). Personas can also be created by employing a variety of techniques such as Grounded Theory model (Faily and Flechais, 2011) and other qualitative and quantitative data collection methods (McGinn and Kotamraju, 2008).

The most notable elements of a persona are user goals and objectives, and user behaviour in relation to using the system. In building a persona, user objectives refer to the user motivations that determine why they use the system when they use it i.e. what motivates them when they click on a service to use or a product to buy, pick up the phone to call business etc. (Shewan, 2016).

In this study, personas were created based on data collected from the interviews and focus group methods, see section 3.3.2.4. The personas were used to support the design of the personalised prototype which aimed to display the services that the target user groups were most likely to use.

3.2.4 Prototyping and Heuristics

To explore personalisation, a prototype was built, see section 3.3.3. According to Beaudouin-Lafon and Mackay (2002, p.1018), a prototype is defined "as a concrete representation of part or all of an interactive system. A prototype is a tangible artifact, not an abstract description that requires interpretation. Designers, as well as managers, developers, customer and end users, can use these artifacts to envision and to reflect upon the final system".

Prototyping, the process of building a prototype is an integral part of any user experience design process (Dam and Teo, 2020). Prototyping serves several purposes including (1) evaluation and testing; (2) the understanding of user experience, needs, and values; (3) design idea generation; and (4) communication among designers (Lim et al., 2008).

The main steps of prototyping as an iterative design methodology include determine objectives, develop, refine, demonstrate, test and implement (Volchko, 2017). Discussing prototyping as a component of software development methodology, Budde et al. (1984, p. 4) described prototyping as a four-step process including functional selection (what would the prototype exhibit), construction, evaluation and further use (a throw-away prototype or evolved into a final product). In modern Product Service Systems (PSS), where business models are based on the cohesive and collaborative delivery of products and services, Tran and Park (2015) presented an iterative PSS prototyping framework with steps including creation of the prototype after the preliminary design, demonstration of the prototype to the users, active user participation by sending feedback, analysis of the feedback, refinement of the prototype, visualisation of the revised prototype, user evaluation and modification.

The existing prototyping methods to build prototypes provide general guidance. However, prototyping is an integral part of any User Experience (UX) design project (Banarjee, 2014) delivering a variety of products and services across the domains and hence the method varies depending upon the context in which it operates. Prototype fidelity that indicates the extent to which the prototype is similar to the end product, is an important factor to consider the usability testing of the prototype (Zhou and Rau, 2019). Lo-fidelity prototyping is a quick and easy way to convert design concepts into artefacts to collect and analyse feedback in the early stage of design (Esposito, 2018). In medium-fidelity prototyping, a fidelity more than lo-fidelity or paper prototyping is required usually computer representations or mockups (Hartson and Pyla, 2012, p.397). Hi-fidelity prototype is the last line of testing before moving on to the execution of solutions and represent the more realistic picture of the end product (Dam and Siang, 2019).

There are many variants of prototyping approaches such as storyboards based on user narratives (Brajnik and Giachin, 2014; Farra et al., 2016), physical modelling (LEGO, cardboard models, clay models, 3D printing etc.) (Mathias et al., 2019), Wizard of Oz prototyping (Browne, 2019), user-driven prototyping (Dam and Teo, 2019) etc. Here, narrative-driven

prototyping was used to build the personalised prototype, where the design process is driven by user words of mouth or stories (Grimaldi et al., 2013; Spaulding and Faste, 2013).

In this research, the personalised prototype was experimental. In the construction of an experimental prototype, emphasis should be on the intended evaluation, not the long term use (Camburn et al., 2017).

The personalised prototype was used for heuristic evaluation against a set of domain-specific heuristics developed for the personalised systems. The heuristics were built by conducting the literature review of the heuristics/features of the existing personalised systems and analysis of the data collected from the users.

The personalised heuristics and the prototyping approach used to build personalised dashboard are discussed in chapter 5.

3.2.5 Approach to Integrating Multiple Sources

This study used Triangulation as a qualitative research methods strategy, which uses multiple research methods, philosophies and data sources to increase the validity, reliability and legitimation of research (Moon, 2019). Triangulation refers to the use of more than one method to test the validity of the results through the convergence of information from different sources (Carter et al., 2014). The combined use of individual interviews and focus groups have been reported to enhance data richness and contributes to knowledge production and synthesis (Lambert and Loiselle, 2008). Comparing the results from individual interviews and focus groups in a randomised health-care seeking study, Guest et al. (2017) found that individual interviews were more effective than a focus group in generating a list of topics or items in the health-care domain.

Focus groups and individual interviews were used to triangulate, substantiate and cross-check findings. Joslin and Müller (2016) argued that philosophical and methodological triangulation, which refers to the application of several philosophical perspectives, provides for more practice-relevant identification and understanding of phenomena.

In this research, method triangulation was used where more than one research methods – focus group and interviews were used to collect data (Fotheringham, 2010). Triangulation and integration of the data from multiple methods involve identifying themes from the data sources, which are then 'convergence coded' to identify agreement, silence and dissonance between the themes (Adams et al., 2015, pp.95–101).

The data obtained from the triangulation of interviews and focus group methods was used to build personas for the target citizen groups and user's desired system features. These findings were used to develop the personalised prototype to explore how personalisation could be provided. Experiments with the prototype and literature review resulted in a set of e-government personalisation heuristics, see section 3.3.3 providing a tool for development and evaluation of the personalised prototype. Finally, the findings were integrated to provide a method to design personalised e-government systems, see section 3.3.5.

3.3 Research Design

To answer the research question, "How can personalisation be applied to enable e-government service delivery for citizens?", a five-stage research strategy was designed to integrate different components of this study coherently and logically. This research design defines a blueprint for the collection and analysis of data employing suitable research methods. The literature review was performed at the beginning of each stage to provide a solid foundation of knowledge for the methods used at that stage. Figure 3.3.1 provides an overall view of the research design, with subsequent sections providing more detail for each stage.

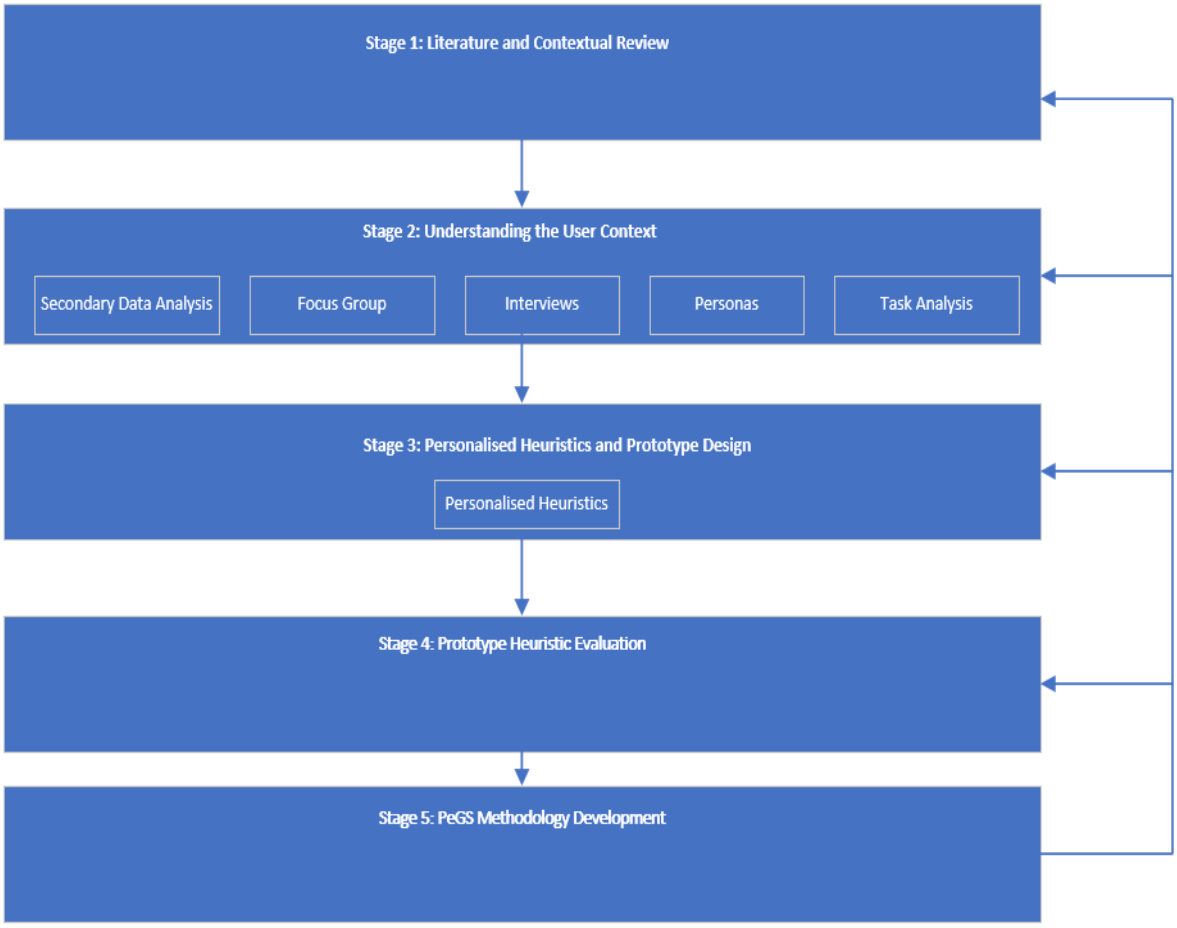


Figure 3.3.1 *Research design diagram*

3.3.1 Stage 1: Literature and Contextual Review

A literature review (chapter 2) was conducted to find existing personalisation techniques, the commonly used design approaches and methods to personalise products and services.

The personalised recommendation techniques such as content-based filtering, collaborative filtering, hybrid filtering etc. (section 2.1) used by commercial websites, could be used to design personalised e-government. However, implementing these techniques could not easily meet the challenges in the design of e-government services such as a range of services provided to the entire population, laws bound services and others explained in section 2.3.

Existing design approaches and methods for personalisation were reviewed (sections 2.4 and 2.5), identifying that existing design approaches and methods could not be easily applied to

e-government nor to meet the challenges in the design of personalised e-government. The literature review highlighted that there was a research gap and paved the way for exploring new approaches to personalise e-government services.

3.3.2 Stage 2: Understanding the User Context

In this stage of the research design process, the goal was to understand users' experiences and expectations from e-government, their perspectives on personalisation and personalised e-government.

Understanding user context was critical to this research because it was required to know if personalising e-government services could meet user requirements. For this purpose, both extensive (data on widespread trends) and intensive (in-depth interpretive data) user data was collected and analysed. Extensive user data was analysed by performing secondary data analysis and intensive user data was collected and analysed using focus group, interviews, task analysis and personas.

3.3.2.1 Secondary Data Analysis

Extensive user data was analysed by performing secondary data analysis of e-government services usage by the users. This research analysed secondary data to explore user behaviour in relation to using local e-government services of Durham County Council (DCC). Secondary data for one year (from 9 September 2014 till 8 September 2015) was provided from the Google analytics account of DCC website in the form of the pageviews report that shows the number of page views. This page views report produced descriptive statistics such as the count and percentage of page views in the selected time period. The page view report was analysed in two different ways aiming to identify the most likely services to be further explored with users and incorporated into the prototype.

The annual pageviews report was analysed to find the list of most commonly used services. Secondly, longitudinal analysis used quarterly pageviews for the year from 9 September 2014

till 8 September 2015. Analysis of the quarterly pageview reports was performed by viewing and relating usage of commonly used services to different factors in that time period. The most commonly used services and factors affecting their use were used to personalise the related services. Findings are presented in section 4.2.

3.3.2.2 Exploratory Focus Group

Intensive data was collected by conducting an exploratory focus group to explore citizens' expectations, pain points, experience with the use of existing public e-services and their perspective on personalising these services.

Focus group participants were selected from a volunteer group of UK citizens who were residents of County Durham, who used local public e-services and therefore could describe their experience with these services. Participants were invited by email explaining the purpose of the activity. The invitation email and a supporting document sent to the prospective participants explaining the purpose of the focus group is given in 'Appendix G: Focus Group Invitation Email'. A meeting room with a display monitor and a portable flipchart stand was booked for an hour. As recommended by Roller and Lavrakas (2015), participants were sat face-to-face around a table for effective group discussion.

Open-ended questions listed in Table 3.3.2.2.1 were designed to explore themes related to the User Centred Design approach to personalise e-government services, as identified in the literature review (see section 2.4.1) such as previous user interaction, pain points, expectations and their perspective on personalising e-government. The follow-up questions asked were related to the same themes.

The focus group session began with a brief introduction to this research study including a presentation covering e-government, uses of personalisation in e-commerce, personalisation techniques and ideally how personalisation could be applied in local e-government to improve the delivery of e-services. Participants were encouraged to openly discuss their experience with e-government, and they were told that the data collected from the focus group would be anonymously used in this research study. Participants were asked about their

previous interaction with the e-government, what went well, what did not go well and how could those services be improved.

Question theme	Question
User previous interaction with e-government	What council (Local Authority) public e-services have you used?
User experience and pain points in using e-government services	Did you have any issues using those services?
User expectations from e-government	Can you make any suggestions to further improve those services?
User perspective on personalising e-government	Do you think a personalised version (if any) of those services would improve the service delivery?

Table 3.3.2.2.1 *Focus group questionnaire and themes*

The focus group discussion was audio recorded in a smart mobile phone device for detailed analysis and transcribed. See 'Appendix B: Focus Group Discussion' for the transcribed data. A set of preconceived themes and the related questions (Table 3.3.2.2.1) were developed and the data analysis was performed with these themes in mind. The audio recording was listened to carefully and transcribed discussions were thoroughly read a few times to familiarise with the users' responses. The user statements relevant to this research themes were colour highlighted and coded by giving them meaningful names. The related codes were then grouped into themes. The themes were then further reviewed to make sure they represent the right data. Finally, the themes were defined and named into focused and non-overlapping themes before generating the report.

Data from the focus group provided input to the design and build features of personalised prototype as discussed in section 3.3.3. Results of the focus group conducted with residents of County Durham are given in section 4.3.

3.3.2.3 Interviews

To collect users' requirements and build their personas, semi-structured interviews were conducted with the citizens from the volunteer group invited for the focus group but those who were not involved in the focus group. An interview invitation email was sent to the participants as shown in the 'Appendix H: Interview Invitation Sample Email'. Like the focus group, interviews explored user experience and expectations from e-government. Therefore, interview data was used to triangulate, substantiate and cross-check the findings from the focus group.

The open-ended questionnaire listed in Table 3.3.2.3.1 was designed to explore themes related to User Centred Design approach and personas (section 3.2.3) such as user demographics/technology awareness, service usage behaviour etc. The follow-up questions asked were related to the same themes.

Question theme	**Question**
Personal information such as demographics and technology awareness	Would you specify your age, qualification, employment status and technical/e-government savviness?
User previous service usage behaviour	What council (Local Authority) public e-services have you used?
User goals and objectives	Why have you chosen to use e-government services?
User experience and pain points in using e-government services	Did you have any issues using e-government services?
User expectations from e-government	Can you make any suggestions to further improve those services?

Table 3.3.2.3.1 *Interviews questionnaire and themes*

Each interview began with a brief personal introduction followed by an introduction to this research study. Participants were encouraged to openly discuss their experience with e-government and told that the data collected from the interviews would be anonymously used

in this research study. Participants were asked about their previous interaction with e-government, what went well, what did not go well and how could those services be improved.

The interviews data were transcribed. See "Appendix C: Data Collected from Interviews' Participants" for the summary of interviews data. Thematic analysis of the interviews data was performed as for focus group above. Results from the interviews are given in section 4.4.

3.3.2.4 Personas

A four-step method was used to build personas as suggested by Google Developers (2018).

1. **Understanding the product:** Understanding of the product is required to collect data from the customers in relation to using that product. In the context of this study, the author of this thesis already had the basic knowledge of the Durham County Council website and public e-services gained by working for the council.

2. **Understand the customers:** This step determined who the target users were and what information was needed about users to build personas. Typical customer segments in Durham are working adults with children and students; thus, personas were built for these user groups. The information needed to build personas included demographics, user goals and objectives, services usage behaviour and pain points.

3. **User data collection and analysis:** The data required to build personas were collected and analysed using interviews method as discussed in the previous section.

4. **Illustrate personas:** In this step, personas were presented in a well-defined template built by customer experience and UX design agency Telepathy (Summers, 2014). Personas built for working adults with children and students are illustrated in Figure 4.5.4.1 and Figure 4.5.4.2 respectively.

Further details about the personas built in this study are in section 4.5.

3.3.2.5 Task Analysis

In this study, Hierarchical Task Analysis (HTA) was used as a technique to understand what tasks were required by the users to make a public e-service request, automate tasks where possible and to map those tasks to interface design elements. There is no standard approach, the existing studies have used similar steps to perform task analysis including task identification, information gathering about the task, task decomposition, apply notations and HTA validation (Maguire et al., 1998, p.121; TaskArchitect, 2017; Usability Body of Knowledge, 2012). Here, an eight-step HTA method was used to conduct task analysis.

1. **Select a task:** A task or service was selected for HTA from the commonly used services (section 4.2).

2. **Gather task information:** Gathering task information usually requires understanding the existing task/service and discussion with the service stakeholders; however, in the context of this study, tasks were well known to the author who was involved in the development of the service selected for HTA.

3. **Decompose task into subtasks and find tasks relationships:** Once enough information was collected in the previous step, the task was decomposed into subtasks and their relationships determined. Task decomposition involves decomposing a higher-level task to low-level subtasks between 4 and 8 (Usability Body of Knowledge, 2012). Relationships between tasks here refer to the dependency among tasks such as before-after tasks required to complete the main task.

4. **Draw HTA diagrams:** HTA notations were applied to represent tasks, subtasks at various levels, flow of information between tasks, decision points and other third-party systems/data sources required to accomplish the task. The HTA diagram was drawn (Figure 4.6.1.1) to represent tasks after performing task optimisation, automation and personalisation as discussed in the next step.

5. **Task optimisation and automation:** After the HTA of current user activities, the flair of task analysis was done to optimise, automate and hence improve user tasks. In this step, user and system tasks were identified and distinguished. User tasks that required input from the users were converted to system tasks where possible. This makes the task easier to perform by the user. Unnecessary tasks were removed, and new tasks added. For task personalisation, user information from direct user input was replaced by information from the user profile database.

6. **Task-based segmentation:** In this step, various user segments were derived, for which tasks could be personalised. This study found that decision points in the HTA (step 4) enable user segments to be derived and tasks adapted for the derived user segments. Here, this approach of deriving user segment from task analysis, task-based user segmentation approach is further explained in section 4.6.2.

7. **Validate HTA:** This step requires HTA validation by further discussion with the stakeholders including business analysts and other informants to explore design flaws and fix any issues. Here, the HTA was thoroughly self-reviewed to make sure the task automation and task-based segmentation were valid and would inform the design of personalised service.

8. **Use HTA as design input:** Finally, the HTA was used as a crucial input to the design of the personalised services (section 5.4).

The Task Analysis and the Personas were used to support the design of the prototype, as discussed in the next section.

3.3.3 Stage 3: Personalised Heuristics and Prototype design

The most common objective of prototyping is to explore and test new design concepts (Hertel and Dittmar, 2017). In the context of this study, the main objective was to develop an

experimental prototype of a personalised e-government system that would adapt and display the services that target users would be most likely to use.

A narrative-driven design approach to prototyping was used to build a personalised e-government prototype with the following steps.

1. **Set prototype objectives:** In this first step, the objectives of personalised prototype in the design process are determined. Various objectives of the prototype include obtaining user feedback early in the design process (Deininger et al., 2017), refinement of new design concepts (Camburn et al., 2017), source of communication across the team (Berglund and Leifer, 2013) etc.

2. **Build design narratives:** The narrative here refers to the user story related to user experience, interaction with the system, system quality etc. In the design process, the use of narratives may not only convey the story of the stakeholders to interact with the system but also the feel, qualities, provenance of the system and understanding of system users (Childs et al., 2013). The data collected from users in the focus group and interviews were in the form of user narratives i.e. their stories of interaction with the system. In these narratives, users explicitly stated their experience with the e-government system including their value propositions, which contains user statements about user's desired features most valued to the users. During the data analysis of user narratives, value propositions were highlighted and used to build design concepts for the prototype. Further details of how the narratives were built for the personalised Durham County Council prototype are given in section 5.3.

3. **Build design concepts:** Basic design concepts were created for the personalised prototype through reviewing existing most popular personalised systems such as Amazon, My Yahoo and local government personalised examples. Review of the personalised system architecture and recommendation techniques (see section 2.1) helped to generate design ideas about the adaptations for the target users. Using the task analysis of the most commonly used public e-services, personalised interaction dialogues were developed. See section 5.4 for details.

4. **Visualise design concepts by medium-fidelity prototyping:** After generating design concepts, mockups were created to describe how the target user interacts with the interface to make a service request and how the system adapts for that target user. Mockups are medium-fidelity screens produced on mockup creation tools that help make design ideas concrete and demonstrate system or product features in an abstract or high-level way (Camburn et al., 2017).

   The medium-fidelity mockups for the personalised e-government portal are provided in section 5.5.

5. **Build hi-fidelity prototype:** Finally, the medium-fidelity mockups created in the previous section guided the creation of an interactive hi-fidelity interactive personalised prototype using tools and languages such as Visual Studio 2017 enterprise edition, HTML, CSS, C# and SQL Server database. See section 5.6 for details.

The personalised prototype was used for heuristic evaluation against a set of domain-specific heuristics developed for the personalised e-government systems discussed in the next section.

3.3.3.1 Personalised Heuristics

To assess the prototype, guidance and advice in the literature for personalised systems were reviewed along with data collected from the users, and a set of heuristics for e-government personalised systems was developed. This aimed both to guide the design of the prototype and to provide a means of evaluation.

The widely used 10 Nielson's heuristics originally developed by Jakob Nielson and Rolf Molich (Molich and Nielsen, 1990) provide general usability guidelines to improve usability and user interaction, they do not provide specific features of specific applications such as adaptability, learnability and playability (Quiñones et al., 2018). Although domain-specific heuristics for personalised systems are discussed in some form in the existing literature, an aggregate list was not found by this study.

To facilitate the process of personalised prototype building and evaluation, it was planned to develop a list of features (heuristics) for the personalised systems. Several methodologies to build domain-specific heuristics (Hermawati and Lawson, 2016; Lechner et al., 2013; Nielsen and Molich, 1990; Quiñones et al., 2018; Rusu et al., 2011) were reviewed. Based on the reviewed methods, the method used to develop personalised e-government heuristics has the following steps:

1- As with Rusu et al. (2011), Quiñones et al. (2018) and Molich and Nielsen (1990), a literature review was undertaken to identify heuristics in the research and practitioner communities to find usability/UX features and existing usability heuristics for personalised applications.

2- Following Lechner et al. (2013) and Somervell et al. (2003), users were integrated into the process. User desired system features specific to a personalised system were explored and elicited aiming to identify potential new heuristics through users highlighting the system features important for them.

3- Results from steps 1 & 2 i.e. the usability features (heuristics) and the user's desired system features were compared. Duplicated features were merged. Following Quiñones et al. (2018) [Selection stage], the features with no match were further explored, both in the literature and through discussions with users and experts. The most appropriate features were then converted to new heuristics.

4- As in Rusu et al. (2011) [Explicative Stage] and Quiñones et al. (2018) [Selection Stage & Specification Stage], the heuristics from step 3 were further refined and specified into a template. The template gave each heuristic a meaningful name, described the purpose of each heuristic and explained how that heuristic was linked to e-government personalisation.

5- Although no formal validation and refinement of personalised heuristics were performed as suggested by Rusu et al. (2011) and Quiñones et al. (2018) [Validation stage & Refinement Stage] due to time constraints, the heuristics were used as a

checklist to evaluate the prototype. During the heuristic evaluation of the personalised prototype, experts' feedback was positive. This study, however, strongly recommends performing further validation and refinement of the personalised heuristics.

The personalised heuristics developed by this study are further discussed in section 5.2. They were also used for the heuristic evaluation as detailed in the next section.

3.3.4 Stage 4: Prototype Heuristic Evaluation

The Durham County Council (DCC) personalised prototype built in the previous stage was evaluated in this stage. Initially, it was planned to perform a comparative evaluation of personalised and non-personalised versions of the prototype with end users. However, after a first few test cases, it was realised that the personalised system changed state for each user and comparative evaluation could not always produce valid results. Therefore, it was decided to evaluate the DCC personalised prototype with experts using heuristic evaluation. The heuristic evaluation used in this study had the following steps:

1. **Produce a list of heuristics:** In the first step, a list of heuristics was developed to evaluate the personalised prototype. A majority of the existing heuristic evaluation studies used Nielsen's usability heuristics (Nielsen, 1994; Nielsen and Molich, 1990). However, Nielsen's heuristics and other traditional usability heuristics such as those built by Jill Gerhardt-Powals' cognitive engineering principles (Ballav, 2017) or Shneiderman's Eight Golden Rules of Interface Design (Atkinson et al., 2007) do not specify the core features of personalised systems. Therefore, a new set of heuristics were developed for the personalised systems as detailed in section 5.2.

2. **Define the scope of evaluation:** This step defined the scope of the evaluation, which figured out what parts of the application needs to be evaluated (Koh, 2016). Unlike user testing, the responsibility of analysing the interface is with the evaluator in the heuristic evaluation session. However, if the evaluators are naive within the domain

then guidance should be provided to the evaluators (Nielsen, 1994). This research defined a set of task usage scenarios for the evaluators to make sure they understand what parts of the personalised dashboard need to be evaluated. See 'Appendix D: Sample Heuristic Evaluation Document' for the task scenarios.

3. **Select evaluators:** Once the scope of the evaluation process was defined and task scenarios finalised, the evaluators were selected. Nielson recommends using 3 to 5 evaluators for more optimistic evaluation results (Nielsen, 1994).

   Performing heuristic evaluation by evaluators from the same team might not produce the desired outcome and the results may be biased (Fontanella, 2019). Experts, who have knowledge about specific customer needs such as UX (user experience) experts or Human Computer Interaction (HCI) experts might be the best candidates for heuristic evaluation.

   Therefore, evaluators with a varied skill set were selected with expertise in HCI/UX design including a senior software consultant, PhD and Master students. One evaluator was involved in the test heuristic evaluation session as explained in the next step and the rest of the evaluators were involved in the main heuristic evaluation session.

4. **Test heuristic evaluation and briefing session:** Initially, a test heuristic evaluation exercise of the personalised dashboard was performed in this step with a software consultant who had over ten years' experience. A comprehensive document was prepared including instructions about the task scenarios (step 2) and some open-ended questionnaire covering the compatibility of the personalised heuristics with the interface inspected. See 'Appendix D: Sample Heuristic Evaluation Document' for details.

   Evaluators were briefed about the details of the personalised heuristics and the personalised prototype to facilitate the heuristic evaluation.

5. **Conduct heuristic evaluation:** In this step, evaluators went through the system and performed an evaluation against the list of heuristics. Evaluators were instructed to

provide open feedback about the heuristics not covered by the task scenarios only because scenarios were simply provided to guide the evaluators through the evaluation process. The prototype was hosted on the internet to provide remote and easy access. Even though the evaluation was designed to take one to two hours, the evaluators were told to provide feedback within ample time of three weeks.

6. **Analysis of the feedback and debriefing session:** After the heuristic evaluation was completed, the feedback data from all the evaluators were analysed. Thematic analysis of the feedback data was performed as for other qualitative data (section 3.3.2.2) by analysing data against each heuristic.

   As this was an exploratory prototype, no debriefing was held as individual responses were aggregated during analysis.

3.3.5 Stage 5: PeGS Methodology Development

As identified in the literature review (section 2.5), there is a lack of methodologies for personalising e-government systems. In developing a new methodology, design approaches and methods that were developed and applied within this doctoral research to understand how e-government systems should be personalised for users were integrated. The activities performed at each stage encompassing design methods were mapped into a series of steps transformed into a new design method called PeGS (Personalisation of eGovernment Services).

The following steps were used to develop PeGS including Method Requirements, Literature Review & Method Selection, Method Review and Refinement, Draft or Initial Personalisation Method, Methodology Application & Refinement and Validation.

1- In this step, requirements for the PeGS method were defined including goals and basic conditions regarding the development of this method. Personalisation provides a technology toolbox of features to tailor content and services for the users but would personalisation provides any value to the end users? (Van Velsen, 2011). To answer

this question and considering the challenges in the design of e-government (section 2.3) which adds further complexity to the design of e-government, it was planned to seek a design method to personalise e-government with the involvement of end users and focus on user tasks.

2- As suggested by Küpper et al. (2018) and Carroll et al. (2013) approaches to build a new method, the existing literature was reviewed to find the "best fit" UCD design approaches and methods which had previously been used to personalise public and commercial services. The "best fit" design methods here refer to the methods which could meet the challenges in the design of e-government (section 2.3), offer citizens participation, user segmentation and profiling, focus on tasks, prototyping and/or evaluation in the design process.

3- In this step, a draft of the design methodology was selected by integrating the "best fit" stages and methods of the design approaches reviewed in the previous step. The "best fit" stages refer to those stages which fit the goals of the PeGS method. For example, 'User and services research' stage was selected to ensure citizen participation and focus on tasks.

4- Following Veiseth et al. (2011) and Adesola and Baines (2005) approach to build a new method, the draft methodology developed in the previous step was then applied practically to design personalised e-government services of Durham County Council. The steps and methods used in the methodology were amended and adjusted during this practical exercise to best fit the needs of stakeholders and achieve the goals of this research.

5- Finally, the draft design methodology was refined into the final draft.

6- Unlike Adesola and Baines (2005) who suggest performing initial validation of the new method with experts to get their opinions about the new method soon after the draft version is developed. Here, the validation was performed after the final draft was

developed. Early validation approach was not used because the draft method was never used and tested.

After the final draft of the PeGS method, a document was written explaining each step of the PeGS in detail followed by open-ended questionnaire about various steps and methods used at these steps. An example case study was included demonstrating how each step of the PeGS was used to design personalised prototype of Durham County Council public e-services.

The PeGS document was tested with a couple of experts to make sure they understand the PeGS and the questionnaire. The document was amended, simplified and improved based on the feedback from the test cases.

It was planned to validate the PeGS method using a Delphi study, which involves collecting experts' opinions in multiple rounds (2 or more) till a consensus is built (Behmann et al., 2012; Dreesen et al., 2013; Hsu and Sandford, 2007). Delphi was selected as it provides structured group communication to gather a consensus of expert opinions in the face of uncertain outcomes and lead to more accurate forecasts than unstructured approaches when used as a forecasting tool (Grime and Wright, 2016). However, although a number of experts were invited, there was little take-up and an alternative method to validate the PeGS method was selected. See 'Appendix E: Invitation email to Participate in Delphi Study' for the invitation email sent.

Individual interviews with experts were selected to validate the PeGS method. The experts were Durham County Council staff, who had experience with designing and supporting public e-services and those who were able to implement such a methodology. Semi-structured interviews were conducted aiming to get expert feedback regarding its usefulness and limitations in the context of e-government.

Before the experts' interviews, a detailed PeGS document was emailed to each participant including an open-ended questionnaire about the PeGS' various steps and techniques. See 'Appendix F: PeGS (Personalisation of eGovernment Services) Validation Document' for the PeGS document sent to the experts for validation.

Thematic analysis of the experts' interviews data was performed as for other qualitative data (section 3.3.2.2).

Further details of the PeGS validation are given in section 7.3.

3.4 Ethics and Consent

Ethics approval was granted by the University of Sunderland Ethics board. All participants gave informed consent.

3.5 Summary

This chapter argued that pragmatism is the philosophical position of this research, which is focused on the inquiry of the research or research question. Unlike other research paradigms such as positivist paradigm which only accepts the objective reality in this world or constructivist paradigm based on the subjective perceptions of the research participants, the pragmatic approach mostly uses multimethod or mixed methods research approach to effectively answer the research question in the research context.

With the pragmatic position, this research used qualitative research methods along with user-centred approaches including prototyping and heuristics. The research methods used were explained in the context of local e-government. A five-stage research design process was followed, which guided this research to effectively use various methods and approaches to implement personalisation in e-government. Each stage discussed how the research activities were performed and the methods used for the effective outcome.

The following chapters discuss the results of the methods and techniques used at various stages of the research design discussed in this chapter to personalise e-government.

4 UNDERSTANDING THE USER CONTEXT: RESULTS FROM STAGE 2

This chapter presents the results from the methods used in Stage 2 'Understanding the User Context' of the research design as explained in section 3.3.2. These results provide user and system requirements, which is key information to answer the research question, "How can personalisation be applied to enable e-government service delivery for citizens?". This chapter contains the following main sections.

4.1 Introduction - User research in eGovernment Context: This section presents a brief introduction to the user research methods and the context in which user research was carried out.

4.2 Google Analytics: Secondary Data Analysis: This section explains how Google Analytics data of the Durham County Council (DCC) website was analysed and results derived. This section explores the usage of e-government services in date/time context and concludes that e-government services can be personalised based on various service usage factors.

4.3 Citizen's Focus Group: This section presents a detailed overview of the focus group conducted with the UK citizens and their perspective of personalising e-government services. This section concludes that user satisfaction can be achieved by personalising e-government services and highlights the user's desired features to improve system design.

4.4 Citizens' Interviews: Results: This section briefly reviews the data collected from the interviews' participants and how the data was used to build user personas encompassing user behaviour, goals and objectives and pain points for the target users.

4.5 Personas: This section discusses the use of personas as a user participation tool and its importance in user modelling for a personalised system. The steps to create citizen persona are explained. This section concludes that personas provide key information to create user profiles and adapt the system to display services users would be most likely to use in the personalised system.

4.6 Task Analysis of eGovernment Services: This section presents an overview of the task analysis and its importance in the design of e-government services. The steps required to perform Hierarchical Task Analysis (HTA) including task optimisation and automation are also discussed. The application of HTA using an example case of Garden Waste Collection Service is demonstrated with the task-based segmentation technique derived from the HTA is also explained.

4.1 Introduction - User research in eGovernment Context

User research is indispensable for designing a system. According to Robert Schumacher (2010, p. 6; cited in Sauro and Lewis, 2012, p.10), "User research is the systematic study of the goals, needs and capabilities of users so as to specify design, construction or improvement of tools to benefit how users work and live".

System design is for real people in the real world. There are various ways to conduct user research including direct communication with users (interviews, focus group, surveys etc.), investigation of what users do (observation, video ethnography etc.) and combination of both (applied ethnography, contextual enquiry etc.) (Daae and Boks, 2015). The customer data privacy regulations may pose challenges to directly observe user interaction with e-government services. Therefore, direct communication methods were used in this research. Not only was the Google analytics data used but also direct communication methods were used to collect data. The Google analytics data was used as a starting point for additional user research (Hay, 2017).

The methods used for user research are detailed in section 3.3.2. The findings from Google Analytics, focus group, interviews, building personas and task analysis methods as detailed below were used to gain a better understanding of Durham County Council (DCC)'s e-government user needs and experiences.

4.2 Google Analytics: Secondary Data Analysis

To explore citizens usage of Durham County Council (DCC) web services/information, the

yearly pageviews report from Google Analytics account of Durham County Council (DCC) website was analysed from 9 September 2014 till 8 September 2015. Table 4.2.1 shows the top ten commonly used services published on the web pages from the yearly Google Analytics pageviews report. Services to personalise can be selected from the list of commonly used services.

As discussed in section 3.3.2.1, pageview is defined as a view of a page of the website when that page is loaded in the browser. Google Analytics pageviews report provides the number of web page views by the users in a selected time period.

Service/Information	**Page views** % of total:100% (11,205,175)
Current council jobs and apprenticeships	10.18%
Planning permission	1.53%
My services e.g. political representatives (Councillor, MP), bin collection dates, nearest libraries, schools, leisure centres, etc.	1.39%
Website search	1.30%
Recycling	1.29%
Enquiries (How to contact council)	1.27%
Bin collections	1.18%
School holidays	1.11%
Council tax	1.05%
Garden waste	0.97%

Table 4.2.1 *Google Analytics pageviews report of DCC website*

With the list of commonly used services, it was planned to find the factors behind the use of these services. To achieve this, the longitudinal analysis of the quarterly pageviews data for the year from 09 September 2014 till 08 September 2015 was performed. The longitudinal analysis of the quarterly data for the selected year listed in Table 4.2.2 revealed that the most popular services used by the citizens change with seasons, incidents or important events. For example, viewing Google Analytics data from 11 March 2015 till 10 June 2015 explored that most citizens subscribed to the Garden Waste Collection Service (2.19% of 2,947,022 total page views) and was among the top ten most used service. Garden Waste Collection Service

(GWCS) is a seasonal service and usually runs in the summer from April to November every year in County Durham.

Quarter dates	Services (mostly used)	Page views	Usage factors
09 September 2014 till 09 December 2014	Guy Fawkes bonfire night and fireworks information page	1.01 % of 2,447,559 total page views	Date/time context (Guy Fawkes night observed on 5 November every year)
10 December 2014 till 10 March 2015	Weather station cameras, School closures	1.59%, 1.3% of 2,895,975 total page views	Adverse weather conditions during winter season such as snow, rain and fog
11 March 2015 till 10 June 2015	Planning permission, Garden Waste Collection Service (GWCS)	2.19% of 2,947,022 total page views	Spring season most suitable for construction and renovation, subscriptions for the GWCS for the summer season
11 June 2015 till 08 September 2015	Durham city traffic cameras	2.22% of 2,328,090 of total page views	Major road works and traffic conditions around Durham City during that time period

Table 4.2.2 *Quarterly data of Durham County Council services pageviews from Google Analytics with possible reasons for services usage*

From the Google Analytics findings in Table 4.2.2, it seems likely that the usage factors can be used to filter and display services for the users providing personalisation opportunities. For example, services related to seasons and events at fixed dates could be presented for certain time periods between those dates and made available to the public for easy access. Services related to unexpected incidents such as climate change effects could be customised and displayed for the public as soon as the incident occurs. The services usage data also provided examples of regularly used services with personalisation opportunities based on date/time of the occurrence of those services.

Based on these findings from Google Analytics, this study developed an e-government service ontology graph which classifies the services based on their usage factors and, models the relationship between services and citizen. This is as shown in Figure 4.2.1. Ovals in the e-government ontology graph represent services, citizen and their attributes. The concepts from the e-government ontology need further development and improvement, which could be used to personalise e-government services for the citizens. For example, seasonal services

can be displayed during that specific season for the citizen. This is demonstrated in the personalised prototype by building a services adaptation screen displaying winter services for a fictitious 'David' user persona (target user group) in section 5.6.2.

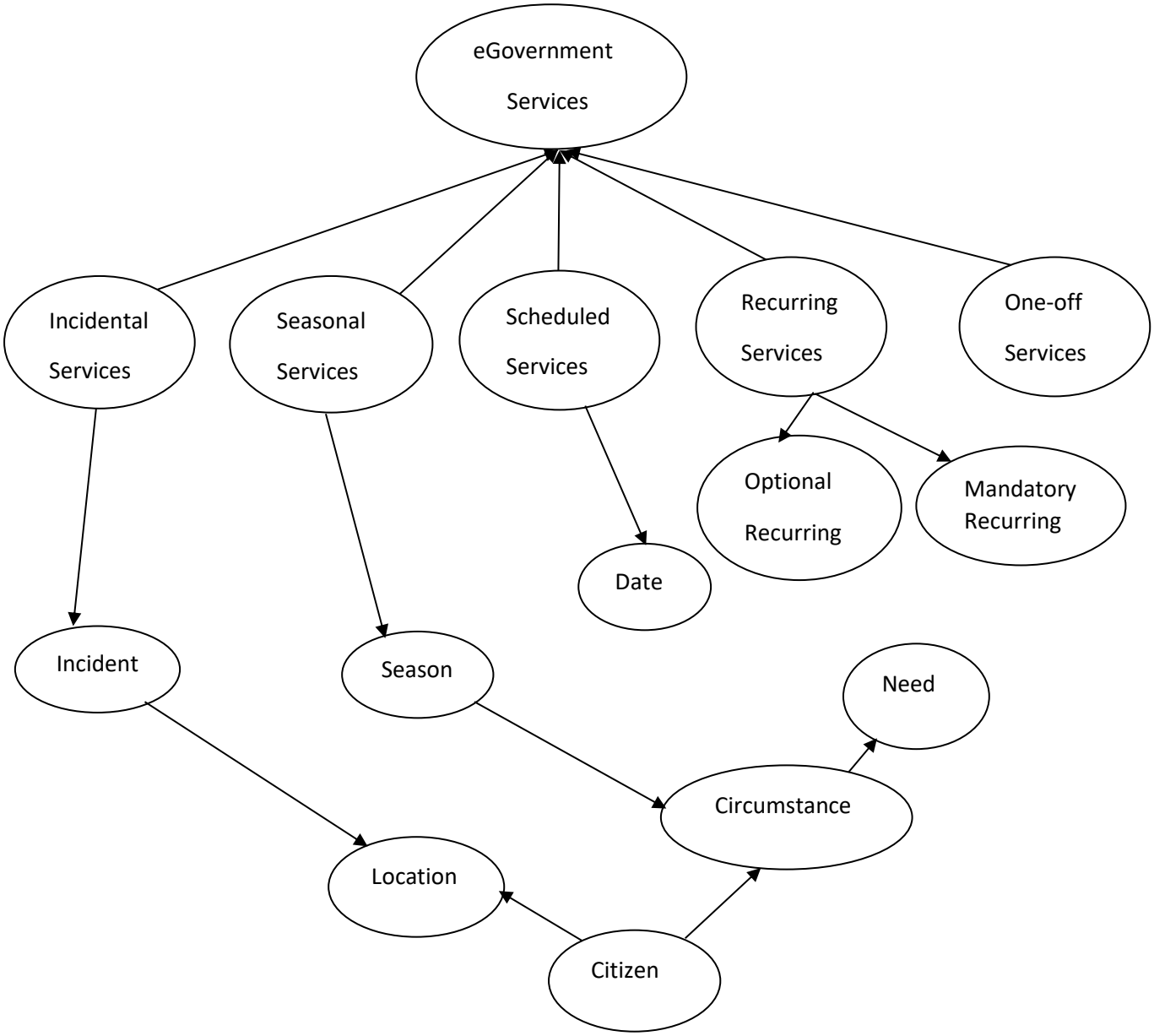


Figure 4.2.1 *Durham County Council e-government service ontology graph for citizen interaction*

4.3 Citizen's Focus Group

Following the method in section 3.3.2.2, a focus group was conducted with the UK citizens mostly residents from County Durham to gather requirements from the participants and find their views on personalisation. The purpose of the focus group was to:

1. Explore user experience with the local e-government services that citizens used in the past
2. Gain insights into users' views about the existing e-government service delivery
3. Find users' perspectives on personalised e-government service delivery

Five citizens mainly residents of County Durham attended the focus group including four men and a woman. Participants in the focus group shared the following attributes:

Age group: 25-55, **Employment status:** employed, **Gender:** any, **Computer users:** yes, **Education:** qualified to a degree level

Considering the age group, participants of the focus group represent a large citizens group of County Durham citizens as revealed by Office for National Statistics (ONS) in sub-national population estimates for County Durham in 2018, which reported that people in the age group 16-64 years were 62.2% of the total population of 526,980 (Durham County Council, 2019). The same target users with the high level of education tend to use the Internet daily and hence potential to use e-government as reflected from the findings in Eurostat ICT Survey, where 93% of those EU users who used the Internet every day had a high level of education (Seybert and Reinecke, 2013).

All five participants were actively engaged in the focus group discussion as transcribed in 'Appendix B: Focus Group Discussion'. The results from the focus group are explained in the next section.

4.3.1 Focus Group: Results

Thematic analysis of the focus group data revealed two major categories including a citizens' perspective on personalisation and their expectations from e-government services.

Participants' perspectives and views on personalisation resulted in four themes, summarized as follows.

1. **Users' perspective on personalisation:** Overall participants found the idea of personalisation attractive, with the view that it should be used to make interaction easier and faster. The participants perceived that personalisation could improve user satisfaction.

2. **Utility:** Tailoring tasks to fit user characteristics for example, in relation to a user postcode (e.g. for bin collection schedules), family situation (e.g. where your children go to school), payment choices (e.g. alerts for Council Tax) and not asking for unnecessary details or information, should already be stored.

3. **User input reduction:** All the participants highlighted the need for e-government services to remember and know things about citizens. Standard information such as date of birth, address, dependents, etc. should be available across services and users should have to engage with minimal data entry.

4. **Customisation:** All the participants saw the benefits of customisable dashboards enabling them to structure the personalised e-government space as appropriate to them. Whilst participants agreed that for many people similar customisation would be effective, the possibility of user customisation was seen as important, so that each individual had some control over the display.

The analysis revealed a set of user expectations that need to be considered in delivering personalised e-government services. Main user expectations identified in the focus group were:

1. **Single entry of information required for transactional series:** Whilst most sectors seem to have understood the need for information storage, this isn't always seen in e-government services and is desired in e-government.

This was revealed by two participants of the focus group, who proposed the reuse of information for any subsequent transactional e-government services. One participant quoted, “It would have been better for the website to record the information required for my school meal transaction instead of entering the same information about school and my children every month before making the payment”. Supporting this, another participant said, “I pay for my child music tuition fee every month and enter the same information repeatedly”.

2. **Reminder alerts for repeat users:** This is a typical facility offered by e-commerce, and citizens expect the same level of service in e-government services. One participant explained his regular use of household bin collection service by saying, “I am not good in remembering the collection turn for household waste and recycling bins and check the collection type almost every week on the council website”. Another participant, who preferred setting up personalised reminder alerts for the use of recurring service said, “I have set up reminder alerts for my bin collections in my Microsoft Outlook calendar”.

3. **Tracking of engagement with the council:** This feature is considered essential by users and reflects the tracking potential now provided by suppliers such as the supermarkets and Amazon so that users know the status of their enquiry. One of the participants, who has been actively engaged with e-government indicated, “In most cases, where I reported faulty streetlights, traffic lights and fly-tipping; I had to ring the council to chase the progress of my service request with the council”. Telling the story of her reported missed recycling bin, another participant revealed, “I reported missed recycling bin to the council and did not receive a reply within 3 days. Finally, I rang the customer services department of the council to find about my missed bin collection”. This suggested a need for enquiry status tracking of service requests.

4. **Easy location for regular services:** This relates to the provision of regular services to the top of the personalised area or dashboard and thus in an easier to locate position for the users. The existence of a personalised portal for the use of more regular

services was preferred as indicated by one participant, “the website should provide easy access to the services that people most frequently use.”

Personalised service delivery has the ability to present users with the tailored services that fit user needs and hence achieve a high level of user satisfaction. This is particularly true for services that users most regularly use. Ideally, personalisation based on citizen profiles would eliminate most of the issues indicated by the participants of the focus group. A user profile would store user information, which can be reused to personalise certain services that require that information. On a personalised portal, each service request submitted by a user can be easily tracked and personalised reminder alerts can easily be set up.

To collect requirements of the target user groups and build their personas, individual interviews were conducted. With some common themes, the interviews were also used to validate and triangulate the results from the focus group. The next two sections present results from the interviews and personas.

4.4 Citizens’ Interviews: Results

Following the method in section 3.3.2.3, individual interviews were conducted with 12 adult users (7 male and 5 female users), who were mainly residents of County Durham. A summary of the data collected from the interviews’ participants is provided in “Appendix C: Data Collected from Interviews’ Participants”.

Thematic analysis of the interview data resulted in the generation of five categories including demographics and technology awareness, user behaviour (what services users use), goals/objectives (what motivates users to use these services), user expectations and pain points in relation to using local public e-services. User demographics and service usage behaviour data were further analysed. It was found that participants with families & children (6 out of 12) and those studying (4 out of 12) tend to use similar services within each group. Analysis of the data collected from the interviews’ participants in relation to user behaviour patterns based on their use of public e-services of Durham County Council formed two target user groups including ‘Working adult with children’ and ‘Adult student’. The interviews

resultant themes against the target user groups are listed in Table 4.4.1. Personas were built for these target user groups as discussed in the next section.

The interviews' themes of user expectations and paint points were found similar to the ones revealed by the focus group. This was proved by cross-checking and hence the interviews further triangulated and validated results from the focus group.

Theme	**Explanation of theme**	**Examples from results for user groups** **A:** Working adult with children **B:** Adult student
Demographics and technology awareness	Technical and other attributes relating to the structure of the participants	**A**: age 30-50 years, Employed, Technology savvy, Social media users, family with children
		B: age 20-30 years, Student, Technology savvy, Social media users No children
User behaviour	The previous public e-services used by the users	**A:** Children & family, Waste collection, Roads & Streets and Environmental public e-services
		B: Student finance, Council tax discount, Health & wellbeing, local events and career opportunities related services
Goals/objectives	Why users used public e-services? (motivations to use services)	**A:** Interactive services, Online 24/7 availability, Minimum service input, Easy location of services
		B: User-friendly, smart devices friendly, easy to access and competitive services
Pain points	Issues experienced using public e-services	**A:** Can't keep track of submitted service requests, lack of information reuse, Service not easy to find
		B: Cluttered information, Not mobile friendly interface
User expectations	What users want from e-government?	**A:** Keep track of service request progress, easy to find the location of services, Information reuse
		B: Easy to access information, responsive services

Table 4.4.1 *Interviews resultant themes for the 'Working adult with children' and 'Adult student' target user groups*

4.5 Personas

In this research, the personas provided important information to design service adaptations for the personalised e-government prototype as discussed in section 5.6.2. These personas were also to be used to evaluate the personalised prototype, see 'Appendix D: Sample Heuristic Evaluation Document' for details.

Following a four-step method (Google Developers, 2018) as briefly described in section 3.3.2.4, user personas were built to encompass user needs, goals, expectations and behaviour of the residents of Durham County in relation to using DCC e-government services. Further details of these steps are as follows.

4.5.1 Step1: Understanding the Product

In the context of this study, the product was the Durham County Council web portal with public e-services published. Understanding the product requires knowledge of the product gained by personal experience or discussion with the back-office staff, customer support and other stakeholders. Here, the personal experience helped to understand the product.

Although e-government services are fundamentally different from each other, there are commonalities in the flow of information through each service. For example, if customers use a web form to submit a service request then the information is received by the concerned back office staff for further processing. Information about the related services is linked and grouped on the web portal.

4.5.2 Step 2: Understand the Customers

eGovernment serves a large base of users (citizens) including children, adults and senior citizens. Unlike e-commerce which can focus on a single target user segment of buyers, e-government must take all the citizens into account (Van Velsen et al., 2009).

User groups such as citizens with special needs, senior citizens and adults were considered for creating personas. User participation of citizens with special needs and senior citizens in the design process was challenging. Some of the challenges include assessing the accessibility guidelines to make websites accessible for the people with disabilities (Caldwell et al., 2008) and understanding their use of special equipment such as screen readers, challenges in the usability requirements for senior citizens (Kane, 2019) etc. Therefore, the decision was made to focus on adults. The adults target group represents a large portion of the County Durham population as discussed at the beginning of section 4.3. The next section explains how data was collected and personas were built for the adult user group.

4.5.3 Step 3: User Data Collection and Analysis

In this step, interviews were conducted with the adult residents of Durham County Council. Analysis of the data collected from the participants in relation to user behaviour patterns based on their use of public e-services of Durham County Council formed two personas including 'Working adult with children' and 'Adult student'. See section 4.4 for details.

Users belong to 'Working adult with children' were employed and had children. According to European Commission (2020), adults aged 35-44 form a large group (53%) of users who use public authorities websites to get information as revealed in the 2019 annual survey on the use of ICT (Information and Communication Technologies) in households and by individuals. Unlike adults, only 23% of senior citizens aged 65-75 used government websites. This made 'Working adult with children' most suitable for this research. Students belong to 'Adult student' users group have several unique characteristics that made them appropriate for this research such as competency, knowledge, practicality, goal-oriented, autonomy etc. (Malamed, 2009).

Results from the interviews in Table 4.4.1 revealed that target user groups tend to use similar services. 'Working adult with children' use mainly children & family services along with other commonly used services such as waste collection services, roads and streets services, building regulations and environmental services. 'Adult student' users group most likely to use services such as council tax discount, career opportunities, student finance and other commonly used

services. Information about user pain points or frustration with the system was collected that gives clues to improve system features. For example, users highlighted that some web pages were cluttered with information without the summary of key information. This suggests that a summary of important information should be highlighted on each web page. This information was used to illustrate the target user personas as discussed in the next section.

4.5.4 Step 4: Illustrate Persona

A well-defined persona template built by customer experience and UX design agency Telepathy (Summers, 2014) was used in this research. To make the personas look real, each persona was given a name and a photo added to it (Davey, 2019; Ooi, 2010). Named persona Mike in Figure 4.5.4.1 illustrates information about the 'Working adult with children' user group and named persona Sarah in Figure 4.5.4.2 illustrates 'Adult student' group information.

These personas were used to build user profiles and service adaptations for the personalised prototype. See section 5.3 and section 5.6.2 for details.

With the personas built for the target users, the next step is to design the services used by those users. The next section explains the task analysis technique to explore and design the services for the target personas.

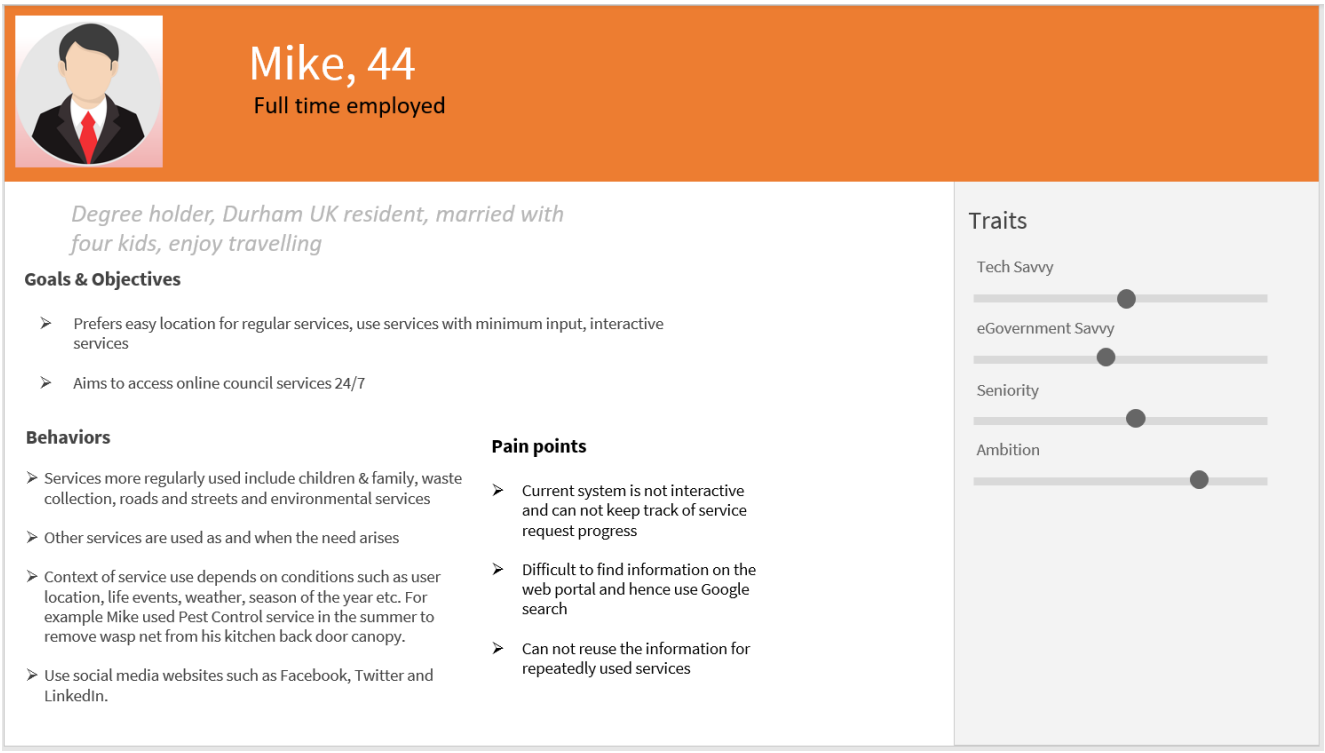


Figure 4.5.4.1 *Mike persona illustrating working adult with children user group*

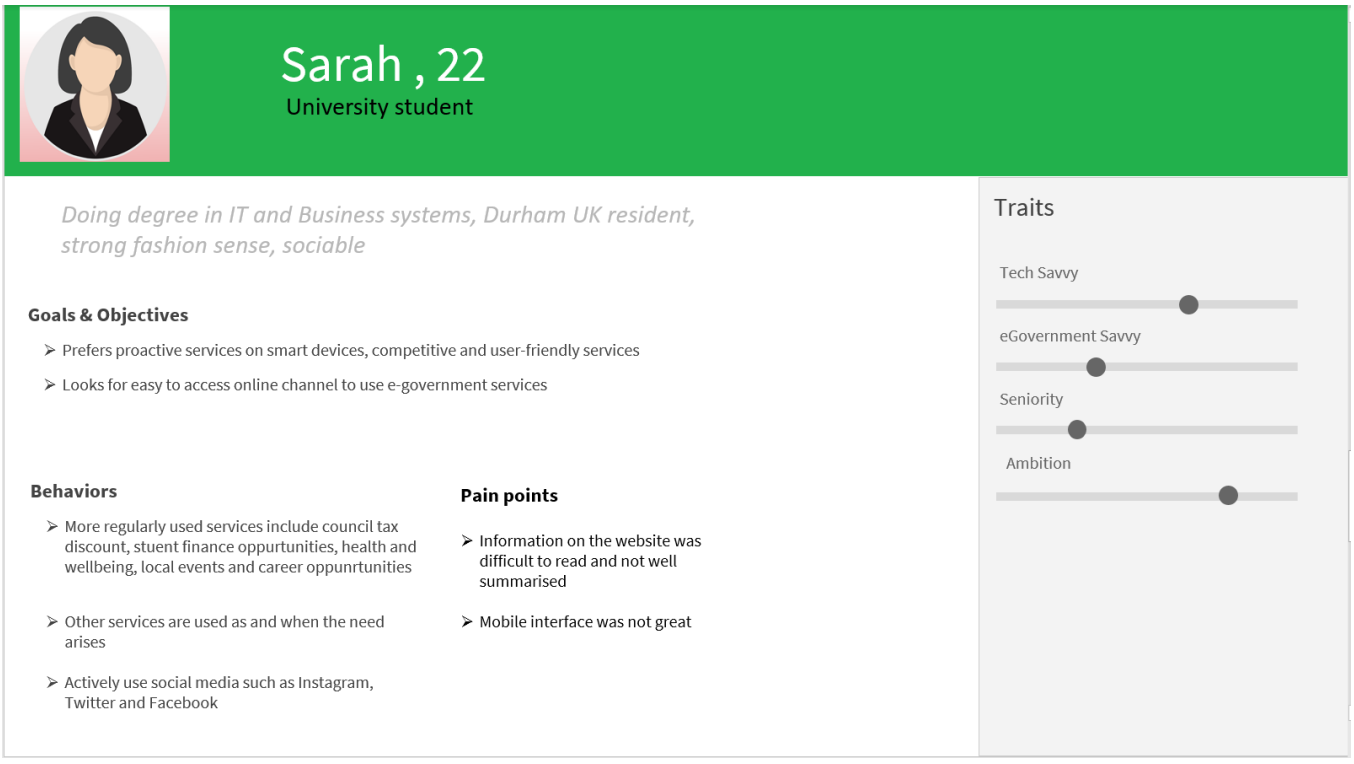


Figure 4.5.4.2 *Sarah persona illustrating adult students*

4.6 Task Analysis of eGovernment Services

Knowing the commonly used public e-services and their usage factors in e-government ontology, it was required to design those services for the target personas. Following the method in section 3.3.2.5, this section demonstrates how Hierarchical Task Analysis (HTA) was applied using an example case of Garden Waste Collection Service (GWCS). GWCS was selected from the list of commonly used public e-services as revealed in Table 4.2.1. As detailed in Figure 4.2.1, GWCS is classified as a seasonal service which is used during the summer season and can be popped up for the target user personas on the personalised system during the summer.

GWCS is one of the most frequently searched for services, which offers a fortnightly garden waste collection for more than 190,000 properties across the County and charge a fee for this service (*Who is eligible for garden waste collections? - Durham County Council*, no date). GWCS provides several specialised tasks/services that make it a suitable service to demonstrate HTA.

4.6.1 Hierarchical Task Analysis of Garden Waste Collection Service

This section focuses on the Hierarchical Task Analysis (HTA) of Garden Waste Collection Service (GWCS) provided by Durham County Council. GWCS provides a number of specialised services that include:

1. Join/Subscribe to the GWCS
2. Exchange garden waste bins
3. Order additional bin(s)
4. Appeal to include a property for garden waste collection
5. Check garden waste collection date

All the existing garden waste specialised services were individually examined by understanding input, output, information processing and interaction with the data sources. Finally, HTA of the existing GWCS was carried out by decomposing specialised garden waste

collection tasks into various level subtasks and depicting the flow of information throughout the process in terms of decision points as shown in Figure 4.6.1.1.

GWCS is triggered by the user property address input and have the following steps:

1. The property address is checked for eligibility to the GWCS. If eligible then step 2 is executed else user can appeal for the property to be included in the garden waste collection scheme.

2. The eligible property address is further checked for subscription to the GWCS. If the property is not already subscribed to the GWCS then step 3 is executed else step 4 is executed.

3. For a property not subscribed to the GWCS, it is required to subscribe before accessing any other specialised garden waste collection services.

4. For a property subscribed to the GWCS, user can choose any other specialised garden waste collection services.

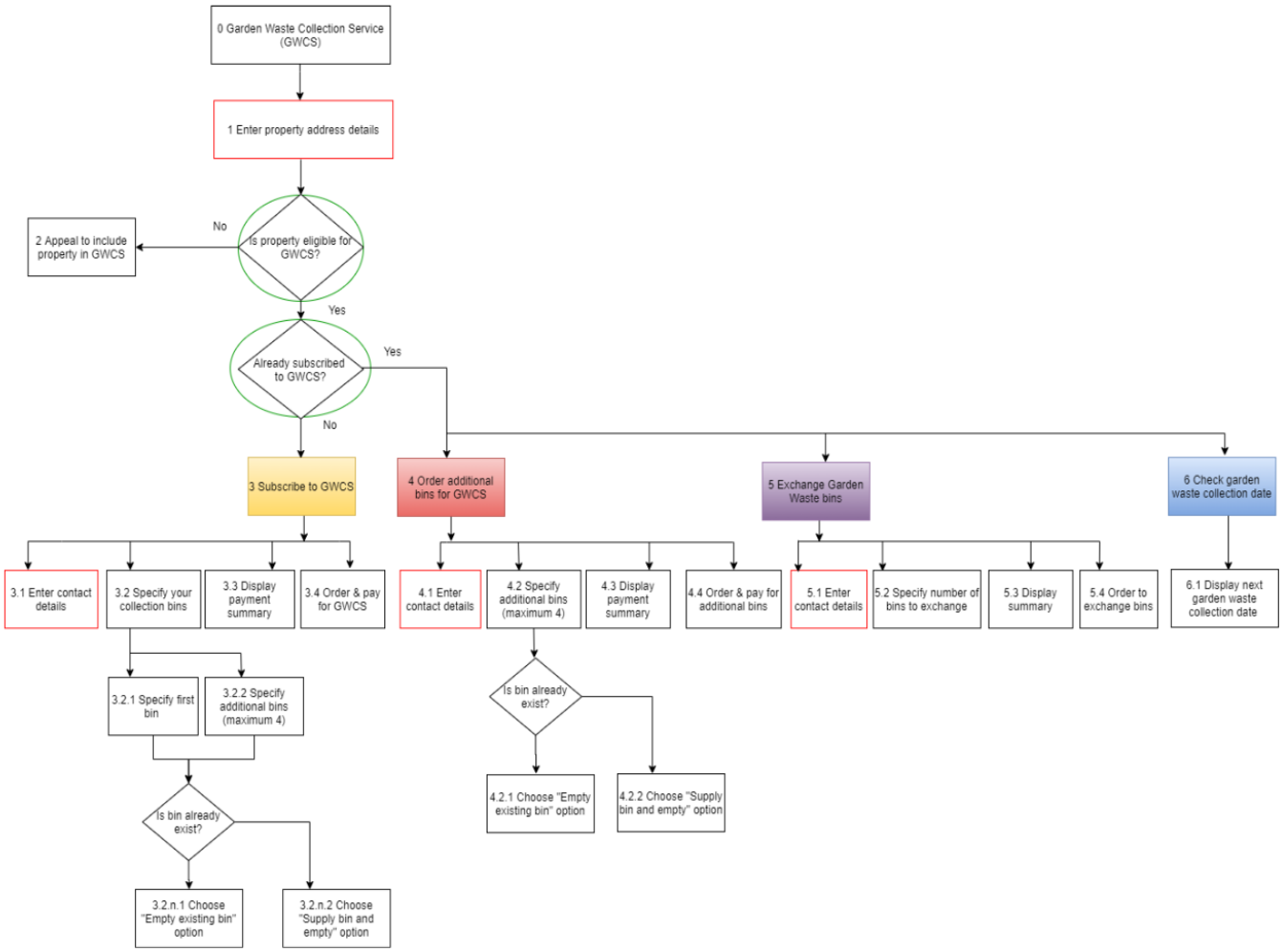


Figure 4.6.1.1 *Hierarchical Task Analysis diagram of Garden Waste Collection Service*

After task decomposition and information flow analysis, user and system tasks were identified and highlighted in colour. In Figure 4.6.1.1, tasks requiring direct data input from the users are highlighted with red borders. In a personalised system, user profiles contain basic demographics about the individual users themselves such as name, address, gender etc. For the tasks that require direct user input, the data can be accessed from the user profile to automate these tasks instead of direct user input.

4.6.2 Task-based User Segmentation of Garden Waste Collection Service

The decision points in the Hierarchical Task Analysis provide information to segment users enabling tasks to be personalised. Unlike using task analysis as a tool to learn about ordinary

users by observing them in action (Hackos and Reddish, 1998 cited in Arnowitz et al., 2000), this study used task analysis to focus on optimisation and personalisation for broad user groups. To achieve this, the research developed a new Task-based user segmentation technique as discussed in Sarwar and Hall (2017) to derive user segments from the HTA enabling tasks to be personalised. Using this technique, the design of public e-services is centred around the tasks instead of the end users. This section demonstrates task-based user segmentation using the HTA of Garden Waste Collection Service (GWCS).

The decision points represented by diamond symbols in Figure 4.6.1.1 provide information about an approach to identify various user segments for which services may be personalised. The decision point: “Is property eligible for GWCS” identifies two main user segments, 1) Users with properties eligible for GWCS and, 2) Users with properties not eligible for GWCS. Further decision points indicate that some of these segments can be further divided into sub-segments. For example, eligible properties might have already been registered for the garden waste collection and hence creating sub-segments 1.1) Users with eligible properties subscribed to GWCS and 1.2) User with eligible properties not subscribed to the GWCS.

Through allocating users to a segment, they are then only presented with the tasks under the segment branch. Thus, the service rather than being generic and catch-all are tailored to the user with this task restriction providing the basis of service personalisation. Once tasks are fulfilled for example, “Subscribe to GWCS”, this becomes superfluous and is not displayed unless the subscription is cancelled or lapses. Similarly order additional bins, exchange bins, check collection dates, etc. tasks are displayed when the user property has already been registered for the GWCS.

User profiles contain information about the individual users themselves; however, user profiles should be further extended to allow personalised access to services. This study proposes that the profiles should be extended to include attributes that represent the segment(s) that the user is in. For example, using a rule-based approach (Matuszewska, 2018), a Boolean attribute “Garden waste eligibility” could be added to the user profile to represent if the user property is eligible for the GWCS. This approach to extend user profiles should be cautiously used because the new attribute value may change with the change in user circumstances such as a change in the user address when the user moves to a new

property not eligible for the GWCS. Either user profile has to be updated regularly or the new attribute value needs to be calculated dynamically.

Segmenting users based on the tasks influence the design of the personalised system by displaying only the relevant tasks to those user segments. For example, users who have subscribed to the GWCS will have garden waste collection dates and other garden waste collection tasks displayed. For those who do not have eligibility for GWCS, this service would not be displayed freeing up screen space for other, more useful information. Through segmenting at each decision point, users are provided with tailored information.

4.7 Key Findings

Stage 2 'Understanding the User Context' of this research was aimed to find users' experiences and expectations from e-government and their perspective on personalisation.

The main findings and outcomes of this stage include:

User Experiences / Expectations: Users perceived personalisation as the right technique with the potential to improve e-government service delivery. For effective and personalised e-government service delivery, users expect features such as information reuse, easy location of regular services, proactive service delivery, service request progress tracking and customisation.

Identification of Service usage factors for personalisation: Analysis of Google Analytics data revealed service usage factors such as date/time context, incidents, seasons etc., which could be used to personalise services. These usage factors were used to build an ontology of e-government services that can be used to categorise services and citizen interactions with these services by factors such as seasonality.

Creation of Personas for the design of personalised adaptations: Personas built in this exercise provided key information to create user profiles, personalised adaptations with services that target users would be most likely to use and the user's desired system features for the personalised prototype.

A new 'Task-based user segmentation' technique: The task analysis of the DCC public e-service resulted in the creation of a new task-based user segmentation approach. This approach focuses on basing personalised system design on tasks and broad user groups rather than individual personalisation.

The outcome of this stage of the research was used to inform the design of the personalised prototype as discussed in the following chapter.

5 PERSONALISED HEURISTICS AND PROTOTYE DESIGN: RESULTS FROM STAGE 3

This chapter presents the results from Stage 3 'Personalised Heuristics and Prototype Design' of the research design.

The previous chapter presented results from user research including requirements for the design of personalised e-government prototype. This chapter presents an overview of the prototyping activities adopted to build personalised prototype and explains its features. The sections in this chapter include:

5.1 Prototyping Approach: This section presents a brief overview of the prototyping approach used by this study and discusses the peculiar characteristics of e-government that make e-government personalised prototyping challenging.

5.2 Personalised Heuristics: This section discusses the domain-specific heuristics developed for the personalised systems and explains how each heuristic improves the usability of the personalised system.

5.3 Building Design Narratives: In this section, the use of narratives in the design of the personalised prototype is demonstrated by giving examples of the user narratives collected from the focus group and interviews conducted in this study.

5.4 Design Concepts Formation: This section explains how design concepts or ideas were created for the design of the personalised prototype. The sources of inspiration to create design concepts for the personalised e-government prototype are discussed in detail.

5.5 Visualisation of Design Concepts by Medium-Fidelity Prototyping: The conversion of design concepts into medium-fidelity mockup visuals is explained in this section. The materialisation of abstract design concepts into visuals helps receive early design feedback and provides an opportunity to improve the design in the beginning.

5.6 Building Hi-Fidelity Personalised Prototype: This section discusses how the interactive hi-fidelity personalised e-government prototype was built. The tools used to create the hi-

fidelity prototype and the salient features of the personalised e-government prototype are explained in detail.

5.7 Limitations of the Personalised Prototype: This section briefly discusses the limitations of the personalised prototype.

5.1 Prototyping Approach

One of the fundamental principles of any User Centred Design (UCD) process is early prototyping to develop and evaluate design with users (Kotamraju and Van der Geest, 2012; W3C Web Accessibility Initiative, 2008).

After collecting user requirements by conducting user research (chapter 4), the personalised e-government prototype of Durham County Council was built as a proof of concept to test whether the personalised design concepts could be implemented. This approach of building a prototype is called experimental prototyping, which differs from Exploratory prototyping where a prototype is used to explore various design solutions and Evolutionary prototyping where the prototype is evolved into the fully functional product (Hertel and Dittmar, 2017).

Personalised e-government systems are significantly different from commercial personalised systems, needing to target all citizens, provide a diverse range of services, deliver services in compliance with the law, and are highly integrated. With these characteristics being somewhat different from other systems, it was difficult to work out how to design a personalised e-government prototype. Therefore, literature was reviewed to identify heuristics or design features specific to personalised e-government systems. This was intended both to guide the design and enable the system to be evaluated. Heuristics specific to the personalised e-government domain, whilst those relating to usability such as Nielsen's usability heuristics (Nielson, 1994) are assumed to be part of the basic design.

With the personalised heuristics developed, other steps were involved in building the personalised prototype as discussed in section 3.3.3. The next section explains personalised heuristics followed by sections explaining other steps required to build the prototype.

5.2 Personalised Heuristics

Following Neilsen's method (Nielsen and Molich, 1990) and other similar methods to build heuristics as further detailed in section 3.3.3.1, a set of nine heuristics was developed for the personalised e-government applications. Examples of how these heuristics were used for the design of the personalised e-government system are discussed in section 5.4 and section 5.6. The personalised heuristics developed for the personalised applications include:

5.2.1 User Profile Controllability (User Profile Control)

Controllability or user control for a personalised system refers to the satisfactory user sense of control while interacting with a personalised system. In the context of personalisation, Jameson (2007; cited in Van Velsen et al., 2015) defined controllability as "the extent to which the user can bring about or prevent particular actions or states of the system if he or she has the goal of doing so". Jannach et al. (2017) defined user control as a set of mechanisms that has an immediate effect on the recommendations of a personalised system. One way of giving control to the user is to change user preferences using a static user profile form.

For personalised systems where personalisation is based on data from a user profile, user control can be achieved when a user can influence data collection from the user profile (Van Velsen et al., 2015). In other words, changing user profile information by the users gives them a sense of controlling the personalised system. Ahn et al. (2007 cited in Hijikata et al., 2014) stated, this might enable users to understand more easily the reasons underlying recommendations. Hijikata et al. (2014) argued that user satisfaction might be related to the user's understanding of the recommendation mechanism. Bakalov et al. (2013) conducted a user study to allow users to control and change user model (user profile attributes) and resulting personalisation effects in the recommender system of a web-based biochemical literature application by using a visually adaptable interface. This study found that this adaptable approach improved usability and transparency of the personalised system.

5.2.2 Interface Customisation

Users should be given an option to override a personalised interface. Apart from influencing user profile, the right level of customisation does give users control to change the personalised interface. To understand this right level of customisation, it is important to understand various types of personalisation. Personalisation can either be adaptive or adaptable. Adaptive personalisation is performed by a system with no user customisation while an adaptable personalised system allows users to customise their own interface. Both types of personalisation have their advantages and disadvantages.

Adaptive personalisation does not require much user effort to perform tasks but lacks user control, transparency, and predictability. Unlike adaptive personalisation, adaptable systems provide end user tools to control and change the system but not all users are interested to have full control to change the system (Rigas and Al-Omar, 2010; Schade, 2016b). Experiment based user studies have proved that users perform better and are more satisfied with a mixed-initiative interface where elements of the adaptive and adaptable approaches are blended to mitigate the disadvantages and increase the advantages of both approaches (Findlater and McGrenere, 2004; Rigas and Al-Omar, 2010).

The right level of customisation for a user dashboard would include designing the dashboard that lets users save the view they have configured, and offer various ways to tag or highlight important information (Juicebox, 2015). Although useful to move the existing content around on a customised system, adding interesting content or removing unwanted content to a personalised system are the features that users would be most likely to customise (McCarthy, 2008).

5.2.3 Service Request Progress Tracking

For e-commerce websites, online order status tracking is one of the significant features, where users can check the status of their orders and receive any updates. Analysis of data collected from over a thousand users of e-commerce websites, Dholakia and Zhao (2010)

found that order tracking attribute was significantly important for user satisfaction and user repurchase intention.

For e-government services, the results of our focus group (section 4.3.1) conducted with citizens shown strong demand for user enquiry updates and progress tracking. A similar pattern was discovered among citizens by the UK Government Digital Service team (Herlihy, 2015).

5.2.4 Minimise Input Burden

Personalised systems should save user information correctly and reuse that information when required. In repeat services, saving and reusing user information minimises input burden on users. Ideally, form fields should be prefilled from the user information and users should be allowed to edit that information in case the information is inaccurate or needs updating (Schade, 2016b). Modern browsers do autofill fields with the data stored in cookies, however, personalised systems autofill fields with the user information stored in either the user profile or another database storing user data. Autofill form fields save user time and energy to refill the same information again and again. Users are most likely to fill the form if they are asked to fill less information (Bolton, 2015). This is not only true for forms but also other features and controls can be used to minimise user input. For example, a map displaying streetlights in a geographical location is easier and quicker to locate and select the required streetlight on the map. Address finder control can be used to make address search easier without typing the whole address.

5.2.5 Service Availability and Access

A well-designed system should not only provide personalised features and services to the users but also give users the option to choose non-personalised alternatives (Nielson, 1998). User requirements change over time and a personalised system might not always adapt to exactly what users need. Bad personalisation is a bad user experience design and can distract users (Mullin, 2016). Nielson (1998) gave a simple example of weather forecast application,

where 95% of the time users would want to know the weather forecast of the area where they live but 5% of the time they would need to know the weather for other areas. Therefore, the weather forecast application should not be strictly personalised to forecast user local area weather and should forecast weather of other areas searched by city name, postcode or ZIP code. Schade (2016a) discussed that in some cases, there may well be a good reason to use personalisation to remove user access to certain information but in other cases, users may miss out important information by such restricted access.

Government websites should not restrict user access to services other than to filter for the user. In some cases, there might be a good reason to remove user access to certain services for example a user with no garden in the property might not be interested in the Garden Waste Collection Service registration. In other instances, users with no garden in the property may require to know garden waste collection dates for a relative or a friend who has no access to the internet. This shows that personalised systems should restrict user access sparingly. In a personalised prototype, features such as search or A-Z navigation index can be used to access any other services that user may require to use. Also, individual services should be flexible enough to allow non-personalised access for example address personalised to a user should be allowed to change.

5.2.6 Ownership

The ownership here refers to the sense of ownership created by displaying username in labels and messages on a personalised system. Generally, people are more attentive to their names than other words. Brain activation was examined in response to hearing one's own first name in contrast to hearing the names of others (Carmody and Lewis, 2006 cited in Grennan, 2015). According to Packaging Gateway (2019), "for many people, receiving an item that's been specially tailored with the recipient's name or image creates a unique sense of ownership that a standard off-the-shelf gift can't always provide".

In name-based personalisation, usernames are extracted from their profiles and included in the messages personalised for those users such a greet customer by displaying Hi [Username]. A survey conducted by leading global technology and business consultancy group Accenture

among 1500 customers aged 18 to 60 years old across the US and UK revealed that 56% of the customers were more likely to shop at a retailer in-store and online that recognizes them by name (Accenture, 2016). Personalisation by name is a basic but useful design principle despite the fact that much more can be done in a personalised system such as relevant recommendations, remember and learning about customer behaviour etc.

5.2.7 Display the Right Data to the Right Audience

One of the most important design principles of a personalised system is to display the right data to the right audience (Borden, 2015). A personalised system that displays the same content for everyone makes the system cluttered and kills the purpose of personalisation. For example, the personalised dashboard for the support team would not be useful for the sales team. The important step of designing a personalised area or dashboard is to focus on the requirements of target user segments or groups and build a personalised view for each user segment when the personalised system is accessed by that target user segment (Juicebox, 2015; Meacham, 2017; Smith, 2015).

5.2.8 Grouping and Navigation

Related data should be grouped and placed together on a personalised dashboard (Few, 2007; Smith, 2015). Grouping similar information together would help users find and navigate through the information easily (Mazenko, 2016). Mixing different types of data or services would otherwise create a cluttered dashboard difficult to use. Similar data usually fall under the same category such as rubbish collection services, product inventory data, sales data, human resource information etc.

5.2.9 Data and Privacy Statement

Personalisation uses the user profile data to display the personalised features. Most users are concerned about their data usage by organisations holding user data. Therefore,

organisations need to be transparent about their usage of customer data. A survey carried out by Censuswide (a survey consultant organisation) for the Chartered Institute of Marketing (CIM) with a sample of 2245 UK adults and 500 marketers revealed that more than half consumers (57%) do not trust any organisation or business to use their data responsibly with a major concern of data sharing without consent (40%) (Netimperative, 2016). The same survey found that 92% of the consumers do not understand how organisations use their personal data and 31% have no idea how and where it is used. To explore customer attitudes toward privacy in the UK, Foresight Factory conducted a survey on behalf of the Direct Marketing Association (DMA) involving 1047 respondents, which found that despite the privacy concern (84% in 2015 vs 75% in 2017), the number of UK people who are more likely to exchange their personal information in return of personalised products or services has risen from 26% in 2015 to 34% in 2017 (Direct Marketing Association, 2018). This survey has also revealed that 41% of the UK customers are happy for the government departments to share their personal information to other government departments and just 29% are happy for the businesses to share their information to other businesses. This shows that the UK public has more trust in the public sector organisations to share their data than private sector organisations.

Organisations need to be transparent to win customers trust otherwise customers won't share their personal data with those organisations, which in turn affects personalisation. Transparency can be achieved by organisations explaining to customers how they use their data, inform customers about the benefits of using the data and keep the data usage in compliance with the privacy laws such as General Data Protection Regulation (GDPR) and EU-US Privacy Shield (Pepe, 2017). This information should be explicitly stated to the customers under a privacy statement. Experts do believe that tighter security requirements could also improve customer experience (Coleman, 2018).

5.3 Building Design Narratives

The design of personalised e-government prototype was supported by citizen narratives or user stories of the target user groups or segments based on their expectations and past

interaction with e-government. Citizen narratives for the target personas were extracted from the focus group and interviews (sections 4.3 and 4.4) about their experience of using local public e-services.

In narratives of the target personas, users explained their interaction and experiences with the e-government services providing information about the tasks they perform, their pain points and what they expect from those services. Listed below is an example of user narrative of Mike's persona belongs to 'Adult family with children' target group.

Narrative: Mike

Mike Nichols is a 44 years old full-time employee, who works as a support analyst in a public sector organisation. Mike has three children. Mike enjoys watching movies on the internet and surfs social networking websites on his laptop. He uses local e-government when the need arises. Mike is also interested in the local events in and around the city.

Mike used the local government website to register for the Garden Waste Collection Service. Mike paid for the garden waste service online but did not receive subsequent updates such as when the service would start, and the bins delivered. **A:** *Mike was not happy with the service because the system was not updating Mike with the progress of the service request.*

Mike used the local government website to find the nearest schools from his house and check school holidays information. **B:** *He was able to find his required information, but It took him longer to search for his nearest schools and find school information for his children.*

Value propositions of the narrative

The value propositions in the user narrative as explained above are italicised, which informed the design of the personalised e-government prototype. Listed below is the summary of the interpretation of these value propositions.

1. **Mike A:** The new system should update the user with the progress made in the user service request.

2. **Mike B:** The system should personalise based on user address, display nearest schools to the user address and allow the user to choose specific schools.

These value propositions provided useful information to build design concepts. The next section presents an overview of how design concepts were generated from other sources to build the personalised e-government prototype.

5.4 Design Concepts Formation

To build the personalised prototype for e-government services, this study investigated various features of the existing personalised systems, salient features and layouts of personalised accounts or dashboards, users and system requirements. The main sources of inspiration to generate design ideas include the following.

1. **Personalised System Design and UCD Techniques**

   Literature review of the personalisation (section 2.1) formed the design concepts for three core elements of a personalised system including user profiles, content modelling and filtering/recommendation techniques (Gao et al., 2010).

   User profiles were created for the target personas with authorised access to the personalised prototype, which displayed the services that the target users would be most likely to use. This idea was generated from the rule-based filtering technique. Although recommended for personalised systems, advanced machine learning and recommendation were not used in the personalised prototype.

2. **Hierarchical Task Analysis**

   Hierarchical Task Analysis (HTA) performed in section 4.6 provided key information to design tasks required to accomplish the service requests. For example, tasks that require user input can be converted into and represented by web form controls

(Hornsby, 2010). Figure 4.6.1.1 shows detailed HTA of the Garden Waste Collection Service, where tasks such as 'Enter contact details' and 'Specify your collection bins' were converted into web form controls (See Figure 5.6.7.1 for garden waste collection service web form).

3. Personalised Account Layout

Layout refers to the positioning, grouping and ordering of content on the screen (Few, 2008). One of the commonly used layouts to display personal content providing simplicity, consistency and continuous flow of information is grid layout with cards displaying the content or widgets (Bakusevych, 2018). Grid layout is used by online giant companies such as Amazon and My Yahoo (See Figure 5.4.1 for Amazon personal account layout). For the personalised e-government prototype, a grid layout was chosen to display the e-government services in the form of cards.

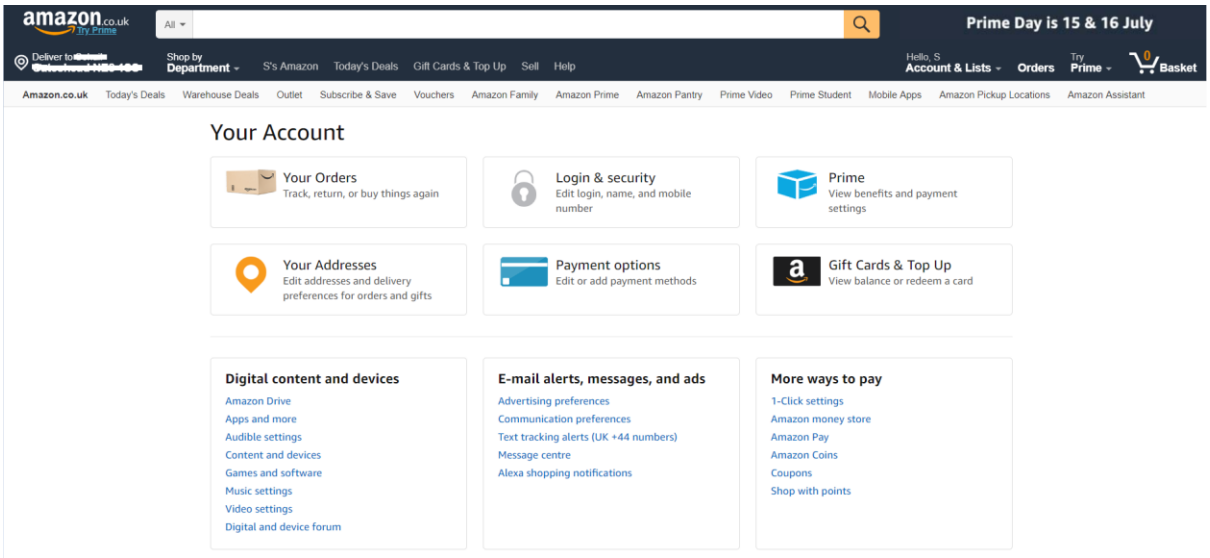


Figure 5.4.1 *Amazon 'Your Account' screen - an example of grid layout*

4. **Personalised Heuristics**

Personalised heuristics are usability features for personalised systems that help in the design and evaluation of the personalised systems. This study developed a set of nine heuristics by conducting a literature review and user research. These heuristics include user profile controllability, interface customisation, service request progress tracking, minimise input burden, service availability and access, ownership, display the right data to the right audience, grouping and navigation, and data and privacy statement. These heuristics are further explained in section 5.2.

5.5 Visualisation of Design Concepts by Medium-Fidelity Prototyping

In the design of the personalised e-government prototype, medium-fidelity mockup visuals of the personalised dashboard were created to visualise the design concepts generated in section 5.4. A free online mockup creation tool called 'Lumzy' was used to create these mockups.

A mockup storyboard shown in Figure 5.5.1 was created that describes target user interaction with the personalised prototype to subscribe for the Garden Waste Collection Service and report a faulty streetlight. The prototype provided authorised access to the users with the login screen and allowed users to create profiles with the registration screen. Similar services were grouped for easy navigation. This is shown in Figure 5.5.4 where rubbish and recycling services are grouped together.

For reporting a faulty streetlight, a user needs to click on 'Roads and streets' and 'Report a street lighting issue' options to display the personalised map with icons representing streetlight lamps around the user profile address. The user selects the icon representing the faulty streetlight on the map and submits the form pre-filled with user details. The user selects 'Rubbish and recycling services' to subscribe to the Garden Waste Collection Service and see the waste collection dates.

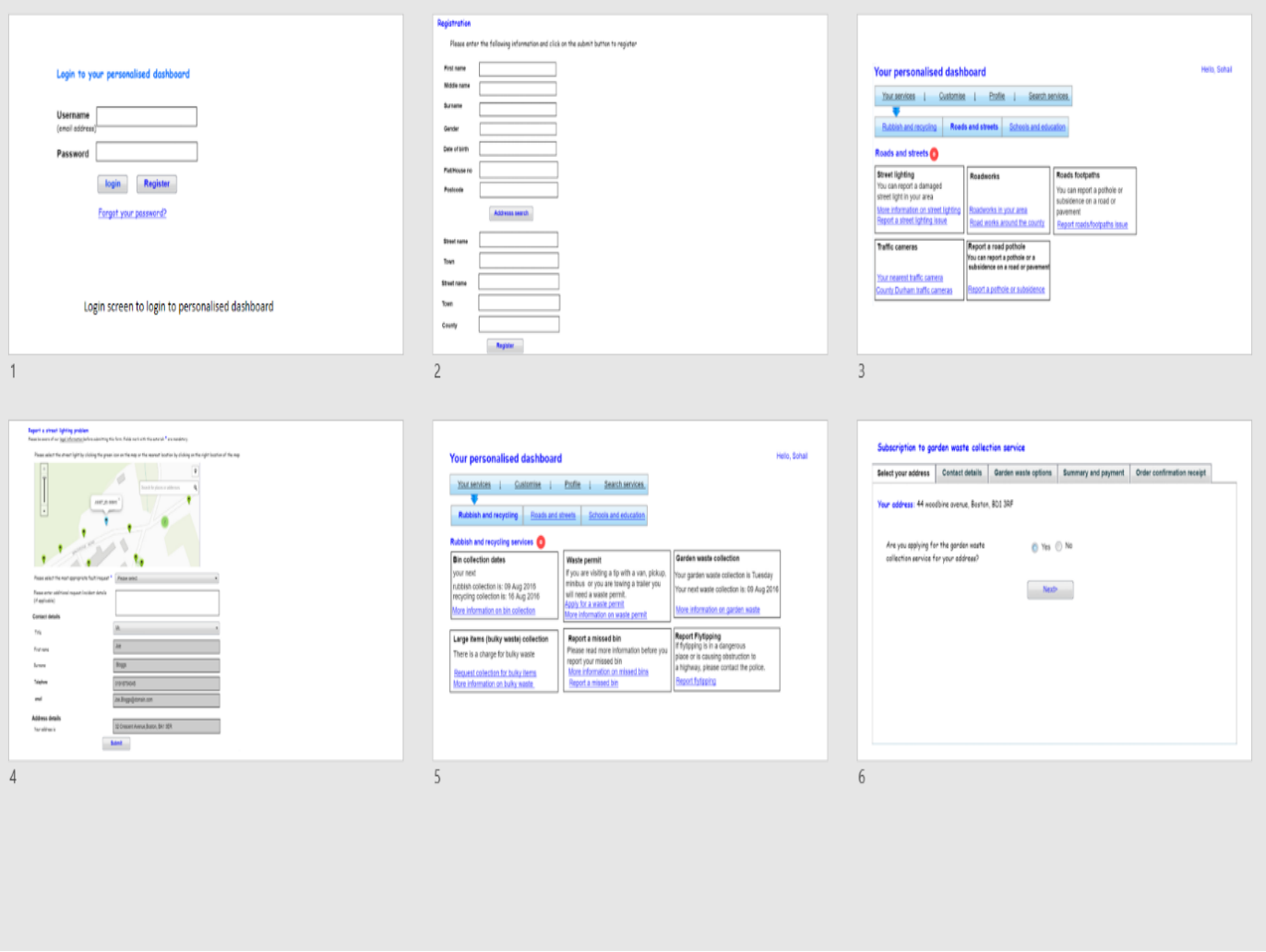


Figure 5.5.1 *Storyboard screens for the user who report a faulty streetlight and subscribe to the Garden Waste Collection Service*

A close view of the individual mockup screens for login, registration and personalised dashboard displaying rubbish and recycling services are shown in Figure 5.5.2, Figure 5.5.3 and Figure 5.5.4 respectively.

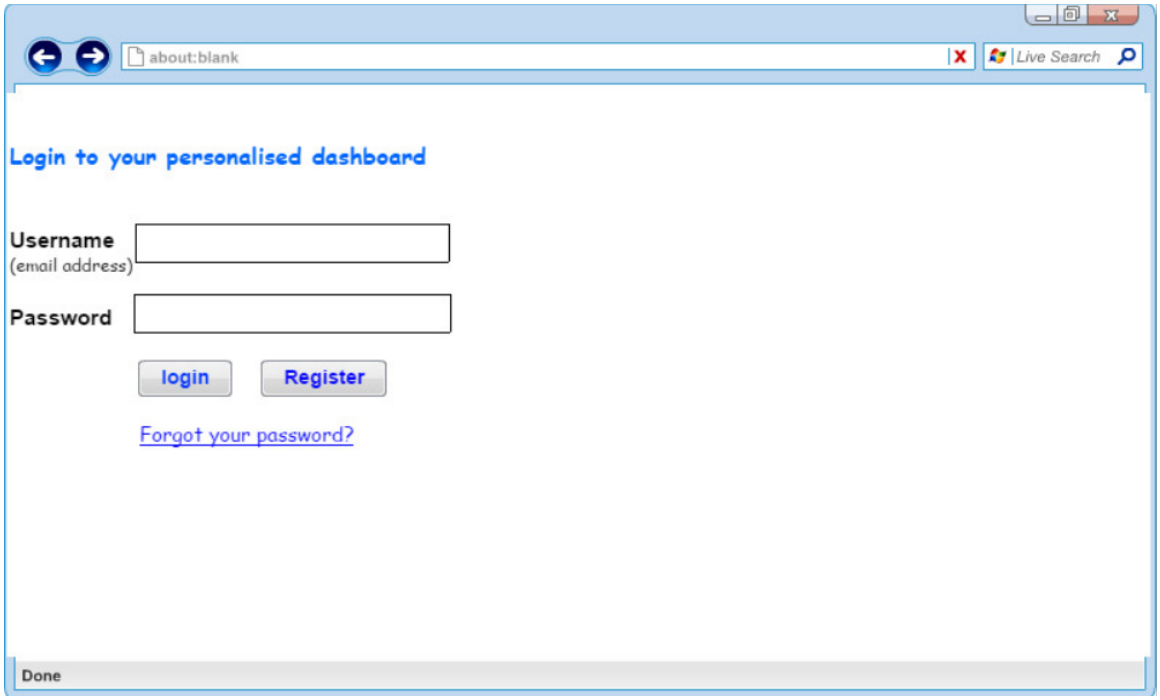


Figure 5.5.2 *Login screen mockup*

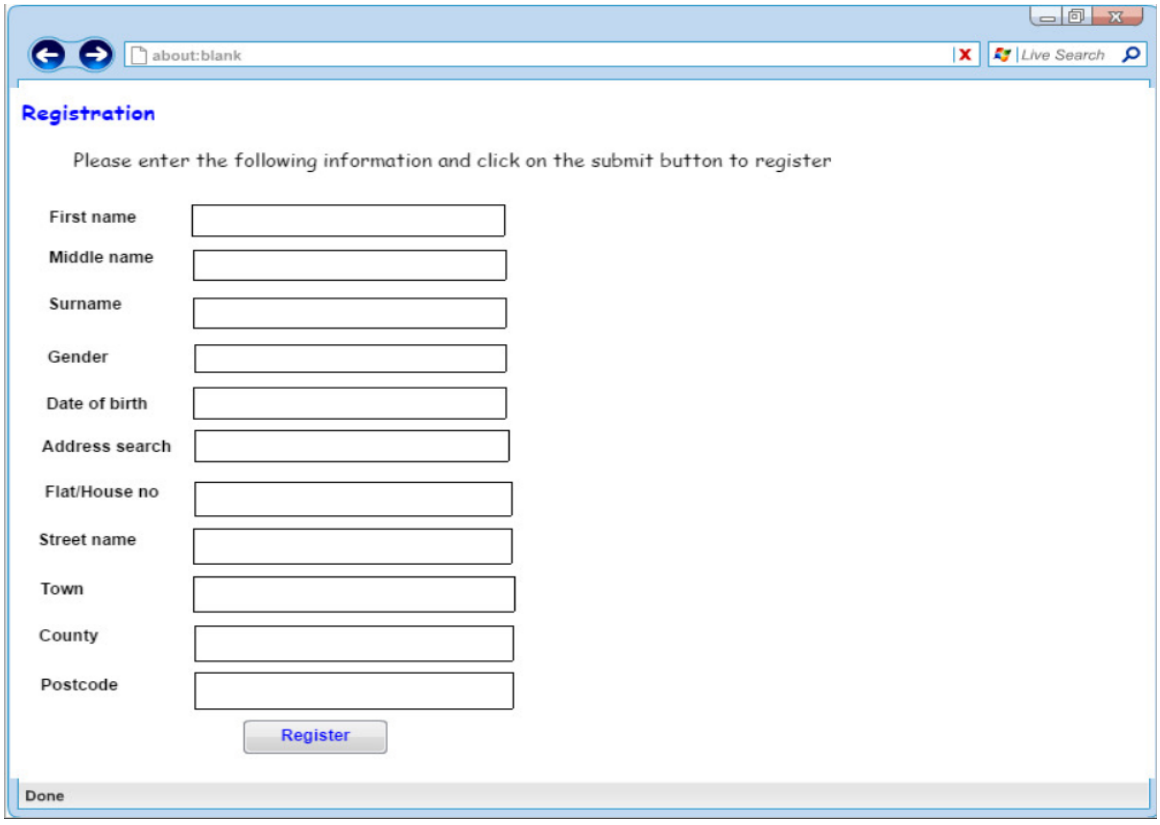


Figure 5.5.3 *Registration screen mockup*

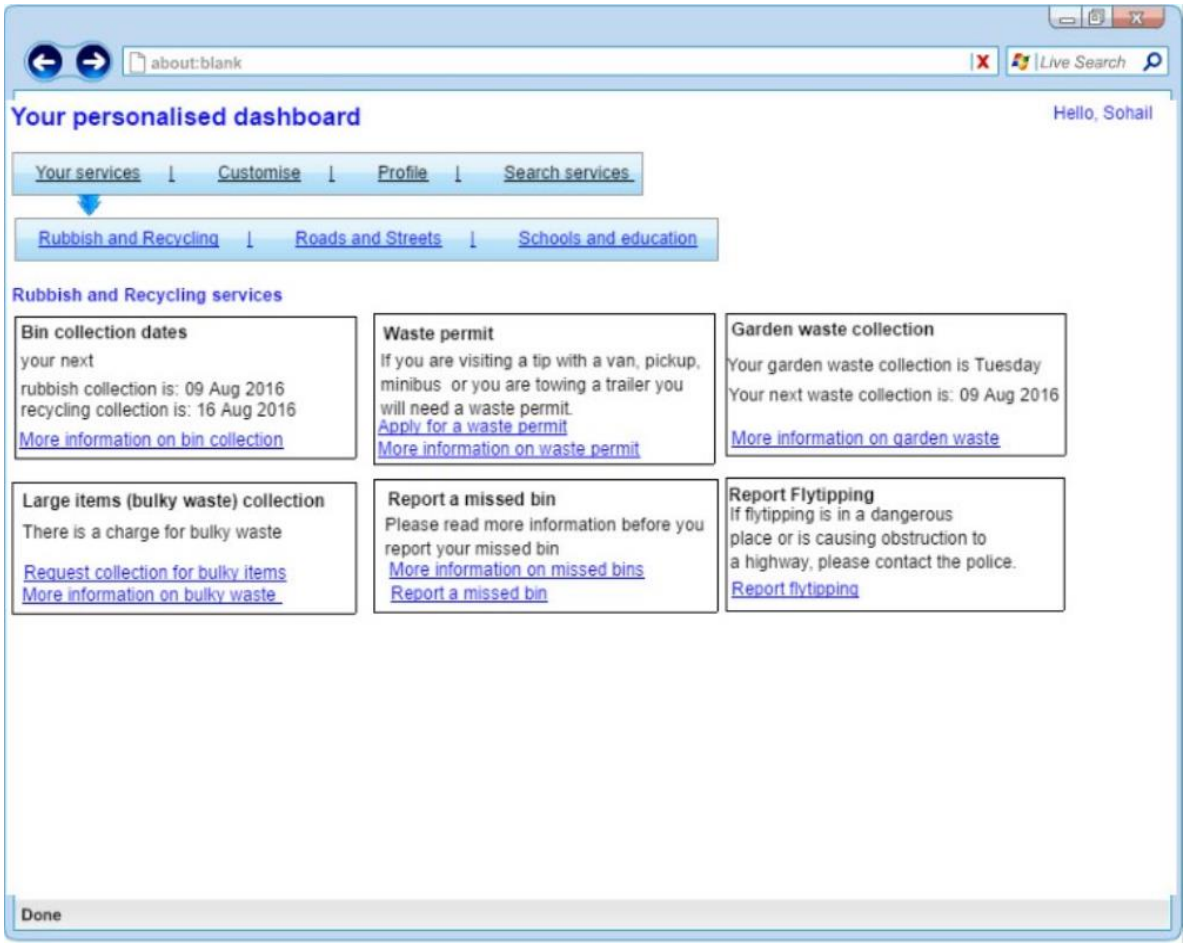


Figure 5.5.4 *Mockup screen displaying a group of rubbish and recycling waste collection services*

The medium-fidelity mockups created at this stage provided a template to build the hi-fidelity prototype, which is explained in the next section.

5.6 Building Hi-Fidelity Personalised Prototype

The hi-fidelity prototype was built to demonstrate the salient features of a personalised system as presented in the form of heuristics in section 5.2. Although interactive, less focus was given to the graphics of the interface. This is because the prototype was experimental and not supposed to evolve into a fully functional product. A brief synopsis of the tools used to construct the personalised prototype and its salient features are listed below.

5.6.1 Tools and Languages Used to Construct the Prototype

Microsoft Visual Studio 2017 Enterprise edition was used to build the personalised prototype. Visual Studio is an integrated development environment that provides the tools required to write and edit code with a variety of code editing features. In the beginning, HTML and CSS languages were used to build static web pages for the prototype. Later, more interactive features were required to add to the web pages. Therefore, dynamic web pages were built using C# programming and connected to a SQL Server database.

5.6.2 Adaptations for the Target Personas

The core feature of a personalised system is to adapt for the target persona and to display the most appropriate services the target users are most likely to use as discussed in the 'Display the right data to the right audience' heuristic in section 5.2.7.

The personalised prototype was built to adapt for the target personas as discussed in section 4.5. User profiles were created with credentials (username/password) for the Mike and Sarah personas representing 'Working adult with children' and 'Adult student' target user segments respectively.

To demonstrate an adaptation for the winter seasonal services as derived from e-government services ontology in section 4.2, a third user profile was created for a fictitious David persona.

Service adaptation for the target personas include:

1- **Adaptation for 'Working Adult with Children' Persona:** When a user logs in with credentials: Mike/Mike (Username/Password), prototype redirects to a web page that display services for working family with kids along with other commonly used services. This is shown in Figure 5.6.2.1.

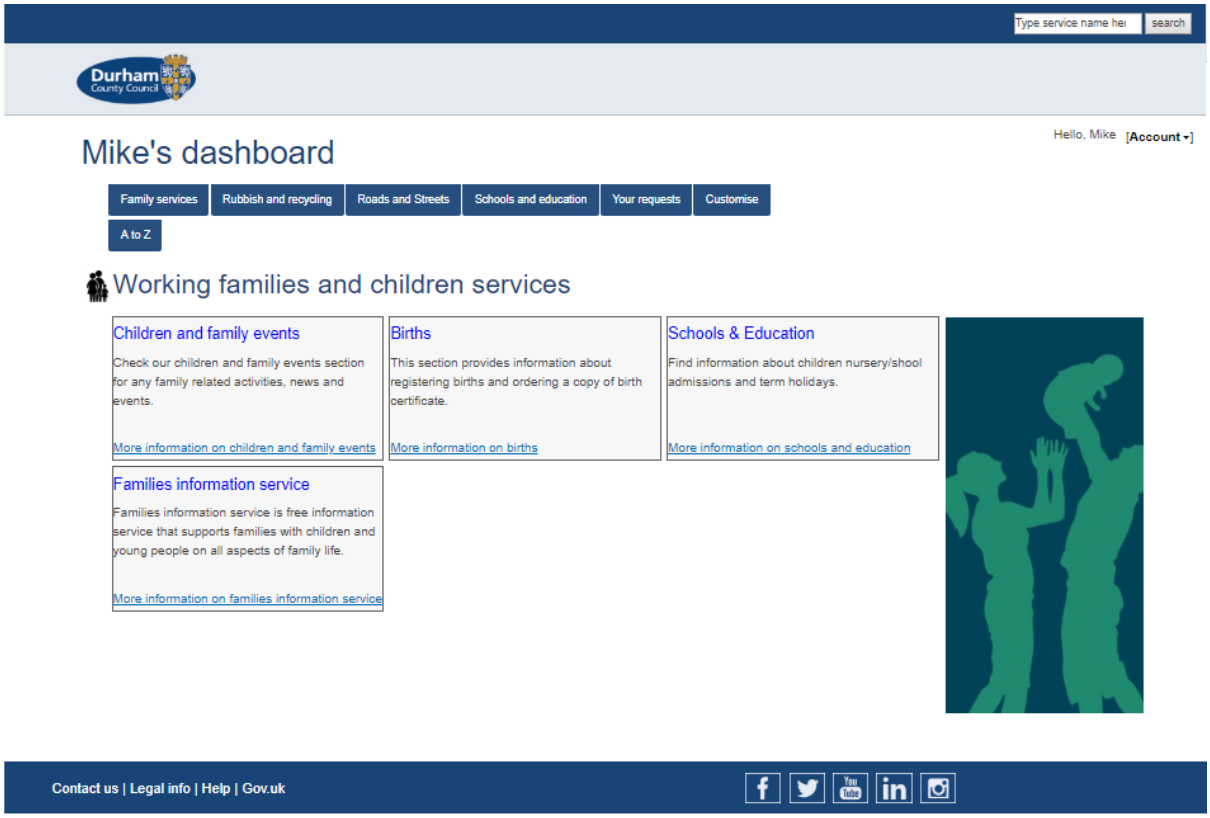


Figure 5.6.2.1 *Personalised prototype adaptation for users belong to working families with children persona*

2- **Adaptation for 'Adult student' persona:** When a user logs in with credentials: Sarah/Sarah (Username/Password), prototype redirects to a web page that displays services for the adult student along with other commonly used services. Figure 5.6.2.2 shows personalised adaptation for adult students.

3- **Adaptation for Fictitious David Persona to Demonstrate Seasonal Services:** When a user logs in with credentials: David/David (Username/Password), prototype redirects to a web page that displays services that people are most likely to use in the winter season. Adaptation based on the winter season can be suitable for any target user segment. See Figure 5.6.2.3 for the prototype adaptation for the services used in the winter season.

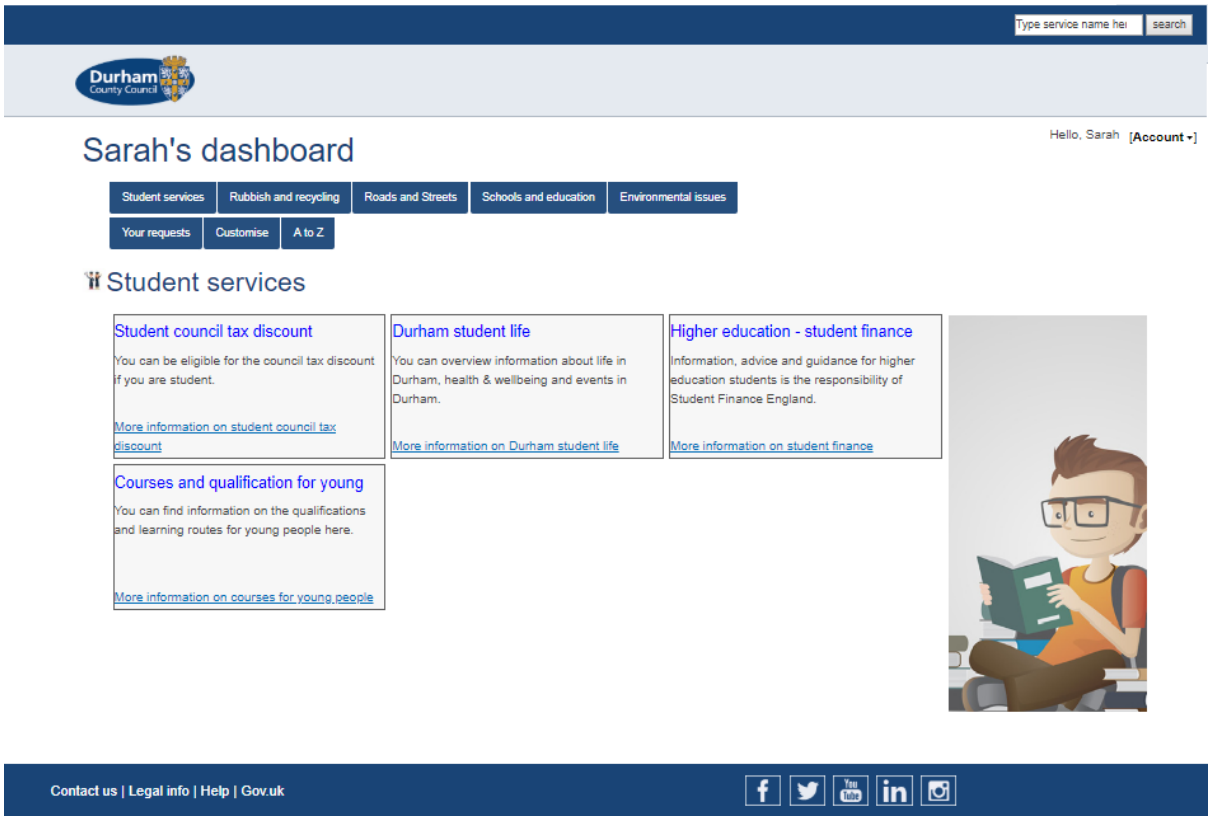


Figure 5.6.2.2 *Personalised prototype adaptation for adult students*

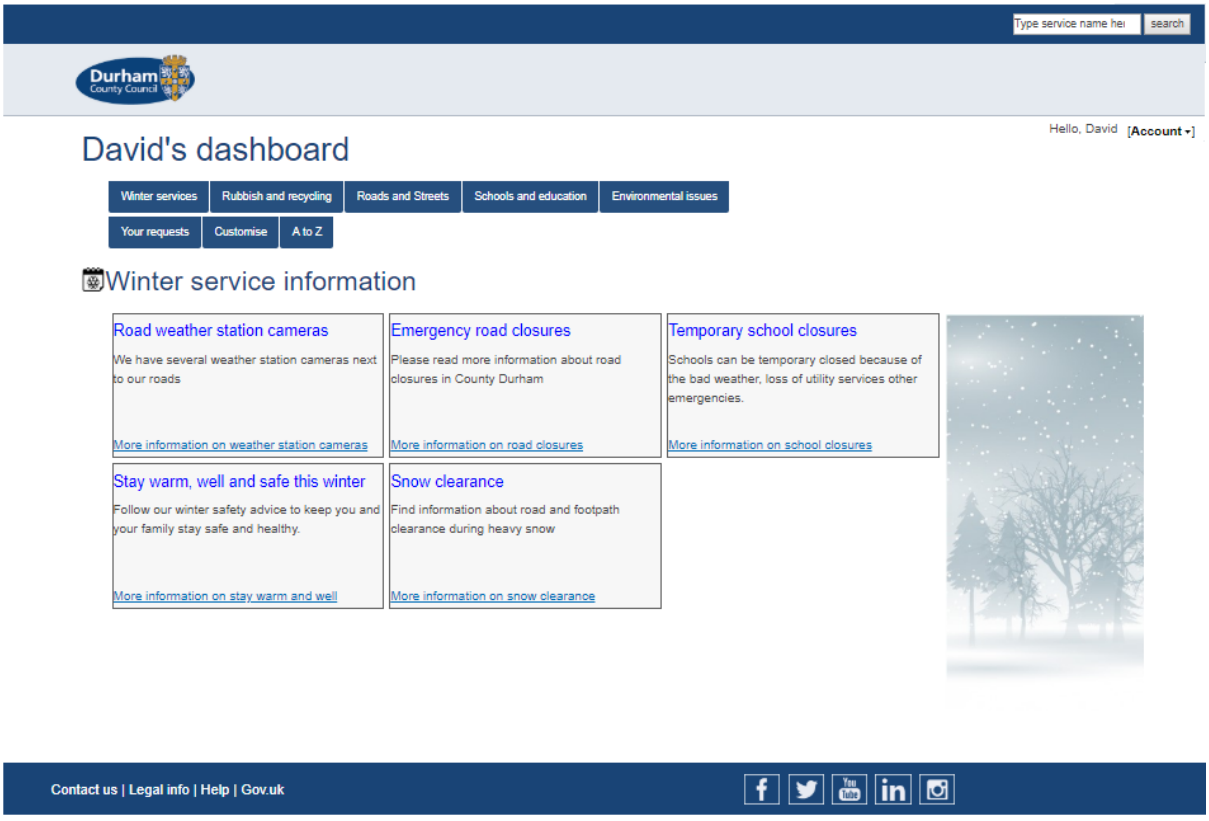


Figure 5.6.2.3 *Personalised prototype adaptation displaying services that people are most likely use in the winter season*

5.6.3 Interface Customisation

Interface customisation refers to the user ability to modify the interface to suit user needs. Providing the right level of 'Interface customisation' is a personalised system heuristic explained in section 5.2.2. As discussed in section 5.2.2, the right level of interface customisation can be implemented by various features such as allowing users to add wanted content and remove unwanted content.

The personalised prototype demonstrates indicative customisation by allowing users to add/remove certain top navigation options for the service groupings without implementing further customisation. This is shown in Figure 5.6.3.1, where a user can select or deselect certain top main navigation menu options. By clicking on the 'Save' button the main navigation modifies and displays the selected options.

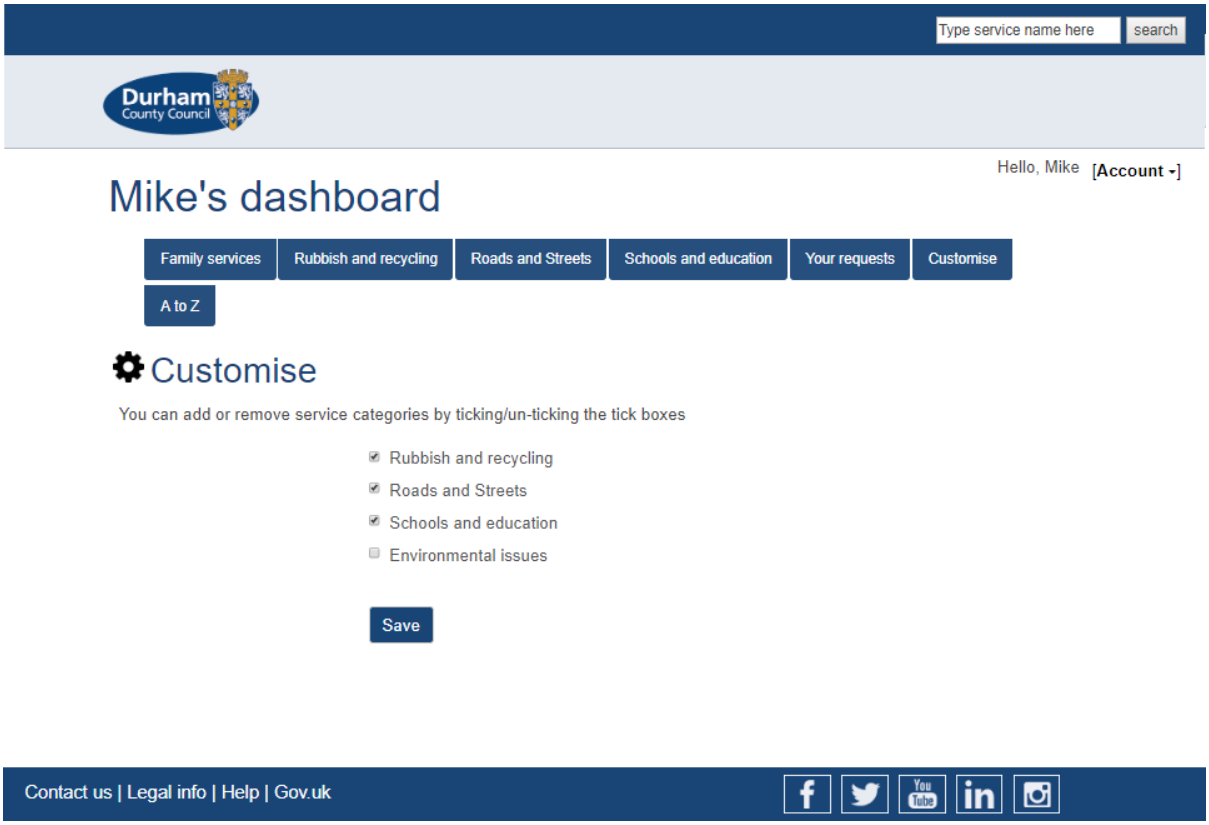


Figure 5.6.3.1 *Prototype page that customises main navigation*

5.6.4 Service Requests Progress Tracking

To demonstrate the personalised systems heuristic 'Service request progress tracking' in section 5.2.3, a web page was built in the personalised prototype that displays a list of previously submitted service requests. This is shown in Figure 5.6.4.1.

Service request progress tracking is a common feature across many business domains. For example, in e-commerce websites such as Amazon, eBay etc., it is common to display a list of user previous orders along with order status information. The service requests should date back to a fixed period defined by organisation policy.

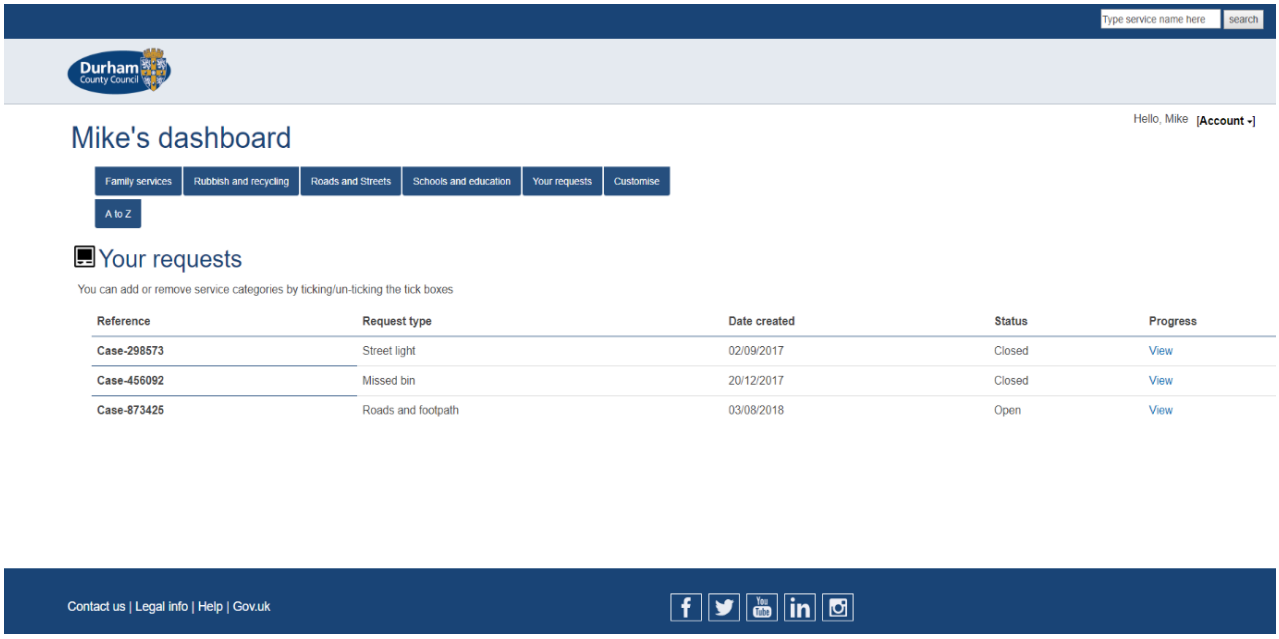


Figure 5.6.4.1 *Prototype web page that lists all the service requests previously logged by the user*

A service request usually goes through several stages in its life cycle. At each stage, the service request is processed in some form. After a service request is received, it is usually processed by several back-office departments before it is finally closed. Ideally, the personalised dashboard should display the progress of the service request through all stages unless the information is confidential. Figure 5.6.4.2 shows the progress tracking of a report streetlight fault request through several back-office stages including request submission, request processed by highways team and the closed stage.

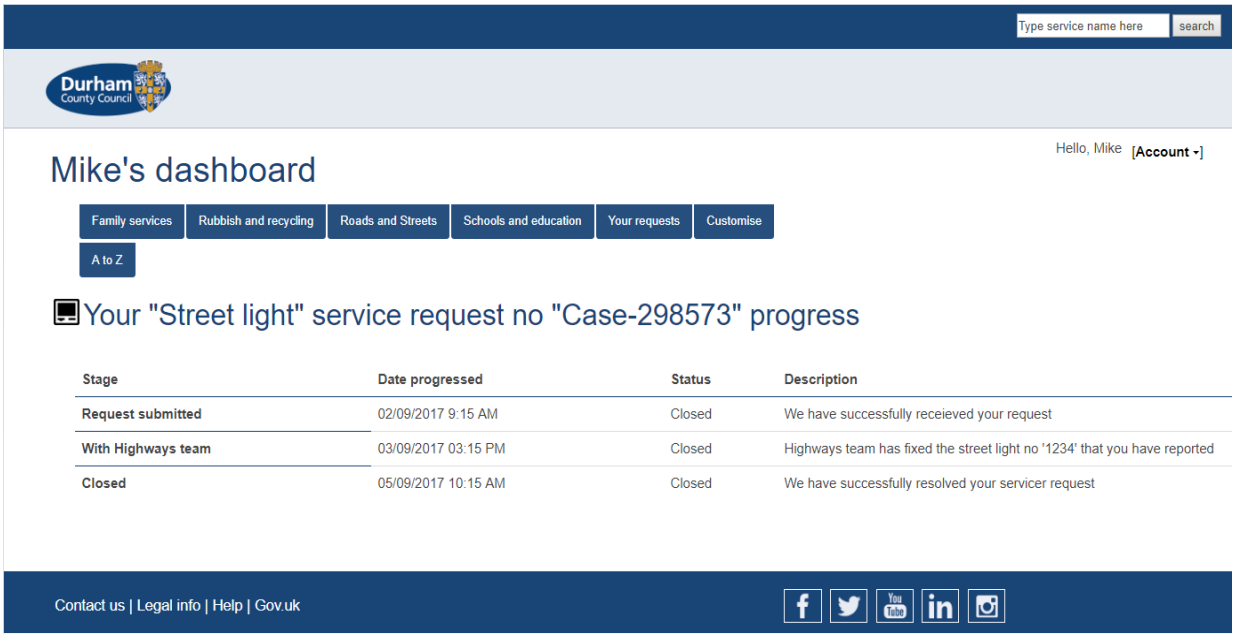


Figure 5.6.4.2 *Personalised prototype web page that demonstrates the streetlight service request progress through several stages*

5.6.5 Service personalisation

Service personalisation here refers to the personalisation of individual services based on user profile attributes such as user address, user current location, work status etc. Personalising services based on user profile attributes enables personalised systems heuristic 'User profile controllability (user profile control) ', which allows the user to control personalisation by changing user profile attributes. This is further explained in section 5.2.1.

To demonstrate service personalisation, the personalised prototype allowed services such as 'My nearest schools' and 'Report a streetlight fault' to adapt based on the user profile address. For example, 'My nearest school' service was built to display schools nearest to the user profile address on the map and similarly, the 'Report a streetlight fault' service map was developed to display streetlights around the user profile address. These are shown in Figure 5.6.5.1 and Figure 5.6.5.2 respectively. If users change their profile address, these services will adapt accordingly.

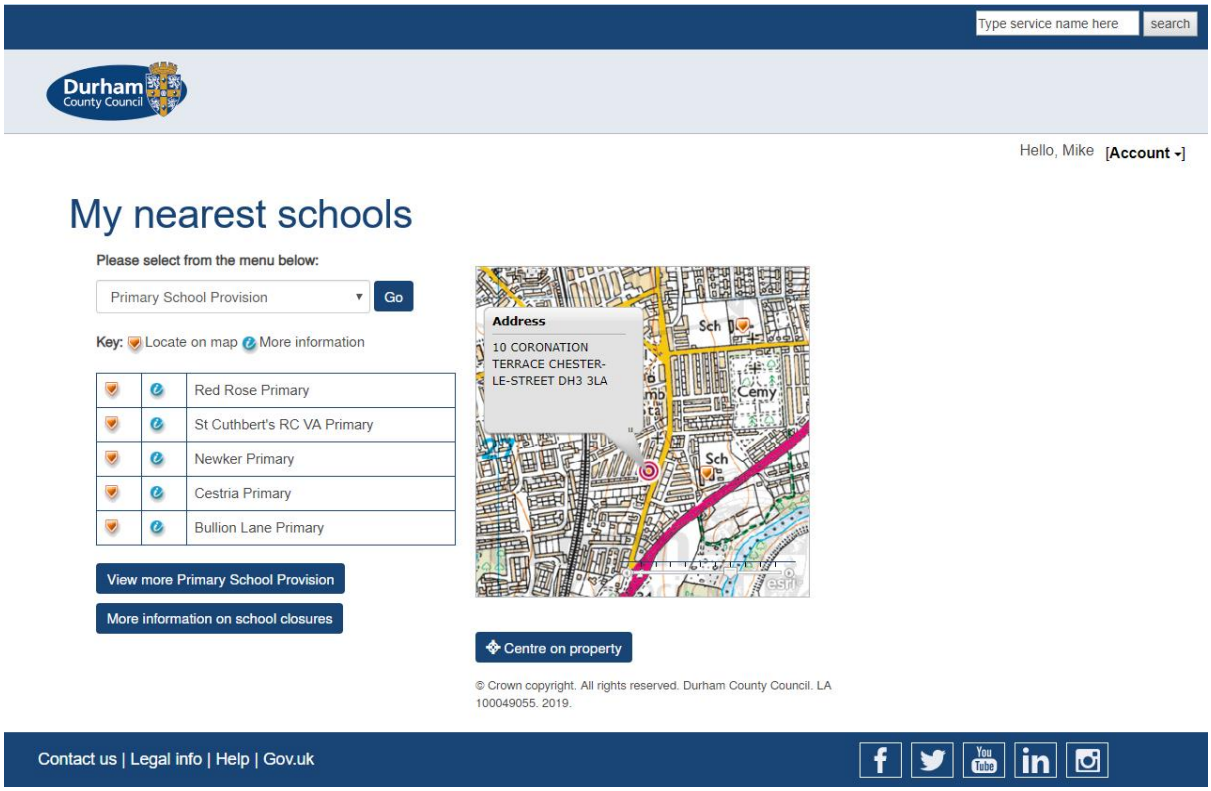


Figure 5.6.5.1 *Prototype web page displaying nearest schools to the user profile address*

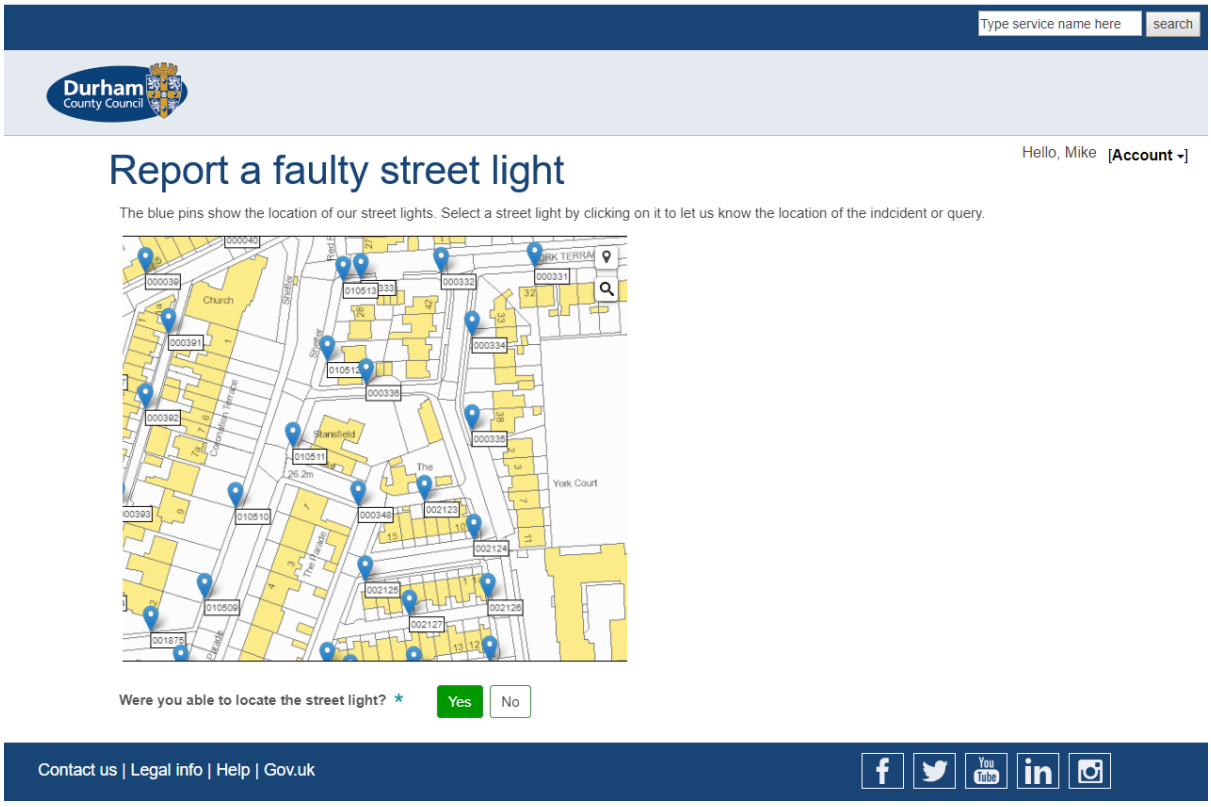


Figure 5.6.5.2 *Prototype page that displays streetlights around the user profile address*

5.6.6 Service Grouping

Services that fall under the same category were grouped and displayed together on the same page. This follows the 'Grouping and navigation' heuristic for the personalised systems explained in section 5.2.8. Service grouping helps users find and navigate the services easily.

The service groups can be accessed from the main navigation, for example, clicking on 'Rubbish and recycling' navigation option displays a group of services including rubbish and recycling bin collection dates, waste permit, garden waste collection, bulky waste items collection and report a missed bin service. This is shown in Figure 5.6.6.1.

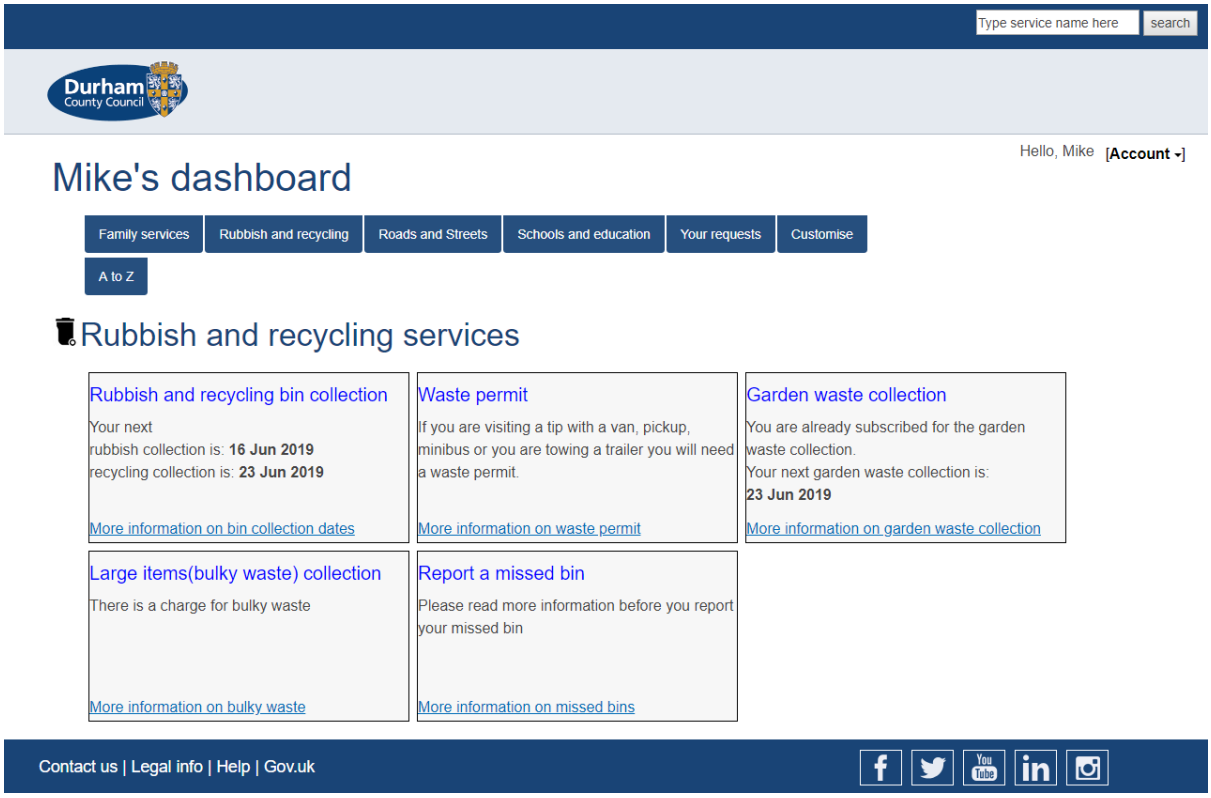


Figure 5.6.6.1 *Prototype page displaying a group of rubbish and recycling services*

5.6.7 Access to Both Personalised and Non-Personalised Services

In a better designed personalised system, user access should not be restricted to personalised services only. This is further elaborated in the 'Service availability and access' heuristic in section 5.2.5, which emphasised the need to give users access to both personalised and non-personalised services in a personalised system.

In the personalised prototype, access to both personalised and non-personalised services was demonstrated by giving access to all services at a broader level and allowing the user to override personalised tasks at the service level. At a broader level, the prototype features such as 'A to Z' list of services and search functionality were provided to give access to those services which were not directly displayed on the personalised dashboard.

At a service level, users were given options to override the task personalisation. For example, on selection to subscribe for the Garden Waste Collection Service, the subscription proceeds for the user address. However, the option was provided to select a different property address. Figure 5.6.7.1 shows the prototype screen which demonstrates this by asking the user a question 'Is this garden waste subscription for your property?' followed by choosing a different address if the user selects 'No' option. This is particularly useful if the user requires to order garden waste collection for a friend or family member.

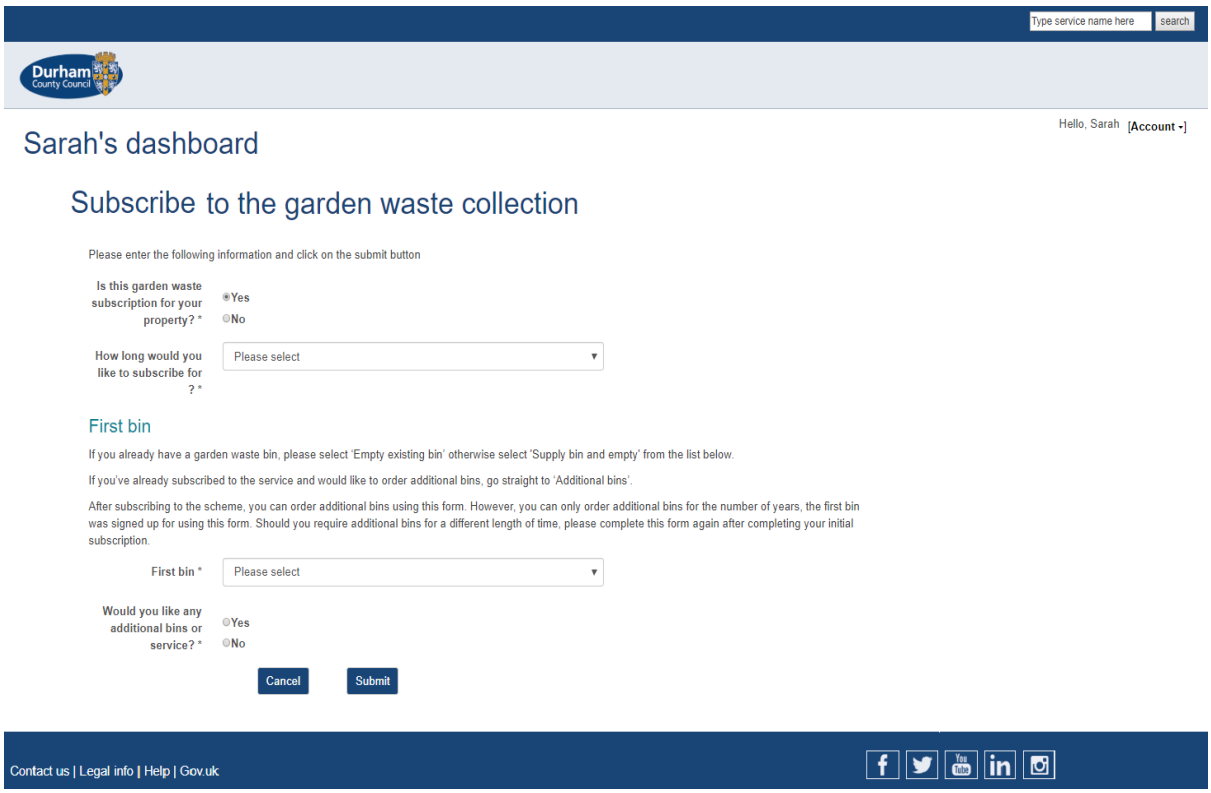


Figure 5.6.7.1 *Prototype page that displays garden waste collection service subscription form*

5.7 Limitations of the Personalised Prototype

As discussed in section 5.1, the purpose of the experimental personalised prototype built in this study was to test the main design concepts for a personalised e-government portal. Therefore, the prototyping was focused on the features such as those desired by the users extracted from the user narratives, service adaptations and personalised tasks for the target user personas.

Although interactive, not much attention was given to the graphics of the personalised web-based prototype. The prototype design was not made responsive for each browser, it was built to work in common browsers only such as Internet Explorer and Chrome. Also, the prototype was not built to be mobile-friendly.

One of the challenges in building the personalised prototype was the display of services on the portal. Local government provides hundreds of different services to the citizens. Only a few services were selected to display under each service category on the personalised portal.

5.8 Summary

This chapter presented the prototyping activities required to build the personalised e-government prototype. The personalised e-government prototype was built as a proof of concept to test whether the personalised design concepts could be implemented. The characteristics of e-government such as providing a diverse range of services to all the citizens and delivering services in compliance with the law make the design of personalised e-government somewhat different from other systems. Therefore, a set of domain-specific heuristics were developed for the personalised e-government systems, which were used to design the personalised e-government prototype.

The design concepts or ideas for the personalised e-government prototype were generated from various sources such as user narratives of the target user segments, existing personalised systems and techniques, personalised heuristics and task analysis of e-government services. These design ideas were visualised in the form of medium-fidelity

mockups, which were then evolved into a hi-fidelity personalised prototype. The construction of the personalised e-government prototype involved creating interactive adaptive screens displaying the services that the target user segments would be more likely to use and screens for features such as login, registration, service request progress updates, customisation etc. With the personalised prototype ready, the next stage is to perform the prototype evaluation as explained in the next chapter.

6 EVALUATION OF PERSONALISED SYSTEM PROTOTYPE: RESULTS FROM STAGE 4

The evaluation of the personalised prototype built as discussed in the previous chapter is performed at Stage 4 'Prototype Heuristic Evaluation' of the research design. This chapter discusses various approaches taken to evaluate the personalised systems and presents the results of the heuristic evaluation method used at Stage 4 to evaluate the personalised e-government prototype as discussed in section 3.3.4.

6.1 Existing Studies Based on Personalised Systems Evaluation: This section presents an overview of the existing studies that discussed the evaluation of adaptive (personalised) systems. This overview provides a guide to choose the most appropriate method for the evaluation of adaptive systems.

6.2 Evaluation Approaches to Personalised Systems: This section discusses various types of approaches and methods to evaluate personalised systems. Derived from the task analysis, this section explains a task-based evaluation method, where the various task adaptations required to achieve a service request can be evaluated.

6.3 Heuristic Evaluation of Personalised Prototype: The heuristic evaluation of the personalised prototype by usability experts is discussed in this section. This section also explains the results of the heuristic evaluation method used for the evaluation of the personalised e-government prototype.

6.1 Existing Studies Based on Personalised Systems Evaluation

Evaluation is an integral part of any User Centred Design (UCD) method. According to Osterlind et al. (2013; cited in Nikpay et al., 2015, p.112), evaluation is defined as "the identification, clarification, and application of defensible criteria to determine an evaluation object's value, its merit or worth, in regard to those criteria". The main goals of software evaluation are to compare alternative software applications to choose the best fitting software for the desired purpose, to assess system functionality and usability and to unearth system weaknesses and problems (Gediga et al., 2001; Nikpay et al., 2015; Van Velsen, 2011).

Evaluation of personalised systems is inherently complex and different from the evaluation of non-personalised systems. This is because, unlike non-personalised systems, the output of a personalised system is different for different users. In addition, some usability principles or heuristics such as predictability, controllability, appropriateness of adaptations etc. need to be taken into consideration.

A variety of approaches and techniques exist to evaluate personalised or adaptive systems, which made it challenging to choose the most appropriate method. Various studies in the literature provide a guide for the selection of most suitable evaluation methods. This section presents a literature review of the existing studies discussing the approaches and techniques for the evaluation of personalised systems.

Discussing the evaluation of early personalised or adaptive learning systems, Weibelzahl (2002) collated a synopsis of 43 evaluation studies of mainly adaptive systems in the learning domain based on the sample sizes of users, evaluation criteria and the stages of system lifecycle. It was reported that about a quarter of these studies had a single user, hypothetical users or no users at all in their sample sizes. Only 14 out of 43 studies had a good sample. The most frequent evaluation criteria included system accuracy, domain knowledge and duration of the interaction. These criteria are mostly suitable for the evaluation of adaptive learning systems. Most of the evaluation studies evaluated running systems and some evaluated systems in the early exploratory stages. This review does not describe what evaluation techniques are useful.

Assessing the evaluation variables and techniques, Van Velsen (2011) conducted a comprehensive survey of 63 studies based on the evaluation of various personalised systems. Some of the commonly assessed variables during the evaluation of personalised systems include usability, perceived usefulness, appropriateness of adaptation and intention to use. Evaluation techniques to evaluate personalised systems in the reviewed studies include comparing personalised and non-personalised systems, prototyping, questionnaire, interviews, data log collection, focus group, thinking aloud and expert reviews. Van Velsen (2011) not only reviewed the exiting evaluation practices but also provided suggestions to improve or avoid the inappropriate use of these evaluation techniques.

Mulwa et al. (2011) conducted a concise review of 56 existing User Centred Evaluation (UCE) based studies and summarised the pitfalls and problems in those studies. The UCE methods used at various phases of the evaluation referred to as stages of a User Centred Design method used in the existing evaluation studies were summarised. For example, focus groups and interviews could be used in a preliminary phase of evaluation to evaluate usability, the intention of to use and perceived usefulness. Experiment based testing could be performed at the final phase to assess interface and content adaptation. Examples of the problems identified in the existing approaches include too much emphasis on the summative evaluation rather than the formative evaluation, insufficient resources such as evaluating the system with a small number of users etc.

The classification of usability evaluation methods for interactive adaptive systems was performed by Dhouib et al. (2016) based on usability factors, development phases, adaptation layers (see section 6.2.1), stakeholders, evaluation location, resources (temporal and financial resources) and advantages/disadvantages of the evaluation method. The reviewed evaluation methods include the cognitive walkthrough, heuristic evaluation, focus group, user-as-wizard, task-based experiment and simulated users. These classification criteria help evaluators to select the right evaluation methods that fit their needs.

Apart from proposing the layered adaptation model, Paramythis et al. (2010) described a decision process for the selection of evaluation methods to evaluate each layer of an interactive adaptive system in various phases of development. An overview of evaluation criteria for each layer of a layered interactive adaptive system was given along with the suitable evaluation methods. This decision process and evaluation criteria provide evaluators with a guide to select evaluation methods suitable for their evaluation.

Instead of a general discussion around evaluating adaptive systems or various layers of an adaptive system, some studies have been specific about the evaluation of recommender algorithms that recommend items to the users. Unlike the traditional evaluation of the accuracy of recommender system algorithms, Wu et al. (2012) also emphasised evaluation of recommender algorithms based on other facets such as coverage, diversity, serendipity etc. and analysed a dataset of 500 customers of a discount coupon company called VELO. Coverage refers to the percentage of items for which the personalised algorithm can generate recommendations. Recommending similar items may not always be as useful, this suggests

the idea of recommending diverse or different items. Serendipity is the measure of surprising and successful recommendations of a personalised system.

The review of the existing studies as presented in this section provides a guideline for the researchers and practitioners to choose the most appropriate evaluation for their domain but do not propose generic techniques to perform the evaluation. The next section summarises various approaches and the associated methods to evaluate personalised systems.

6.2 Evaluation Approaches to Personalised Systems

To facilitate the evaluation of personalised systems, some researchers are agreed to adopt a piecewise or layered approach to evaluate every component of an adaptive system. Others emphasise the use of Human-Computer Interaction (HCI) evaluation methods for adaptive systems. There are studies that combine a layered approach and HCI evaluation for the evaluation of personalised systems. Due to the complexity of adaptive systems, no standard approach for the evaluation of personalised systems has yet been agreed. The next sections describe layered evaluation, HCI methods and existing studies covering personalised systems evaluation in detail.

6.2.1 Layered Evaluation Approach for Adaptive Systems

Some of the traditional evaluation approaches for adaptive systems include evaluation based on subjective user satisfaction, measuring precision, task completion speed, comparison of systems with and without adaptation etc. (Chin, 2001; cited in Brusilovsky et al., 2004; Paramythis et al., 2010). Comparative evaluation between personalised and non-personalised versions of the same system may not always be valid as a personalised system changes state and the comparison might not make sense in a particular state. Also, these traditional evaluation approaches tend to evaluate the system as a whole. For effective evaluation, the idea of evaluating personalised systems evolved to a layered approach where components of an adaptive system are evaluated separately. The layered approach is more rational as personalised system architecture has similar components.

Evaluation of each component of a personalised framework (section 2.1) originated the idea of layered evaluation. Paramythis et al. (2010) proposed a layered adaptation model with the following layers.

1. Collection of input data
2. Interpretation of collected data
3. Modelling of the current state of the world refers to deriving knowledge about the users, the context of system use and applying that knowledge to a dynamic model of adaptive interaction
4. Deciding upon adaptation
5. Applying adaptation

Various evaluation methods such as focus group, cognitive walkthrough, heuristic evaluation etc. can be applied at each layer to evaluate a personalised system. Cognitive walkthrough is a usability inspection method performed by domain experts and is used to identify usability issues in a system focusing on how easy is it for the users to accomplish tasks with the new system (Lira et al., 2014). Heuristic evaluation is the evaluation performed by domain experts against known usability principles. A cognitive walkthrough is task-specific whereas heuristic evaluation takes a holistic view of a system to catch usability problems not caught by other usability inspection methods (The Audiopedia, 2017). Magoulas et al. (2003; cited in Mulwa et al., 2011) proposed an evaluation approach that integrates heuristic evaluation to the layered evaluation. Empirical evaluation is an evaluation based on observation and experiment, which reveals important information about a system that cannot be uncovered otherwise (Chin, 2001). Weibelzahl (2002) proposed a framework based on empirical evaluation of various adaptation layers in a layered evaluation approach. Dhouib et al. (2016) and Paramythis et al. (2010) have discussed the classification of various evaluation methods based on the adaptation layers and appropriateness at each adaptation layer for the adaptive systems.

6.2.2 User Centred Evaluation

Unlike other evaluation techniques as explained in the previous section, User Centred Evaluation (UCE) is a user centred approach that uses HCI methods to explore usability problems of adaptive systems. Tintarev and Masthoff (2009; cited in Mulwa et al., 2011) discussed that existing evaluation approaches such as the layered approach, empirical approach and heuristic approach have not managed to solve all the usability issues and that users still encounter inherent usability problems. Core principles of any UCD approach include evaluation early in the design process to unveil design issues and perform evaluation throughout the design process (Kotamraju and Van der Geest, 2012; W3C Web Accessibility Initiative, 2008).

Numerous studies in the existing literature conducted UCE of personalised systems assessing usability, perceived usefulness, appropriateness of adaptations etc. using a variety of techniques such as questionnaires, focus group, interviews, observation etc. (Mulwa et al., 2011; Van Velsen, 2011). Gena (2006) proposed several evaluation techniques to be used at three main phases of personalised systems development life cycle including requirement phase, preliminary evaluation phase and final evaluation phase. In a user requirements phase, where user requirements are collected to build a system, techniques such as task analysis, observation, interviews and focus groups can be used to collect user requirements and evaluate them. A preliminary evaluation is an evaluation during system development. Techniques such as heuristic evaluation, participative evaluation, prototyping etc. are used in this phase. The final evaluation is the evaluation of a system when that system is developed. The techniques used at this stage include ethnography, where the system is evaluated by actual users in the field instead of in a lab and grounded theory, where system data is gathered and evaluated to derive a theory.

Most of the evaluation methods used in the UCE are HCI methods, which are used in the iterative User Centred Design process and are not acknowledged as personalised systems evaluation methods. However, these methods can provide valuable insights into the design and evaluation of personalised systems. For example, gathering user requirements and performing user task analysis can help to build user model and interaction model for a

personalised system. The following section describes how task analysis can be used as an evaluation method for a personalised system.

6.2.3 Task-based Evaluation

Task analysis (section 4.6) is a technique that can be applied broadly across various domains to describe the observable user behaviour and sequence of activities to perform tasks. Discussing task analysis method as a design and evaluation method for personalised systems, Gena (2006) stated that so far, there has been a little experience in applying task analysis to personalised systems but if task analysis shows the order of actions (system usage patterns) to perform a task then short cuts could be proposed to perform the same task. In addition, if it is possible to segment users then task analysis based on the actions of those targeted segments can provide adaptations to be proposed to the target user segments.

Classifying usability evaluation methods for interactive adaptive systems on the basis of various factors such as resources required, evaluation location, development phases etc., Dhouib et al. (2016) argued that a task-based evaluation experiment where users are given specific tasks to evaluate can be costly in terms of financial and temporal resources. This is because a task-based experiment may require different types of users to test different adaptations of a task. However, a task-based experiment is a user centric evaluation method to provide objective user opinions.

Hierarchical Task Analysis (HTA) illustrates the decomposition of tasks into subtasks and the flow of information through the decision points and tasks required to perform a service request. The information flow through the decision points represented by diamond symbols in HTA diagram determines task routes or branches for the specialised tasks in a service request and allows users to segment based on those task routes. Derived from the HTA, this new user segmentation approach is called task-based user segmentation, which is discussed in a publication emerged from this doctoral thesis by Sarwar and Hall (2017) and explained in section 4.6.2. Specialised tasks represented by task routes can be displayed and personalised to the users belong to the relevant user segment. User segments can be assigned the relevant tasks and engaged in the task-based evaluation.

A task-based evaluation approach provides a procedural evaluation method to assess the appropriateness of task routes for the user segments involved, which makes this intuitively appropriate to use. However, the involvement of user segments to evaluate their task routes adaptations incurs cost. Therefore, this study used a quick and effective heuristic evaluation technique to evaluate the personalised prototype as discussed in the next section.

6.3 Heuristic Evaluation of Personalised Prototype

Heuristic Evaluation (HE) is a usability inspection method, in which several expert evaluators inspect and evaluate the system interface and judge its compliance against a set of usability principles called heuristics (Nielsen, 1994; Nielsen and Molich, 1990). Usability heuristics are general usability principles originally developed by leading usability consultants Jakob Nielson and Rolf Molich based on their personal experience (Molich and Nielsen, 1990). Although more widely used, Nielson's and other traditional heuristics are not the only heuristics used in heuristic evaluation. Domain-specific heuristics can be defined to evaluate specific features of applications such as adaptability, learnability and playability (Quiñones et al., 2018).

Unlike other approaches to evaluate personalised systems as explained in the previous section, heuristic evaluation is a quick and inexpensive technique (Alonso-Ríos et al., 2018) providing valuable expert feedback to explore usability issues. For the experimental personalised prototype built in this study, which was aimed to prove if the prototype was acceptable to personalise e-government, evaluation with non-expert users could hardly reveal usability issues specific to personalised systems.

In this study, a set of domain-specific personalised heuristics were developed to evaluate the personalised prototype. These heuristics are listed in Table 6.3.1 and explained in section 5.2. Following the method in section 3.3.4, the heuristic evaluation was performed to evaluate the personalised prototype against the domain-specific set of heuristics developed for the personalised systems early in the design process (Tan et al., 2009). The results are described in the next section.

Heuristics for personalised systems
1.User profile controllability (user profile control)
2. Interface customisation
3. Service request progress tracking
4. Minimise input burden
5. Service availability and access
6. Ownership
7. Display the right data to the right audience
8. Grouping and navigation
9. Data and privacy statement

Table 6.3.1 *Domain-specific heuristics for the personalised systems*

6.3.1 Heuristic Evaluation of the Personalised Prototype: Results

Feedback data from five evaluators (UXD practitioners) were analysed by comparing their responses against each heuristic. Evaluators responded with their views discussing each heuristic after performing tasks as described in 'Appendix D: Sample Heuristic Evaluation Document' and explaining their interaction with the personalised prototype. The duplicate responses were removed and a list of recommendations for all heuristics was compiled. Listed below is the summary of the results derived from the heuristic evaluation against each heuristic listed in Table 6.3.1.

1. **User Profile Controllability (User Profile Control)**

Evaluators liked the idea of user profile controllability, where users could change the user profile information and the system would personalise accordingly. This was demonstrated in the prototype by allowing the user to change the profile address and see the amenities such as nearest schools to the selected address.

Evaluators suggested extending the user profile-based personalisation to more user profile attributes other than the user address demonstrated in the prototype. For example, attributes such as employment, age etc. should be used to personalise services if possible.

2. Interface Customisation

Evaluators agreed with the use of interface customisation and retention of the state of customisation by the system. The prototype was built to allow only navigation customisation, where users could only add/remove options of the main navigation. However, evaluators argued that customisation should be more widespread across the services. For example, in a school service which displays the nearest schools to the user profile address, users should be able to select schools and the system should display information about the selected schools only.

3. Service Availability and Access

Discussing the availability of services and access on the personalised prototype dashboard, evaluators pointed out that services should be readily available on the dashboard instead of displaying in the A-to-Z list of services. The display of services on the dashboard was the preferred option. The access of e-government services on the dashboard should be consistent and the system should guide users to navigate easily.

4. Service Request Progress Tracking

Service progress tracking allows users to keep track of the progress of their previous service requests. Evaluators found this feature extremely useful and highlighted the

importance of more proactive user communication with the government authorities.

The prototype displayed various stages of service request progress. It was advised to use notification alerts (SMS and email) to notify users of any progress made to the service requests, inform users of new services and allow active chat communication options to the users to escalate any disagreement with the government authorities.

5. Display the Right Data to the Right Audience

Displaying the right data to the right audience is a core feature of any personalised system. In the personalised e-government prototype, this was demonstrated by displaying and personalising the commonly used services for the target user personas.

Overall, evaluators experience with the personalised services was positive. However, they acknowledged the need to customise the service groupings with the ability to add and remove services. This would give users control to customise the system.

6. Minimise Input Burden

The personalised prototype used user profile information not only to personalise services but also to reuse that information in services where required. This was demonstrated by auto form filling in the personalised prototype.

Evaluators also emphasised that the personalised system should remember previous user interactions to minimise input burden. The system should remember user customisation/configuration history and retain this information unless user circumstances change or users decide to change those configuration options.

7. Ownership

All the evaluators were agreed on the importance of name-based personalised messages demonstrated by the personalised prototype; however, they stressed that merely name-based messages were not enough to create a sense of ownership. Evaluators pointed out that adaptive services that meet user needs and customisation tools are the other important factors that give users a sense of ownership. Customisation tools give users a sense of controllability and ownership to change the interface and personalisation.

8. Grouping and Navigation

Evaluators found the service groupings easy to navigate through and acknowledged that the grouping and navigation improved the usability of the personalised portal. Evaluators stressed the need to display the commonly used or critical services on the top in the group of services.

The prototype dashboard grouped and displayed similar services under the same category, for example, the services such as rubbish collection, garden waste collection, bulky waste collection etc. were grouped under the 'Rubbish and recycling' category. Evaluators preferred service grouping on the prototype dashboard over displaying services in the A-to-Z list. It is obvious that services readily available on the personalised dashboard were grouped together and easier to find than the A-Z list of services.

9. Data and Privacy Protection Statement

Displaying the data and privacy protection statement is a legislative requirement, which informs users about how their data is used by the system and its compliance with the privacy laws such as GDPR (Government Data Protection Regulation).

In the personalised prototype, the same data & privacy protection statement hyperlink was added to two places, on the login screen and every page footer. Evaluators preferred the hyperlink in the footer over the login screen as it was more noticeable and easier to find on the page footer.

6.4 Summary

This chapter reviewed several evaluation methods for personalised systems, which provide a guide to choose the appropriate evaluation method. Among the reviewed, layered evaluation and task-based evaluation are logical methods specific to evaluate personalised systems. However, both methods are resource-intensive and difficult to implement.

A simplistic heuristic evaluation method was used to evaluate the personalised prototype. Heuristic evaluation was found to be quick, inexpensive and appropriate to evaluate the personalised prototype against a set of domain-specific heuristics. Unlike user testing which is more productive later in the design process, heuristic evaluation tends to be more effective early in the design process (Tan et al., 2009). Therefore, it was more appropriate to evaluate the personalised prototype built as a proof of concept to personalise e-government.

7 PERSONALISATION OF eGOVERNMENT SERVICES (PeGS) METHODOLOGY DEVELOPMENT: RESULTS FROM STAGE 5

The integration of design techniques and methods applied to personalise e-government as discussed in the previous chapters, resulting in a new design method called PeGS (Personalisation of eGovernment Services). This chapter presents the results of the method used in Stage 5 'PeGS Methodology Development' of the research design by reviewing the development and validation of PeGS.

7.1 Why a New Design Method was Needed?: This section briefly explains the need for a new design method adopted for the design of personalised e-government.

7.2 Steps of the Personalisation of eGovernment Services (PeGS) Method: This section discusses how the PeGS method was developed by integrating techniques from several design approaches used in this study. This section also presents an overview of the PeGS design method and explains its steps with the output produced at each step.

7.3 Personalisation of eGovernment Services (PeGS) Validation: The validation of PeGS method with experts to ensure its suitability to personalise e-government services is explained in this section. The areas of strength and limitations of PeGS method as explored by the experts are also discussed.

7.1 Why a New Design Method was Needed?

Governments are committed to delivering citizen-centric and personalised e-government services with service design that is directly related to user needs and behaviours rather than to the requirements of the governments (United Nations, 2018, p.18). Despite governments commitment to deliver citizen-centric services, the peculiar nature of e-government poses a challenge to its citizen-centric design. Kotamraju and Van der Geest (2012) pointed out four manifestations of the tension between e-government and User Centred Design including contradictory visions of the task between e-government and users, the government must

design for all, governments and users differ in their commitments to the rules and regulations and finally their conflicting desires about the nature of their relationship.

Several existing design approaches with a focus on user needs (User Centred Design), user goals (Goal Directed Design), user participation (Participatory Design), innovation to create value for end users (Design Thinking) and activities enabled by the system to perform tasks (Activity Centred Design) were reviewed as explained in section 2.4. None of the reviewed design approaches alone could meet the challenges in the design of e-government, a new design method was required that not only focused on the user needs but also the activities that enabled users to perform public e-services bound by the laws.

Ideally, in the new design process for e-government, users and other stakeholders should be allowed to participate in the design process. User goals and tasks required to achieve those goals should be considered and analysed. Designers should bring innovation to create value for end users in the design process. eGovernment, where tasks are bound by regulations, should be designed according to those regulations. The requirements to design e-government suggest a design approach that combines the best features of various design methods. The next section explains how a new design method was developed by combining and adapting the best fit features of the exiting reviewed design approaches.

7.2 Development of Personalisation of eGovernment Services (PeGS) Method

The literature review of the existing studies to develop a new methodology from the existing methodologies was performed, which revealed a methodology as explained in section 3.3.5. This methodology was used to build the Personalisation of eGovernment Services (PeGS) design method.

To find a best fit method to design personalised e-government with a focus on users and system activities, a thorough literature review (section 2.4 and section 2.5) of the existing design approaches and methods was conducted to identify common design methodologies used to personalise e-commerce, e-government and both.

Five commonly used design methodologies were selected based on Human Centred Design (User Centred Design), Goal Directed Design, Design Thinking, Participatory Design and Activity Centred Design approaches. Analysis of the suitability of the selected design methodologies was performed by comparing and filtering the best fit stages required to design personalised e-government. Table 7.2.1 lists specific stages of the selected design methodologies and stages of the draft design method derived from the selected methodologies.

Methodology	**Methodology stages**			
	Research	**Analysis**	**Design**	**Evaluation**
User Centred Design (König et al., 2012; Magain, 2013)	User research	User data and task analysis	Prototyping	User testing, Heuristic evaluation
Goal Directed Design (Cooper et al., 2014)	User (end user and other stakeholders) research	User & domain modelling (Personas, scenarios, workflows)	Create design framework	Design refinement & Support
Design Thinking (Brown, 2008; Chon and Sim, 2019)	Empathize (research user needs)	Define (User need analysis)	Ideate & prototyping	Testing
Participatory Design (Barcellini et al., 2015; Kang et al., 2015)	Interactive group discussion	Analysis of group data	Design Workshop to generate ideas	Design feedback
Activity Centred Design (Norman, 2005; Porter, 2008)	Focus on activities	Activities/tasks analysis		
Draft Design Methodology	User and services research	User and domain modelling (Personas, Advanced task analysis)	Ideation, personalised heuristics development and personalised prototyping	Heuristic evaluation

Table 7.2.1 *List of commonly used design methodologies and their stages to develop a draft design methodology*

The draft design methodology was then applied to design and personalise local e-government services of Durham County Council (DCC) with multiple methods used and adapted at each stage. Finally, this draft methodology was refined into the final draft method called PeGS (Personalisation of eGovernment Services). See Table 7.2.2 for the methods used at each stage of the draft design methodology and steps of the final draft PeGS design method.

Stages	Methods	Steps
User and services research	Focus group, Google analytics, Individual Interviews	Service selection and analysis, Targeting audience, Task decomposition and analysis, Task-based user segmentation
User and domain modelling	Building personas, Advanced Task Analysis	
Ideation and personalised prototyping	Define heuristics, Building design concepts and ideas, Prototyping	Prototyping
Evaluation	Heuristic evaluation	Prototype evaluation

Table 7.2.2 *Mapping from draft design methodology to PeGS method*

Figure 7.2.1 outlines the PeGS design methodology, which is an eight-step method that can be used to design a personalised public e-services portal. PeGS was developed through the experiences and approaches conducted in this research, aggregating the most effective techniques. The details of PeGS steps are as follows.

7.2.1 Step 1: Service Selection and Analysis

In this step, analysis of secondary data in relation to e-government service usage is performed to find the common services and their usage context. Here, the secondary data refers to the data that is already collected and available from existing sources such as usage data, feedback from citizens, citizen studies etc. The data sources usually include CRM systems, Google Analytics or other related systems.

Data analysis is performed by identifying and selecting the most commonly used services and their usage factors such as usage context. Ranking/Listing of the selected services should be performed to identify personalise first services. The data usage context analysis will typically reveal opportunities to personalise services based on seasons of the year, events, incidents and other factors. The output of this step includes:

1. List of commonly used services to personalise
2. Services' usage factors (e.g. season, events, etc.) that influence service usage

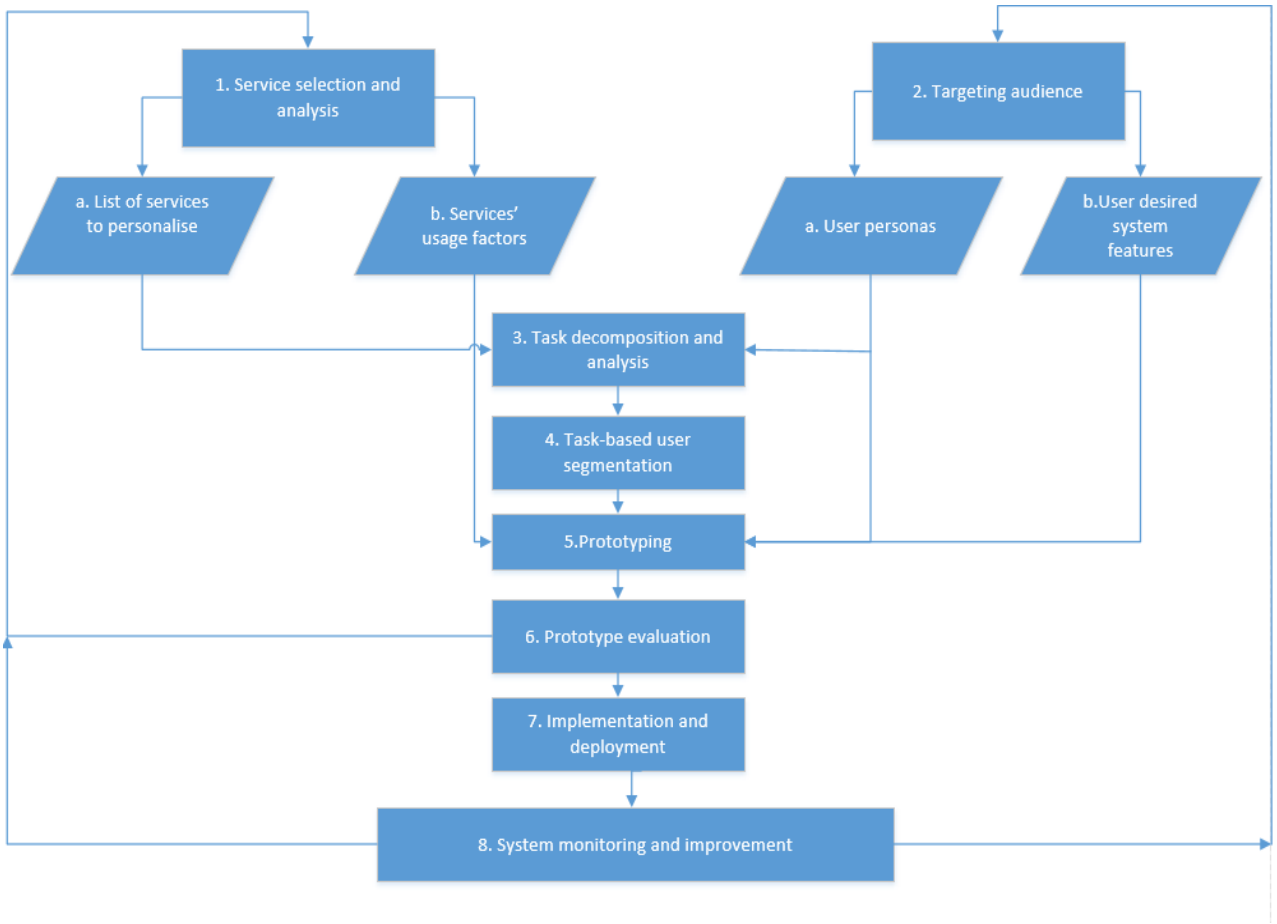


Figure 7.2.1 *PeGS method diagram*

7.2.2 Step 2: Targeting Audience

In this step, user information of a target audience or citizen group in relation to using and personalising e-government services, is collected to build user profiles and user's desired system features.

eGovernment serves a large base of users including all citizens living in a specific region or country. Therefore, census data with a macro-level analysis of the population based on demographics helps in selecting target citizen groups. For example, target citizen groups may include employed adults, adult students, senior citizens etc.

Qualitative data collection methods such as focus group and interviews with participants from the targeted citizen group are used at this stage. The focus group method should be conducted with additional activities that not only cover a discussion about participant experiences using e-government but may also include walkthrough screens highlighting prospective personalised e-government features. The focus group identifies user perspectives and views on personalising public e-services and their expectations revealing the desired system features of the user.

Interviews reveal user information such as user behaviour (what public e-services the target users use?), goals & objectives (why target users use public e-services?), pain points and expectations in relation to using e-government. User information collected in the interviews is structured in design artefacts called Personas. This step concludes with:

1. User personas of the target citizen groups
2. User's desired features in personalised design

7.2.3 Step 3: Task Decomposition and Analysis

This step focuses on system activities and tasks that enable target users to accomplish a specific service request e.g. report a faulty streetlight, register for the garden waste collection, pay for the council tax etc. Hierarchical Task Analysis (HTA) is performed for the selected personalise-first services from step 1 by decomposing tasks into various level sub-tasks, exploring current activities and optimising these. HTA is further extended with the

data/information flow represented in terms of decision points and actions, see section 4.6.1 for details. The decision points are the critical points where decisions are based on the input from a user or system. The output of this step includes:

1. HTA (including decision points) of the personalise-first list of services

7.2.4 Step 4: Task-based User Segmentation

The decision points in the extended Hierarchical Task Analysis (HTA) provide information that enables user segments to be derived. At each decision point, at least two opposite user segments are derived and the relevant tasks for each derived user segment separate from that point onwards. As the tasks branch out from the decision point, the basis for service adaptations is identified for the derived task-based user segments. Identifying user segments and service adaptations is required for service personalisation. This process is further explained and demonstrated in section 4.6.2 by performing extended HTA of Garden Waste Collection Service. The output of this stage is as follows.

1. Task-based user segments

7.2.5 Step 5: Prototyping

The output from step 1 and step 2 is used to build the horizontal design elements required for the overall personalised web portal such as user personas (user profiles) including details such as services the target users are most likely to use and user's desired features. The output from step 3 and step 4 is used to build the vertical design required to design individual e-government services for the target users.

Just before building a prototype, usability heuristics (features) are selected or developed for personalised systems. The heuristics will inform the design and evaluation of the personalised prototype. Finally, a high-fidelity prototype of a personalised web portal is built that adapts for each target user persona based on context-based usage factors and other recommendation techniques. Each user should have authenticated access to the prototype.

The high-fidelity prototype should enable remote access for evaluation and user testing. This step results in:

1. A high-fidelity prototype of a personalised web portal.

7.2.6 Step 6: Prototype Evaluation

The prototype built in the previous step is evaluated using:

1) Heuristic / Expert evaluation with the experts,
2) User Evaluation where user activities should be recorded or monitored by the expert, and/or
3) Other evaluation methods such as think-aloud method, focus group etc.

Usability, perceived usefulness, user satisfaction, appropriateness of adaptation etc. of a personalised prototype are evaluated at this stage. All possible adaptations of the prototype should be evaluated. Based on the user feedback, this process iterates back to the previous stages. Design is further evaluated and refined until it gets to an acceptable form.

Various evaluation methods can be used at this stage. However, this study recommends involving users in the evaluation process. Users belonging to the target user groups should be involved in the evaluation of the web portal. For individual services, users belonging to the task-based user segments (Step 4) should be involved in the testing and evaluation of each service adaptation. The output of this step is as follows.

1. Explore errors and usability issues early in the design process

7.2.7 Step 7: Implementation and Deployment

Finally, the prototype is implemented as a fully functional system, tested and deployed. The deployed system should allow users to submit and capture user feedback about their interaction with the system. The output of this step includes:

1. System implementation and deployment

7.2.8 Step 8: System Monitoring and Improvement

System monitoring and improvement is the post system deployment stage, where success is constantly measured, and system improvement made where required. System success is measured by constantly monitoring the digital channel shift, customer feedback and responding constantly to the customer insights. Digital channel shift refers to the shift in customer communication to online medium from other media such as phone, face-to-face etc. Customer feedback data can be available from the CRM or other related systems. Customer insights can be found and viewed from web analytics.

If the system monitoring data does not show signs of improvement such as the low rate of digital channel shift and customer dissatisfaction, then the process goes back to the previous stages and improvements are made. This step results in:

1. Continuous system improvement by monitoring and responding to the customer insight

7.3 Personalisation of eGovernment Services (PeGS) Validation

To ensure the suitability of PeGS as a design method to personalise e-government services and further explore the strengths and limitations of this method, the validation of PeGS was performed with experts.

Initially, it was planned to use a Delphi study to validate the Personalisation of eGovernment Services (PeGS) design method. Delphi is a structured multi-round process that uses a group of experts to achieve a consensus opinion (Goldman et al., 2008). Conducting bibliographic analysis of the use of Delphi technique over the period of 42 years (from 1975 to 2017), Flostrand et al. (2020) concluded that the use of Delphi method has continued to grow in published scholarly literature for producing forecasts or estimates, and seeking consensus on best policies and practices through the aggregation of expert opinions. In this study, a three-round Delphi study was planned with a group of six Human Computer Interaction (HCI)

experts. However, despite several attempts to contact the potential experts to participate in the Delphi study, there was a little take-up. Therefore, alternative options were considered to validate PeGS.

Alternative methods to validate PeGS including dissemination individual interviews and focus groups with experts were reviewed (Burnett, 2013). Individual interviews tend to generate more discussion topics than focus groups as proved by Guest et al. (2017), who compared the two methods by generating a list of topics/items in the health care domain. Therefore, individual interviews with experts were selected to validate PeGS method.

As discussed in section 3.3.5, semi-structured interviews were conducted with five experts including four IT professionals and a UXD practitioner. Among IT professionals, 2 were business analysts, 1 CRM support team leader and one CRM developer. Before the interviews, a detailed PeGS document was sent to the participants including open-ended questionnaires about the methods and techniques used in the PeGS. Each interview which lasted around 40 minutes was transcribed. The data collected from the interviews were analysed by generating codes (brief descriptions about the topic) and the classification of data into themes and broader categories (Mortensen, 2019; Roulston, 2014, p.305). The data analysis resulted in two main categories including 'PeGS implementation concerns' and 'PeGS salient features' with several related themes. Listed below are the details of these categories.

7.3.1 PeGS Salient Features

The 'PeGS salient features' represents a category of information from the interview participants in support of the PeGS design method. This category includes themes that represent assertions about the strengths of PeGS method. Listed below are the main themes in this category.

1- Secondary Data Analysis

Participants emphasised the importance of using secondary data analysis to improve the

user experience with the public e-services. One participant discussed, “The use of secondary data as a starting point would reveal a breadth of subject matters such as user feedback, user behaviour in relation to the use of e-government services etc.”. Referring to the benefits of using secondary data, another participant said, “Secondary data analysis would provide insights into the customers and their use of services, which could guide the system development process”.

2- Task Analysis and Task-based User Segmentation

Participants agreed with the use of advanced task analysis and task-based user segmentation techniques to personalise public e-services for the citizens. Referring to the display of only relevant tasks and information to the right segment of users, one participant argued, “Changing user view of the service is a much better technique than simply displaying all available options. This would allow users to quick and easy access to the service”. Discussing the potential benefits of task-based user segmentation and personalising tasks for those user segments, another participant said, “This would hopefully result in a resource-saving for the local authority as fewer people would contact them to get information that could, in theory, be fed directly to them”.

3- Personalised Recommendations

The ‘personalised recommendations’ is an important feature to boost sales and revenue in e-commerce. This is equally important for e-government as asserted by one of the participants, “We may use this personalisation approach to cross-sell certain products. For example, we may sell the bulky waste collection and garden waste collection services to those customers who signed up to pay council tax online”. Discussing the benefits of the personalised recommendations another participant said, “Using personalised recommendations, citizens can be presented with targeted messages and services based on their geographical location”.

4- Viability of the PeGS Method

Participants were optimistic about the feasibility and viability of the PeGS design method. In particular, the user centredness of the PeGS method and its clear well-defined steps were appreciated by the participants. Discussing the feasibility of the PeGS method, one participant commented, “I believe the PeGS is a potentially elegant solution to deliver personalised e-government interactions for customers. It is based on sound principles such as specific customer wants and needs rather than just giving visibility to the most used services regardless of customer eligibility”. Highlighting the importance of personalisation and user expectations in PeGS, another participant said, “The personalisation and user segmentation techniques coupled with valued customer insights are highly important to build a system tailored to the user needs”.

7.3.2 PeGS Implementation Concerns

The ‘PeGS implementation concerns’ category of information is based on the concerns raised by the interview participants in the implementation of the PeGS design method. This category includes themes that represent assertions about the limitations of PeGS method. Listed below are the main themes in this category.

1- Level of Personalisation

Personalisation of e-government services offers a unique challenge given the breadth of services offered, which range from universal to highly specialised areas. The level of personalisation refers to how far e-government services need to be personalised. This was the primary concern raised during the PeGS validation. The level of personalisation is determined by several factors such as the granularity of user segments, what needs to be personalised and what recommendation techniques are required to personalise services

for the target user segments. Concerns were raised about the segmentation of users, maintenance of user profiles and extent of personalisation.

Discussing the granularity of user segmentation, one participant said, “Building user personas across a highly complicated sector is challenging. It is difficult to build and maintain a high granular persona”. Pointing to maintaining and updating user profile another participant mentioned, “User profile would need regular updates when user circumstances change such as changes in the employment status, number and age of user’s children etc.”.

2- Validation of Task Analysis

Although task analysis and task-based segmentation methods used in PeGS were recommended by the participants. Validation of the tasks and information flow through these tasks with users may reveal important information as suggested by one participant, “Task analysis and task-based user segmentation techniques would be workable if findings/assumptions from the task analysis are further validated with the users”.

3- User Evaluation

User evaluation of a personalised system with several adaptations is resource-intensive. This is particularly true when multiple adaptations of a service request derived from the task analysis are evaluated by the user segments. One participant proposed an idea to automate the user evaluation based on the user preferences that could be derived from the secondary data.

4- Technology Constraints Imposed by Third-Party Systems

Like any other organisations, government organisations use a variety of in-house built or third-party software applications. Participants raised concerns to implement personalisation using the PeGS method in case third-party software systems do not provide support to personalisation. The implementation of PeGS won't be possible with the use of such third-party applications unless the vendors change these systems.

7.4 Summary

This chapter focused on the development of a new eight-step design method by applying the best fit steps of various other design methods to personalise e-government services. Each step of the new design method called PeGS (Personalisation of eGovernment Services) was explained with the output produced at that step. Finally, an overview of PeGS validation with experts was presented to explore the suitability of PeGS as a design method, its strengths and limitations. The validation process revealed salient features of the PeGS method and some areas of concerns.

8 DISCUSSION

This chapter discusses the approach taken to answer the research question, “How can personalisation be applied to enable e-government service delivery for citizens?”. The key findings presented in the previous chapters are further considered along with a discussion of the work’s contribution to knowledge and opportunities for future work. The chapter contains the following sections.

8.1 Synthesis of Research: This section presents the collation, interpretation and synthesis of the findings from the literature reviewed and activities carried out in this study. The methods and techniques used are discussed in terms of their contribution to the research.

8.2 Originality and Contribution to Knowledge: This section discusses the outcomes that emerged from this study that identifies the originality of this research. A discussion of the contribution to knowledge and the implications that arise are also provided.

8.3 Limitations of this Study: The limitations of this research are briefly discussed, including the limitations of the methods used, organisational barriers that impede the implementation of personalisation in e-government and the replicability issues of using this design approach in different organisational contexts. Reflections on possible improvements to the research design are also discussed.

8.4 Future Work: The section discusses the advancement of the research presented in this thesis by exploring the unexplored areas such as the recommendation techniques to personalise e-government, user testing of the personalised prototype to identify usability issues, further development of e-government ontology and the use of PeGS (Personalisation of eGovernment Services) in different organisational contexts.

8.5 Reflection: This section reflects on the completed research, providing views on both personal and professional development as a result of having completed the PhD.

8.1 Synthesis of Research

This section discusses the approaches, techniques and methods that contributed to the design, development and evaluation of the research presented in this thesis, explaining the impact in terms of addressing the fundamental question of this research, “How can personalisation be applied to enable e-government service delivery for citizens?”.

8.1.1 User Centred Design Approach for eGovernment

User or citizen involvement in the design of e-government has the potential to increase citizen satisfaction and empowerment (Ju et al., 2019), and improve e-government uptake (Kotamraju and Van der Geest, 2012). To achieve high levels of citizen satisfaction, governments across the globe are committed to providing user-centric services (United Nations, 2014). This study applied a User Centred Design (UCD) approach focusing on user needs and expectations to design and personalise e-government services of Durham County Council, a UK local government authority.

After reviewing the commonly used User Centred Design approaches as discussed in section 2.4 including Human Centred Design (International Standard Organisation, 2019), Goal Directed Design (Cooper et al., 2014), Participatory Design (Kang et al., 2015), and Design Thinking (Chon and Sim, 2019), a combination of best fit methods for the design of personalised e-government from these design approaches were selected. These selected methods include upfront user research methods from Human Centred Design without collaborative design activities recommended in Participatory Design, personas for the target users’ segment from Goal Directed Design and design concepts Ideation from Design Thinking.

By involving citizens early in the user research stage of the design, this study found that citizens tend to explain their general interaction and experience with e-government exploring usability issues instead of going into specific details of the public e-services used by them. As suggested by Holgersson and Karlsson (2014), ordinary citizens with little knowledge of government services prefer to participate in upfront user research and requirements gathering activities of Human Centred Design approach and do not prefer to participate in

collaborative Participatory Design activities due to lack of time and knowledge about the e-government domain.

The delivery of personalised public e-services needs a clear strategy with a focus on citizen needs and demands (Kieboom, 2017; Lyons, 2019), which caters for the design of a personalised system requiring user modelling, content modelling and recommendation/filtering techniques (Six, 2018). User modelling requires building a user profile of a target user segment. Segmenting users can provide tremendous opportunities to effectively communicate with users and assess their needs. This study used personas to represent the target user segments illustrating their expectations, pain points, public e-services the target users most likely to use, their goals and objectives.

The effective implementation of any User Centred Design approach requires an organisation strategy for involving users in the design of e-services. The lack of strategic view on citizen participation and reluctance from practitioners towards participation impede its proper implementation (Simonofski, 2019). For e-government, there are inherent challenges in applying the UCD approach. The characteristics of government authorities such as serving the entire population in an area and delivering services bound by laws (Lee and Rao, 2009; Van Dijk et al., 2015) make the citizen-centric design of e-government more challenging. Kotamraju and Van der Geest (2012) presented four manifestations of the tension between UCD and e-government including contradictory visions of the task between e-government and users, the government must design for all, governments and users differ in their commitments to the rules and regulations and finally their conflicting desires about the nature of their relationship.

This tension between User Centred Design and e-government does not mean to stop user involvement in the design of e-government; however, these contradictions need to be recognised and addressed in the design process. With a diverse user base, most User Centred and Participatory Design e-government projects need to continually address stakeholder identification and representation by progressing stepwise and incrementally (Pilemalm, 2018). Focusing too much on user needs may go against the rules and regulations. The inherent challenges in the design of e-government give rise to the need to adapt the design approach to focus not only on users but also on the activities and tasks enabled by the government authorities to make e-government service requests. The next section discusses

how the Activity Centred Design approach and task analysis method were used for the design of personalised e-government.

8.1.2 Activity Centred Design and Task Analysis

Government authorities provide a diverse range of e-services to the public. As discussed in the previous section, the representation and involvement of heterogeneous citizens and other stakeholders in User Centred Design approaches has been reported as a challenge for the design of public e-services (Karlsson et al., 2012; Pilemalm, 2018).

Focusing too much on the requirements of a single target user segment may make a public e-service less usable for other user segments. There are some public e-services aimed at a specific group of citizens such as social care services, many public e-services are offered to all the citizens. According to Karlsson et al. (2012), "Demarcating a target group to define specific design goals is somewhat at odds with the general purpose of e-services". Therefore, this study reviewed and followed Activity Centred Design approach with a focus on activities and tasks enabled by government authorities to perform public e-service requests.

Activity Centred Design (ACD) does not focus on 'the user' as an individual unit and provides a framework which considers what people do, or what designers want them to be able to do, in a more-or-less general sense (Rowland, 2013). This can be a very attractive perspective for e-government where the user-base is diverse, the goals are varied, but the broad activities are less numerous and easier to define.

Activity Centred Design is not a process and is one of many perspectives that can be employed in the design (Holmes, 2018). Therefore, there are no definitive processes, methods and deliverables that are to be used in the Activity Centred Design (Williams, 2009). However, Task Analysis can be used as a tool to perform a detailed analysis of the steps required to perform tasks (Norman, 2008; Rowland, 2013). This study followed the Hierarchical Task Analysis (HTA) approach developed by Ejeh and Hall (2018), which was used to identify and assess the knowledge used in task fulfilment. Here, HTA was used to understand the tasks and flow of information between those tasks required to make public e-service requests.

Traditionally, task analysis is used as a User Centred Design technique to identify and understand user tasks to facilitate and formalise requirements for system design (Liu et al., 2017). A focus on user tasks is a key principle of a User Centred Design approach (International Standard Organisation, 2019). However, this study used Hierarchical Task Analysis as a technique informed by Activity Centred Design to focus on system tasks enabled by a government authority to design public e-services. The reason is that the Hierarchical Task Analysis theory has its roots in system-centric activities (Shepherd, 2001). According to Promann and Zhang (2015), the limitation of classical HTA in its system-centric focus is not considering the wider contexts of the tasks under examination. However, Human Computer Interaction shifted the idea of individual information processing model to a networked and contextually defined set of interactions (Hollan et al., 2000). In the context of e-government, where services are bound by regulations and government authorities are committed to serving all the citizens, Hierarchical Task Analysis with a focus on tasks is a viable approach.

This study performed a detailed task analysis of the Garden Waste Collection Service (section 4.6.1) and demonstrated its usefulness by focusing on the system tasks required by users to make this service request. These tasks were those designed for the users by the government authority without much focus on the users. Focusing on a diverse range of users to design a service request may make the design process overly complicated and, service tailored for the particular likes, dislikes, skills, and needs of a particular target population, the less likely it will be appropriate for others (Norman, 2008). Therefore, it is recommended to focus on detailed task analysis, task automation and personalisation with common tasks to improve the experience for all the users.

A design approach combining the User Centred Design with a focus on users and the Activity Centred Design with a focus on tasks was selected and applied for the design of personalised e-government. This combined design approach follows Williams (2009), who argued that User Centred Design and Activity Centred Design methods should inform each other as one cannot separate the user from activity when researching, designing, or evaluating the user experience. Following the design approach with a focus on users and tasks, the next section explains the user segmentation techniques, personalisation of public e-services and the associated tasks for the target user segments.

8.1.3 User Segmentation for the Effective Personalisation of eGovernment Services

As discussed in section 8.1.1, the design of a personalised system requires user segmentation for effective communication with users and assessing their needs. There are many ways to define user segments including segmentation based on demographic attributes, personality traits, personal interests, psychological status, lifestyles, previous interactions such as items viewed, purchase history etc. (Saia et al., 2016; Zhao et al., 2019). eCommerce can benefit from these segmentation approaches by targeting specific customers for effective marketing. This is different for e-government, where focusing on all facets of users is time-consuming and difficult to achieve with a huge and diverse user population. Furthermore, in most cases, a granular level of user segmentation is not even required for the design of e-government services aimed for all citizens. Therefore, this study targeted broad user segments of working adults with family and adult students based on their high population in County Durham.

To better understand citizens' use of e-government services and the needs of the target user segments, data analytics was used, and citizens were engaged in the discussion. Data analytics revealed service usage factors such as seasons, incidents, scheduled events etc., which could be used to personalise services. A draft e-government ontology graph was developed, see Figure 4.2.1, which classifies services based on the usage factors and models the interaction between citizens and services. Further research is required to develop the e-government service ontology and effectively use this in the process of personalisation. Citizens from the target user segments were engaged in discussion using a focus group and interviews. The discussion revealed user behaviour (what services users use), goals/objectives (what motivates users to use these services), user expectations and pain points in relation to using local public e-services. The results were illustrated in personas (see section 4.5), which formed the basis of personalised interaction of the target user segments with the public e-services.

Government authorities serving huge and diverse user populations, focusing on different user attributes for user segmentation is time-consuming and difficult to achieve. In addition to user segmentation based on user characteristics and other attributes, this study proposed a new task-based user segmentation approach with an emphasis on personalisation of task fulfilment, with user segments derived from the tasks being designed. Derived from the detailed Hierarchical Task Analysis, task-based user segmentation technique was published in

Sarwar and Hall (2017) and further explained in section 4.6.2. This approach enables, personalisation with the experience tailored to the user through incorporating or removing tasks and services most relevant to the user segment. The requirements of the target users' segments for the local e-government provided the basis for building a personalised e-government prototype as discussed in the next section.

8.1.4 Design and Evaluation of Personalised Prototype

To visualise the design concepts built from the user requirements of the target user segments, Hierarchical Task Analysis of the public e-services and personalised systems, a personalised e-government prototype was built. The challenges in the design of e-government as discussed in section 8.1.1 including providing a diverse range of services to all the citizens and delivering services compliant with the law make the design of personalised e-government systems somewhat different to the design of commercial personalised systems. Therefore, literature was reviewed to identify heuristics specific to personalised e-government systems and a set of personalised usability heuristics were developed based on the literature review and user research.

The personalised e-government prototype was built based on the usability guidelines defined by the personalised heuristics and was later assessed against these heuristics in the prototype evaluation by experts. The e-government prototype built in this study was as a proof of concept aimed at showing that the personalised e-government system could be implemented. With the personalised heuristics not evaluated before, the heuristic evaluation was chosen to evaluate the prototype against these heuristics to unveil any usability issues. Empirical evidence showed that evaluation by experts, called Heuristic Evaluation, tend to explore more usability issues than user testing (Maguire and Isherwood, 2018; Tan et al., 2009). Also, heuristic evaluation is inexpensive, fast and does not need special resources (Wilson, 2014, p.8).

The results from heuristic evaluation supported the domain-specific heuristics as useful features to build personalised e-government portal. Evaluators did highlight the limitations

of the prototype; however, they acknowledged the importance of personalised heuristics and their value-added features for the end users.

8.1.5 Design Method to Personalise e-government

At the beginning of this study, various design methods to personalise e-commerce, e-government or both were reviewed. The existing design methods of personalisation as discussed in section 2.5 are technology centred with a focus on implementing personalisation without considering the challenges in the design of e-government. This study could not find a design method that could provide detailed steps to design personalised e-government. Therefore, various design methods and approaches as explained in section 8.1.1 were reviewed and used to personalise e-government.

The design methods and techniques used to personalise local e-government services of Durham County Council were combined and integrated into a new design method called Personalisation of eGovernment Services (PeGS). PeGS was developed by choosing and applying the best fit methods for personalising e-government services from User Centred Design and Activity Centred Design approaches as discussed in the previous sections 8.1.1 and 8.1.2. The best fit here refers to the methods that were effectively used in this study to personalise e-government services and produced the best outcome. See section 7.2 for further details explaining how PeGS was developed.

PeGS is a multi-step iterative design method for e-government with the steps including ‘service selection and analysis’, ‘targeting audience’, ‘task decomposition and analysis’, ‘task-based user segmentation’, ‘prototyping’, ‘prototype evaluation’, ‘implementation and deployment’ and ‘system monitoring and improvement’. These steps reflect the methods used to personalise public e-services of Durham County Council.

To ensure the suitability of PeGS as a viable method to personalise e-government, PeGS was validated with the experts responsible for the provisioning of e-government services. The participants highlighted the strengths and limitations of the PeGS and were positive about the implementation of the PeGS as a viable design method.

8.2 Originality and Contribution to Knowledge

This doctoral thesis aimed to answer the research question, “How can personalisation be applied to enable e-government service delivery for citizens?”.

This research focused on how governments can better provide e-services to citizens through personalisation and applied various methods to design personalised e-government using an illustrative case study of Durham County Council.

The main originality and contribution to the knowledge of this thesis are based on the development of the following.

1. **A Design Approach with a Focus on User Involvement and System Tasks to Enable eGovernment Personalisation**

As discussed in section 8.1, government authorities serve huge and diverse user populations with public e-services bound by regulations, focusing too much on users might not deliver the services effective for all the citizens and be compliant with those regulations. Therefore, this study applied a design approach by combining User Centred Design with a focus on user involvement and an Activity Centred Design approach with a focus on system tasks enabled by the government authority to personalise the e-government system.

Although Williams (2009) discussed that User Centred Design and Activity Centred Design approaches should be used together to design web applications, no formal methods and techniques were specified. This doctoral research presented the design approach by combining User Centred Design and Activity Centred Design and applied the associated methods and techniques to design personalised e-government, which is original.

This research proved that the design approach with a focus on users and system tasks caters for the challenges in the User Centred Design of e-government (see section 8.1.1) and can be used to design personalised e-government, which is a contribution to the e-government domain.

2. eGovernment Ontology for Citizens' Interaction with eGovernment Services

This study contributed to the knowledge by revealing the e-government services usage factors and building the e-government ontology illustrating the classification of e-government services based on the usage factors and modelling the citizen interaction with those services (section 4.2). The e-government ontology provides opportunities for further research and can be used to offer personalised services to the citizens such as displaying the most relevant seasonal services in specific seasons etc.

The idea of using ontologies in the semantic web to specify common modelling representations of the web linked data and to annotate semantics (Taye, 2010) was used. In the semantic web, a similar ontology-based approach for personalised content filtering and retrieval was presented by Cantador et al. (2008). This study extended the use of ontology in the non-semantic web and developed a new ontology to describe the interaction between citizens and e-government service based on the service usage factors and proposed personalisation opportunities.

3. Task-based User Segmentation Technique

Derived from the Hierarchical Task Analysis, this doctoral research developed a new task-based user segmentation technique, which segments users based on task fulfilment and personalises tasks to those user segments. Task-based segmentation is described in a publication that emerged from this doctoral thesis by Sarwar and Hall (2017).

For e-government serving large populations of diverse users, common user segmentation techniques based on demographics and other characteristics are difficult to maintain and often not required. The task-based user segmentation technique can be used to segment users based on tasks without going through other segmentation strategies and personalise

tasks for the derived user segments. Therefore, task-based user segmentation is a significant contribution to knowledge.

4. Personalised Heuristics

Although some domain-specific usability heuristics have been described as features of personalised systems in the existing literature, there are no agreed general usability principles or heuristics for personalised systems. This study contributed to knowledge by developing a set of nine usability heuristics specific for the personalised e-government systems. The details of the personalised heuristics are given in section 5.2. As proved by this study, these personalised heuristics can be used to design and evaluate the personalised e-government systems.

5. Personalisation of eGovernment Services (PeGS) Design Method

The existing methods to design personalised e-commerce, e-government or both (Abdrabbah et al., 2016; Al-hassan et al., 2009; Kaneko et al., 2018; Kramer et al., 2000; Lokhande and Meshram, 2015; Lu et al., 2009; Van Velsen et al., 2010) are based on the user interaction of a target user segment with a product or service and focused on the technical implementation of personalisation. None of the reviewed design methods considered the challenges in the design of e-government. Surveying the literature, Cortés-Cediel et al. (2017) found that there are still a few studies discussing the personalised recommender systems for e-government, which are focused on the specific type of e-government applications not covering the diverse range of e-government services and there are opportunities for further research in this area.

The methods and techniques applied, adapted and developed for exploring how the public e-services of Durham County Council were personalised were developed into a new design method, the Personalisation of eGovernment Services (PeGS). PeGS was developed by

combining and integrating various methods used to personalise public e-services and is a significant contribution to knowledge. See chapter 7 for the details of PeGS method.

PeGS is the outcome of the design approach applied in this study with a focus on users and system tasks to enable the delivery of personalised e-government. Also, PeGS was validated with professionals responsible for the provisioning of public e-services of Durham County Council, who responded positively with an optimistic outlook on the implementation of PeGS. Further research is required to confirm the viability of PeGS.

8.3 Limitations of this Study

One methodological limitation of this doctoral research is the selection of a small sample size of citizens for collecting data in relation to their use of e-government and their perspectives on personalising e-government services. Involving a large user population could further strengthen and generalise the results.

Another potential limitation of this study relates to focus on the requirements the adult citizens. Although user expectations from e-government of other groups of citizens such as senior citizens, children, citizens with special needs etc. may be different to those seen with adults, the basic principle of iterative User Centred Design of involving multiple groups of users holds. Involving other user groups would undoubtedly improve the design process by building e-government that caters to the needs and expectations of those user groups.

The third potential limitation of this research is the limited attention given to the aesthetics and graphics of the personalised prototype. The prototype was a proof of concept aimed at showing that the personalised prototype could be built using the personalised heuristics and later evaluated against those heuristics by experts. Building a more interactive personalised prototype with a focus on graphics and aesthetics could allow further evaluation with experts and users, and hence could result in exploring further usability issues.

The fourth limitation of this study is not considering the organisational barriers that can significantly affect the implementation of personalised e-government services. The organisational barriers that can impede the implementation of personalised public e-services

include financial, legal, technical, process-based and governance-based obstacles (Pieterson et al., 2007). It is essential to deal and cope up with these organisational barriers for the effective implementation of personalised e-government.

Finally, the Personalisation of eGovernment Services (PeGS) design method, one of the outcomes of this study was not validated to a greater extent. PeGS was validated by conducting interviews with the professionals responsible for the provisioning of e-government. Further validation and application of the PeGS to design e-government services of other public sector organisations are required to ensure its suitability as a design method to personalise e-government.

8.4 Future Work

Although this research provided the basis for personalising e-government by proposing an approach to design personalised e-government, there are many ways in which this research could be extended, with a myriad of areas offering future directions across a range of disciplines.

The e-government ontology built in this study illustrates the classification of e-government services based on service usage factors and models the basic interaction between citizens and e-government services. This provides opportunities for further development. Further research could explore areas such as ontology-based personalisation, identifying further categories of e-government services and their attributes.

The personalised heuristics developed to design and evaluate the personalised e-government prototype is an important contribution of this study. The personalised e-government prototype was evaluated against the personalised heuristics by experts. The results of this heuristic evaluation could be validated by user testing in the future. User testing could reveal usability issues that were not explored by the heuristic evaluation.

One area of interest would be to explore the extent or level of personalisation referring to how far the e-government services need to be personalised. Exploring the level of personalisation would involve selecting the appropriate recommendation and user

segmentation techniques for e-government. Future research about the use of personalisation techniques offers tremendous opportunities to reveal high demand areas such as cross-selling and marketing of e-government services. The importance of these areas was revealed by the Durham County Council staff while validating the PeGS (Personalisation of eGovernment Services) method. See section 3.3.5 and section 7.3 for further details.

The impact of government regulations and policies on e-government design must be considered for the effective design and personalisation of e-government services. Goldkuhl (2016) proposed an e-government design research model based on three principles including policy, co-design and theorising principles. Policy encompasses laws, regulations, work practice goals, strategy and other value statements. Further research is required to assess the impact of policies and regulations such as those concerning social welfare, data protection etc. on the design and personalisation of e-government services.

As this study was conducted in the context of a single public authority (Durham County Council), an area of interest would be the application of PeGS method to personalise public e-services of other public-sector organisations. The analysis of data in multiple organisations would allow for a better understanding of similarities and differences among multiple cases and could provide important information to further explore this area.

8.5 Reflection

Reflecting on the subject, this research has changed my perception of personalising e-government services. At the beginning of this research, I viewed personalisation merely a set of recommendation and filtering techniques that require complicated algorithms. I now understand that personalisation of e-government is not merely a set of recommendation techniques but also requires a design approach with a focus on users and tasks. This thesis has investigated and outlined the basics of the design method to personalise e-government, I believe more research is required to realise the full potential of this research discipline.

The originality and contribution of this doctoral research provide easy to use methods and techniques such as task-based user segmentation, the use of personalised heuristics in the design and PeGS, which offer a new perspective on the design and personalisation of

interactive e-government services. Even acknowledging the extensive research that is still needed, the Durham County Council staff who were involved in the validation of the PeGS (Personalisation of eGovernment Services) method revealed that PeGS is an elegant solution to improve citizen interaction with e-government based on their needs and has the potential to improve the e-government services uptake.

I have benefited greatly from undertaking this research both on a personal and a professional level. On a personal level, this research has increased my analytical skills and ability to collect and analyse data, solve design problems and make informed decisions. On a professional level, this research has enhanced and improved my knowledge and design skills to design e-government services with a focus on user, tasks and personalisation techniques.

8.6 Summary

This chapter discussed the approaches and methods that contributed to the design, development and evaluation of the research presented in this thesis and how their contribution shaped this research. Limitations, including the impact of focusing on the requirements of a single adult citizens group, not considering the organisational barriers to implement personalisation in the public sector and other methodological limitations were discussed, along with potential improvements and areas for future work.

The originality and contribution of this research were outlined, clearly highlighting the potential of the design approach, e-government ontology, task-based user segmentation, personalised heuristics and PeGS method presented in this thesis to personalise e-government. The following chapter will conclude this thesis.

9 CONCLUSIONS

This doctoral thesis sought to answer the research question, “How can personalisation be applied to enable e-government service delivery for citizens?”. In doing so, a case study approach was used to illustrate the process to design personalised e-government services of Durham County Council - a UK local government authority. In this final chapter, the main conclusions drawn from this research are presented.

Firstly, this research concludes with a new design approach that focuses on user involvement and system tasks enabled by the government authorities to design personalised e-government. By conducting focus group, interviews and building target user personas as discussed in chapter 4, this research proves that user involvement early in the design of e-government reveals user behaviour (what services users use), goals/objectives (what motivates users to use these services), user expectations and pain points in relation to using public e-services of a target user segment. By knowing the services, a target citizens segment would be most likely to use, the interaction between the target citizens and e-government services could be personalised.

For e-government, which serves almost all citizens and services are bound by laws, too much focus on user requirements is difficult to achieve and hence dependency on the tasks is intrinsic. Based on the concepts of an Activity Centred Design approach (section 2.4.5) with a focus on activities and tasks, Hierarchical Task Analysis was used as explained in section 4.6.1 to understand tasks at various levels of description and the flow of information between these tasks, which informed the design of e-government services. The detailed task analysis with flair can result in task optimisation by automation and personalisation.

Secondly, this research concludes that to better understand citizen demands from e-government, data analytics reveal service usage factors such as seasons, incidents etc., which could be used to personalise public e-services for the citizens. eGovernment services can be classified based on their usage factors, which may form new knowledge and concepts about the use of e-government services. This is evidenced in section 4.2, where an e-government ontology was built by classifying and modelling public e-services based on their usage factors and illustrating the interaction between citizens and these e-services.

Thirdly, this research concludes that for e-government, which serves a diverse user population, using commonly used segmentation approaches such as those based on demographics, geographic or other attributes, and personalising service for those users is difficult to achieve and maintain. Alternatively, derived from the Hierarchical Task Analysis, this study proposed a new user segmentation approach called task-based user segmentation to derive user segments based on task fulfilment and personalises tasks for those user segments. This is demonstrated in section 4.6.2 by using task-based user segmentation approach to segment users and personalise tasks for the users of Garden Waste Collection Service. In a Hierarchical Task Analysis (HTA) of any public service, the information flow through the decision points determines the user segments and specialised tasks for those user segments. These specialised tasks can be personalised and displayed to the relevant user segments.

Fourthly, this research concludes that for personalised e-government systems, where there are no recommended heuristics, developing domain-specific personalised heuristics inform the design and evaluation of personalised e-government prototype. This is evidenced in chapter 5, where it was found that no usability heuristics exist for personalised e-government systems and hence this study developed a set of nine heuristics specific to personalised e-government by conducting a literature review and user research. The personalised heuristics provide usability principles and guidelines to implement various features of the personalised e-government prototype. In addition, these personalised heuristics or principles such as controllability, adaptiveness, appropriateness of adaptations etc. can be used in the heuristic evaluation of the personalised prototype.

Fifthly, this research concludes that the existing methods as reviewed in section 2.5 to personalise e-commerce or e-government are focused on the technical implementation of personalisation without considering the challenges in the design of e-government. Therefore, the techniques and methods applied, adapted and developed in this doctoral research for personalising public e-services of Durham County Council were developed into a new design method, the Personalisation of eGovernment Services (PeGS). See chapter 7 for the details of how PeGS was developed and validated. Unlike the existing methods to design personalised e-services that are based on the interaction of a target user group with a specific product or service, PeGS targets a large user base with a diverse range of public e-services. PeGS was

validated by conducting interviews with professionals responsible for the public e-services provisioning and the overall response was positive, however; further validation is required to ensure its suitability as a design method for personalising e-government.

Finally, this research concludes that the design of personalised e-government is under-researched and more research is needed in this area. In the review of personalising e-government, it was found that little research has been done in this domain and not much consideration was given to the challenges in the design of personalised e-government services. Unlike e-commerce, the characteristics of government authorities to serve the entire population of citizens with a diverse range of public e-services required and constrained by regulations make the design of e-government more challenging.

Along with many others, when beginning this research, I believed that personalising e-government merely needed recommendation techniques with not much focus on user involvement, tasks and challenges in the design of e-government. Having completed this research, I now think differently. Other than recommendation and filtering techniques, the design of personalised e-government should consider several factors such as the focus on users, system tasks, personalised heuristics etc. as demonstrated in this research, which offers considerable potential for future research.

The design of personalised e-government requires interdisciplinary study and this research has taken the approach to integrate existing approaches and methods from HCI, user experience, psychology, e-commerce and e-government. The methods used in this research have existed for many years, yet few researchers have considered aggregating, modifying and applying them to design personalised e-government. This research concludes that personalisation of e-government requires a new design approach based on User Centred Design and Activity Centred Design approaches with a focus on users and tasks respectively. Various techniques and methods were applied, adapted and developed to design personalised e-government services of Durham County Council. These techniques and methods were integrated, and a new PeGS design method was developed. By proposing the design approach and PeGS method to personalise e-government, the research presented in this thesis has answered the research question, “How can personalisation be applied to enable e-government service delivery for citizens?”.

As a final remark, this research concludes that focus on users and tasks in personalisation of e-government services serves two distinct goals. Not only government authorities can provide citizen-centric services that cater to citizen needs and expectation but also, this approach ensures that underlying rules and regulations are met in the delivery of e-government services.

References

Abdrabbah, S. B., Ayachi, R. and Amor, N. B. (2016) 'A Dynamic Community-Based Personalization for e-Government Services', in *Proceedings of the 9th International Conference on Theory and Practice of Electronic Governance*. Montevideo, Uruguay, 01-03 March, pp. 258–265. doi: 10.1145/2910019.2910050.

Abidin, D. M., Junaedi, D. and Sardi, I. L. (2018) 'Analysis and Implementation of Goal-Directed Design in Reproductive Health Learning Media for High School Student Case Study: Mitra Citra Remaja (MCR)', *MATEC Web of Conferences*, 197. doi: 10.1051/matecconf/201819716007.

Accenture (2016) *Consumers Welcome Personalized Offerings but Businesses Are Struggling to Deliver, Finds Accenture Interactive Personalization Research*. [Press release]. 13 October. Available at: http://bit.ly/2e1TncL (Accessed: 1 March 2019).

Accenture (2019a) *Citizens. Know them to serve them.* Available at: https://www.accenture.com/us-en/insights/public-service/citizen-survey-2019 (Accessed: 11 September 2019).

Accenture (2019b) *Nearly One-Third of Citizens Unaware of Digital Government Services, Accenture Survey Finds*. [Press release]. 13 October. Available at: https://newsroom.accenture.com/news/nearly-one-third-of-citizens-unaware-of-digital-government-services-accenture-survey-finds.htm (Accessed: 11 September 2019).

Adams, J., Bateman, B., Becker, F., Cresswell, T., Flynn, D., McNaughton, R., Oluboyede, Y., Robalino, S., Ternent, L., Sood, B. G., Michie, S., Shucksmith, J., Sniehotta, F. F. and Wigham, S. (2015) 'Effectiveness and acceptability of parental financial incentives and quasi-mandatory schemes for increasing uptake of vaccinations in preschool children: systematic review, qualitative study, and discrete choice experiment', *Health Technology Assessment*, 19(94). doi: 10.3310/hta19940.

Adesola, S. and Baines, T. (2005) 'Developing and evaluating a methodology for business process improvement', *Business Process Management Journal*, 11(1), pp. 37–46. doi: 10.1108/14637150510578719.

Agbozo, E. and Spassov, K. (2018) 'Establishing Efficient Governance Through Data-Driven e-Government', in *Proceedings of the 11th International Conference on Theory and Practice of Electronic Governance*. Galway, Ireland, 04-06 April, pp. 662–664. doi: 10.1145/3209415.3209419.

Al-Hassan, M. (2014) *Semantic-Enhanced Hybrid Recommender Systems for Personalised E-government Services*. PhD thesis. University of Technology Sydney. Available at: https://opus.lib.uts.edu.au/bitstream/10453/30504/2/02whole.pdf (Accessed: 3 August 2016).

Al-hassan, M., Lu, H. and Lu, J. (2009) 'A Framework for Delivering Personalized e-Government Services from a Citizen-centric Approach', in *Proceedings of the 11th*

International Conference on Information Integration and Web-based Applications & Services. Kuala Lumpur, Malaysia, 14-16 December, pp. 436–440. doi: 10.1145/1806338.1806419.

Alonso-Ríos, D., Mosqueira-Rey, E. and Moret-Bonillo, V. (2018) 'A Systematic and Generalizable Approach to the Heuristic Evaluation of User Interfaces', *International Journal of Human–Computer Interaction*. Taylor & Francis, 34(12), pp. 1169–1182. doi: 10.1080/10447318.2018.1424101.

Alshenqeeti, H. (2014) 'Interviewing as a Data Collection Method: A Critical Review', *English Linguistics Research*, 3(1), pp. 39–45. doi: 10.5430/elr.v3n1p39.

Annett, J. (2003) 'Hierarchical Task Analysis', in Hollnagel, E. (ed.) *Handbook of Cognitive Task Design*. Mahwah, New Jersey: Lawrence Erlbaum Associates, pp. 17–35.

Arnowitz, J., Fijma, D. and Verlinden, J. (2000) 'Communicating a task analysis with task layer maps', in *Proceedings of the 3rd conference on Designing interactive systems: processes, practices, methods, and techniques*. New York City, New York, USA, 17-19 August: Association for Computing Machinery (DIS '00), pp. 346–353. doi: 10.1145/347642.347789.

Atkinson, B. F. W., Bennett, T. O., Bahr, G. S. and Nelson, M. M. W. (2007) 'Development of a multiple heuristics evaluation table (MHET) to support software development and usability analysis', in *Proceedings of the 4th international conference on Universal access in human computer interaction: coping with diversity*. Beijing, China, 22-27 July: Springer-Verlag (UAHCI'07), pp. 563–572.

Austin, Z. and Sutton, J. (2014) 'Qualitative Research: Getting Started', *The Canadian Journal of Hospital Pharmacy*, 67(6). Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4275140/ (Accessed: 27 January 2020).

Bakalov, F., Meurs, M.-J., König-Ries, B., Sateli, B., Witte, R., Butler, G. and Tsang, A. (2013) 'An Approach to Controlling User Models and Personalization Effects in Recommender Systems', in *Proceedings of the 2013 International Conference on Intelligent User Interfaces*. Santa Monica, California, USA, 19-22 March, pp. 49–56. doi: 10.1145/2449396.2449405.

Bakusevych, T. (2018) *10 rules for better dashboard design*, *Medium*. Available at: https://uxplanet.org/10-rules-for-better-dashboard-design-ef68189d734c (Accessed: 7 August 2019).

Ballav, A. (2017) 'Nielsen's Heuristic Evaluation: Limitations in Principles and Practice', *User Experience Magazine*, 17(4). Available at: http://uxpamagazine.org/nielsens-heuristic-evaluation/ (Accessed: 7 March 2019).

Banarjee, A. (2014) *What a Prototype Is (and Is Not)*, *UX Magazine*. Available at: https://uxmag.com/articles/what-a-prototype-is-and-is-not (Accessed: 30 December 2019).

Barcellini, F., Prost, L. and Cerf, M. (2015) 'Designers' and users' roles in participatory design: What is actually co-designed by participants?', *Applied Ergonomics*, 50, pp. 31–40. doi: 10.1016/j.apergo.2015.02.005.

Baxter, P. and Jack, S. (2008) 'Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers', *The Qualitative Report*, 13(4). Available at: https://nsuworks.nova.edu/tqr/vol13/iss4/2.

Beaudouin-Lafon, M. and Mackay, W. (2002) 'Prototyping tools and techniques', in *The human-computer interaction handbook: fundamentals, evolving technologies and emerging applications*. USA: L. Erlbaum Associates Inc., pp. 1006–1031.

Behmann, M., Jünger, S., Radbruch, L. and Schneider, N. (2012) 'Public health actions to improve palliative care in Germany: Results of a three-round Delphi study', *Health Policy*, 106(3), pp. 303–312. doi: 10.1016/j.healthpol.2012.03.014.

Berglund, A. and Leifer, L. (2013) 'Why we Prototype! An International Comparison of the Linkage between Embedded Knowledge and Objective Learning', *Engineering Education*, 8(1), pp. 2–15. doi: 10.11120/ened.2013.00004.

Bolton, H. (2015) *The Pros and Cons of Autofill in Webforms*. Available at: https://growthhackers.com/articles/the-pros-and-cons-of-autofill-in-webforms (Accessed: 1 March 2019).

Borden, P. (2015) 'The 5 Principles of Great Dashboard Design', *SumAll*, 14 January. Available at: https://blog.sumall.com/journal/5-principles-great-dashboard-design.html (Accessed: 1 March 2019).

Brajnik, G. and Giachin, C. (2014) 'Using sketches and storyboards to assess impact of age difference in user experience', *International Journal of Human-Computer Studies*. (Interplay between User Experience Evaluation and System Development), 72(6), pp. 552–566. doi: 10.1016/j.ijhcs.2013.12.005.

Bräuer, J., Plösch, R., Saft, M. and Körner, C. (2018) 'Measuring object-oriented design principles: The results of focus group-based research', *Journal of Systems and Software*, 140, pp. 74–90. doi: 10.1016/j.jss.2018.03.002.

Braun, V. and Clarke, V. (2012) 'Thematic analysis', in Cooper, H. M., Camic, P. M., Long, D. L., Panter, A. T., Rindskopf, D. M., and Sher, K. j. (eds) *APA handbook of research methods in psychology, Vol 2: Research designs: Quantitative, qualitative, neuropsychological, and biological*. Washington, DC, US: American Psychological Association (APA handbooks in psychology®), pp. 57–71. doi: 10.1037/13620-004.

Braune, J. (2018) 'THE SKILLS AND ATTRIBUTES REQUIRED TO BE A GREAT QUALITATIVE RESEARCHER', *brandspeak*. Available at: https://www.brandspeak.co.uk/blog/articles/the-skills-and-attributes-required-to-be-a-great-qualitative-researcher/ (Accessed: 4 June 2020).

Brown, T. (2008) 'Design Thinking', *Harvard Business Review*. Available at: https://hbr.org/2008/06/design-thinking (Accessed: 2 November 2019).

Browne, J. T. (2019) 'Wizard of Oz Prototyping for Machine Learning Experiences', in *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*. Glasgow, Scotland, UK, 04-09 May (CHI EA '19), pp. 1–6. doi: 10.1145/3290607.3312877.

Brusilovsky, P., Karagiannidis, C. and Sampson, D. (2004) 'Layered evaluation of adaptive learning systems', *International Journal of Continuing Engineering Education and Life Long Learning*, 14(4–5), pp. 402–421. doi: 10.1504/IJCEELL.2004.005729.

Budde, R., Kuhlenkamp, K., Mathiassen, L. and Zullighoven, L. (1984) *Approaches to Prototyping*. Berlin, Heidelberg: Springer-Verlag.

Burnett, E. (2013) 'Member checking v's dissemination focus groups in qualitative research', *Emma's blog*. Available at: https://emmaburnettx.wordpress.com/2013/11/27/member-checking-vs-dissemation-focus-groups-in-qualitative-research/ (Accessed: 12 January 2020).

Caldwell, B., Cooper, M., Reid, L. G. and Vanderheiden, G. (2008) *Web Content Accessibility Guidelines (WCAG) 2.0*. Available at: https://www.w3.org/TR/WCAG20/ (Accessed: 2 January 2020).

Camburn, B., Viswanathan, V., Linsey, J., Anderson, D., Jensen, D., Crawford, R., Otto, K. and Wood, K. (2017) 'Design prototyping methods: state of the art in strategies, techniques, and guidelines', *Design Science*, 3. doi: 10.1017/dsj.2017.10.

Cantador, I., Fernández, M., Vallet, D., Castells, P., Picault, J. and Ribière, M. (2008) 'A Multi-Purpose Ontology-Based Approach for Personalised Content Filtering and Retrieval', in Wallace, M., Angelides, M. C., and Mylonas, P. (eds) *Advances in Semantic Media Adaptation and Personalization*. Berlin, Heidelberg: Springer (Studies in Computational Intelligence), pp. 25–51. doi: 10.1007/978-3-540-76361_2.

Carroll, C., Booth, A., Leaviss, J. and Rick, J. (2013) '"Best fit" framework synthesis: refining the method', *BMC Medical Research Methodology*, 13(1). doi: 10.1186/1471-2288-13-37.

Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J. and Neville, A. J. (2014) 'The Use of Triangulation in Qualitative Research', *Oncology Nursing Forum*, 41(5), pp. 545–547. doi: 10.1188/14.ONF.545-547.

Castleberry, A. and Nolen, A. (2018) 'Thematic analysis of qualitative research data: Is it as easy as it sounds?', *Currents in Pharmacy Teaching and Learning*, 10(6), pp. 807–815. doi: 10.1016/j.cptl.2018.03.019.

Caulfield, J. (2019) *How to Do Thematic Analysis*. Available at: https://www.scribbr.com/methodology/thematic-analysis/ (Accessed: 16 February 2020).

Chang, Y., Lim, Y. and Stolterman, E. (2008) 'Personas: from theory to practices', in *Proceedings of the 5th Nordic conference on Human-computer interaction: building bridges*. Lund, Sweden, 20-22 October: Association for Computing Machinery (NordiCHI '08), pp. 439–442. doi: 10.1145/1463160.1463214.

Childs, P., Zhao, Y. and Grigg, J. (2013) 'Narrative in design development', in *Proceedings of the 15th International Conference on Engineering and Product Design Education*. Dublin, Ireland, 5 September, pp. 108–113. Available at: https://www.designsociety.org/publication/34698/Narrative+in+design+development (Accessed: 7 August 2019).

Chilisa, B. and Kawulich, B. (2012) 'Selecting a research approach: paradigm, methodology and methods', in *Wagner, C., Kawulich, B., & Garner, M. (ed). Doing Social Research: A global context*. London: McGraw-Hill Higher Education.

Chin, D. N. (2001) 'Empirical Evaluation of User Models and User-Adapted Systems', *User Modeling and User-Adapted Interaction*, 11(1), pp. 181–194. doi: 10.1023/A:1011127315884.

Choenaksorn, S. and Maneeroj, S. (2018) 'New Location Recommendation Technique on Social Network', in *Proceedings of the 2018 International Conference on Information Science and System*. Jeju, Republic of Korea, 27-19 April, pp. 3–7. doi: 10.1145/3209914.3209933.

Chon, H. and Sim, J. (2019) 'From design thinking to design knowing: An educational perspective', *Art, Design & Communication in Higher Education*, 18(2), pp. 187–200. doi: https://doi.org/10.1386/adch_00006_1.

Coleman, A. (2018) *Customer experience: privacy vs. personalisation*. Available at: https://www.raconteur.net/retail/customer-experience-privacy-vs-personalisation (Accessed: 1 March 2019).

Constantin, A., Korte, J., Fails, J. A., Alexandru, C. A., Dragomir, M., Pain, H., Good, J., Garzotto, F., Eriksson, E. and Waller, A. (2019) 'Expecting the Unexpected in Participatory Design', in *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*. Glasgow, Scotland, UK, 04-09 May. doi: 10.1145/3290607.3311758.

Cooper, A., Reimann, R., Cronin, D. and Noessel, C. (2014) *About Face: The Essentials of Interaction Design*. New Jersey: John Wiley & Sons.

Cortés-Cediel, M. E., Cantador, I. and Gil, O. (2017) 'Recommender systems for e-governance in smart cities: state of the art and research opportunities', in *Proceedings of the International Workshop on Recommender Systems for Citizens*. Como, Italy, 27 August (CitRec '17), pp. 1–6. doi: 10.1145/3127325.3128331.

Costa, A. P., Reis, L. P. and Loureiro, M. J. (2014) 'Hybrid User Centered Development Methodology: An Application to Educational Software Development', in *New Horizons in Web Based Learning*. Cham: Springer International Publishing (Lecture Notes in Computer Science), pp. 243–253. doi: 10.1007/978-3-319-13296-9_27.

Creswell, J. W. and Poth, C. N. (2016) *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. Newbury Park, Ca: SAGE Publications.

Crossman, A. (2019) *What You Need to Know About the Case Study Research Method*, *ThoughtCo*. Available at: https://www.thoughtco.com/case-study-definition-3026125 (Accessed: 27 January 2020).

Cufoglu, A. (2014) 'User Profiling - A Short Review', *International Journal of Computer Applications*, 108(3), pp. 1–9. doi: 10.5120/18888-0179.

Daae, J. and Boks, C. (2015) 'A classification of user research methods for design for sustainable behaviour', *Journal of Cleaner Production*. (Bridges for a more sustainable future: Joining Environmental Management for Sustainable Universities (EMSU) and the European Roundtable for Sustainable Consumption and Production (ERSCP) conferences), 106, pp. 680–689. doi: 10.1016/j.jclepro.2014.04.056.

Dalrymple, G. (2014) 'Goal Directed Design', *GCD*. Available at: https://gcdtech.com/blog/goal-directed-design/ (Accessed: 14 December 2019).

Dam, R. F. and Teo, Y. S. (2019) *Prototyping: Learn Eight Common Methods and Best Practices*. Available at: https://www.interaction-design.org/literature/article/prototyping-learn-eight-common-methods-and-best-practices (Accessed: 16 February 2020).

Dam, R. F. and Teo, Y. S. (2020) *Design Thinking: Get Started with Prototyping*, *The Interaction Design Foundation*. Available at: https://www.interaction-design.org/literature/article/design-thinking-get-started-with-prototyping (Accessed: 27 January 2020).

Dam, R. and Siang, T. (2019) *What Kind of Prototype Should You Create?*, *The Interaction Design Foundation*. Available at: https://www.interaction-design.org/literature/article/what-kind-of-prototype-should-you-create (Accessed: 7 August 2019).

Davey, N. (2019) *Four sample customer personas - and what we can learn from them*, *MyCustomer*. Available at: https://www.mycustomer.com/marketing/strategy/four-sample-customer-personas-and-what-we-can-learn-from-them (Accessed: 2 January 2020).

Deininger, M., Daly, S. R., Sienko, K. H. and Lee, J. C. (2017) 'Novice designers' use of prototypes in engineering design', *Design studies*, 51, pp. 25–65. doi: 10.1016/j.destud.2017.04.002.

Dell'Era, C. and Landoni, P. (2014) 'Living Lab: A Methodology between User-Centred Design and Participatory Design', *Creativity and Innovation Management*, 23(2), pp. 137–154. doi: 10.1111/caim.12061.

Dholakia, R. R. and Zhao, M. (2010) 'Effects of online store attributes on customer satisfaction and repurchase intentions', *International Journal of Retail & Distribution Management*, 38(7), pp. 482–496. doi: 10.1108/09590551011052098.

Dhouib, A., Trabelsi, A., Kolski, C. and Neji, M. (2016) 'A classification and comparison of usability evaluation methods for interactive adaptive systems', in *2016 9th International Conference on Human System Interactions (HSI)*. Portsmouth, UK, 6-8 July, pp. 246–251. doi: 10.1109/HSI.2016.7529639.

Direct Marketing Association (2018) *Data privacy: What the consumer really thinks*. Available at: https://dma.org.uk/uploads/misc/5a857c4fdf846-data-privacy---what-the-consumer-really-thinks-final_5a857c4fdf799.pdf (Accessed: 4 April 2018).

Dodd, C. and Cordella, A. (2019) 'It Takes Two to Tango: Bringing Together Users and Artificial Intelligence to Create Public Value', in *Proceedings of the 20th Annual International Conference on Digital Government Research*. Dubai, United Arab Emirates, 18-20 June, pp. 389–397. doi: 10.1145/3325112.3325228.

Dreesen, M., Foulon, V., Vanhaecht, K., Hiele, M., De Pourcq, L., Pironi, L., Van Gossum, A., Wanten, G., Baxter, J. P., Joly, F., Cuerda, C. and Willems, L. (2013) 'Development of quality of care interventions for adult patients on home parenteral nutrition (HPN) with a benign underlying disease using a two-round Delphi approach', *Clinical Nutrition*, 32(1), pp. 59–64. doi: 10.1016/j.clnu.2012.05.006.

Duan, H., Wang, Z., Ji, Y., Ma, L., Liu, F., Chi, M., Deng, N. and An, J. (2020) 'Using Goal-Directed Design to Create a Mobile Health App to Improve Patient Compliance With Hypertension Self-Management: Development and Deployment', *JMIR mHealth and uHealth*, 8(2). doi: 10.2196/14466.

Durham County Council (2019) *Population - County Durham*. Available at: https://www.durhaminsight.info/population/ (Accessed: 2 January 2020).

Eggers, W. D. and Hurst, S. (2017) *State governments' digital transformation, What if state government services worked like Amazon?* Available at: https://www2.deloitte.com/us/en/insights/industry/public-sector/state-government-digital-transformation.html (Accessed: 25 November 2019).

Ejeh, P. O. and Hall, L. (2018) 'Applying a Knowledge Evaluation Framework in the Nigerian Public Sector', in *Proceedings of the 19th European Conference on Knowledge Management*. Padua, Italy, 6-7 Septemeber. Available at: https://www.semanticscholar.org/paper/Applying-a-Knowledge-Evaluation-Framework-in-the-Ejeh-Hall/3b6b1ef2b437f3d23e5b0147d45a131838b13e57.

Endsley, M. R. and Jones, D. G. (2011) 'Understanding Situation Awareness in System Design, User-Centered Design', in *Designing for Situation Awareness: An Approach to User-Centered Design, Second Edition*. 2nd Edition. Florida: CRC Press, pp. 7–9.

Esposito, E. (2018) *Low-fidelity vs. high-fidelity prototyping*. Available at: https://www.invisionapp.com/inside-design/low-fi-vs-hi-fi-prototyping/ (Accessed: 7 August 2019).

European Commission (2010) *Digitizing Public Services in Europe: Putting ambition into action*. Available at: https://ec.europa.eu/digital-single-market/sites/digital-agenda/files/egov_report.pdf (Accessed: 23 October 2016).

European Commission (2013) *eGovernment Benchmark 2012 – INSIGHT report*. Available at: https://ec.europa.eu/digital-single-market/sites/digital-agenda/files/eGov%20Benchmark%202012%20insight%20report%20published%20version%200.1%20_0.pdf (Accessed: 11 September 2015).

European Commission (2018) *eGovernment Benchmark 2018, Securing eGovernment for all*. Available at: https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=55487 (Accessed: 9 September 2019).

European Commission (2019a) *eGovernment Benchmark 2019, Empowering Europeans through trusted digital public services*. Available at: https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=62298 (Accessed: 23 November 2019).

European Commission (2019b) *The Future of Government 2030+: A Citizen-Centric Perspective on New Government Models*. Available at: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC115008/futurgov_web_lq_v2.pdf (Accessed: 20 October 2019).

European Commission (2019c) *Digital Public Services*, *Digital Single Market - European Commission*. Available at: https://ec.europa.eu/digital-single-market/en/digital-public-services-scoreboard (Accessed: 11 September 2019).

European Commission (2020) *e-Government – more citizens consult information online*. Available at: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20200307-1 (Accessed: 11 April 2020).

Faily, S. and Flechais, I. (2011) 'Persona cases: a technique for grounding personas', in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Vancouver, BC, Canada, 7-12: Association for Computing Machinery (CHI '11), pp. 2267–2270. doi: 10.1145/1978942.1979274.

Farra, S., Miller, E. T., Hodgson, E., Cosgrove, E., Brady, W., Gneuhs, M. and Baute, B. (2016) 'Storyboard Development for Virtual Reality Simulation', *Clinical Simulation in Nursing*, 12(9), pp. 392–399. doi: 10.1016/j.ecns.2016.04.002.

Few, S. (2007) *Pervasive Hurdles to Effective Dashboard Design*. Available at: https://www.perceptualedge.com/articles/visual_business_intelligence/pervasive_hurdles_to_dd.pdf (Accessed: 28 February 2019).

Few, S. (2008) *With Dashboards Formatting and Layout Definitely Matter*. Available at: https://www.perceptualedge.com/articles/Whitepapers/Formatting_and_Layout_Matter.pdf (Accessed: 1 November 2017).

Findlater, L. and McGrenere, J. (2004) 'A Comparison of Static, Adaptive, and Adaptable Menus', in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Vienna, Austria, 24-29 April, pp. 89–96. doi: 10.1145/985692.985704.

Flostrand, A., Pitt, L. and Bridson, S. (2020) 'The Delphi technique in forecasting– A 42-year bibliographic analysis (1975–2017)', *Technological Forecasting and Social Change*, 150, p. 119773. doi: 10.1016/j.techfore.2019.119773.

Fontanella, C. (2019) *How to Run a Flawless Heuristic Evaluation*. Available at: https://blog.hubspot.com/service/heuristic-evaluation (Accessed: 7 August 2019).

Fotheringham, D. (2010) 'Triangulation for the assessment of clinical nursing skills: A review of theory, use and methodology', *International Journal of Nursing Studies*, 47(3), pp. 386–391. doi: 10.1016/j.ijnurstu.2009.09.004.

Gaddy, C. and Marcus, A. (2006) 'Analyze This: A Task Analysis Primer for Web Design User Experience Magazine', *Usability for the Planet*. Available at: http://uxpamagazine.org/analyze-this/ (Accessed: 15 March 2020).

Gao, M., Liu, K. and Wu, Z. (2010) 'Personalisation in web computing and informatics: Theories, techniques, applications, and future research', *Information Systems Frontiers*, 12(5), pp. 607–629. doi: 10.1007/s10796-009-9199-3.

Gediga, G., Hamborg, K., Osnabrück, U., Gesundheitswissenschaften, F. P. U. and Düntsch, I. (2001) 'Evaluation of Software Systems', *Encyclopedia of Computer Science and Technology*, 45, pp. 166–192. doi: 10.1.1.87.8362.

Gena, C. (2006) 'A User-Centered Approach for Adaptive Systems Evaluation', in *Fifth Workshop on User-Centred Design and Evaluation of Adaptive Systems*. Dublin, Ireland, 20 June, pp. 430–439. Available at: https://pdfs.semanticscholar.org/8e1e/842e56f6f49a97a420824fa0000c947b299f.pdf (Accessed: 5 June 2017).

Germanakos, P. and Belk, M. (2016) *Human-Centred Web Adaptation and Personalization: From Theory to Practice*. New York: Springer International Publishing. doi: 10.1007/978-3-319-28050-9.

Gibbs, A. (1997) 'Focus Groups', *Social Research Update*, Winter(19). Available at: http:/www.soc.surrey.ac.uk/sru/sru19.html (Accessed: 5 December 2019).

Goldkuhl, G. (2016) 'E-government design research: Towards the policy-ingrained IT artifact', *Government Information Quarterly*. (Open and Smart Governments: Strategies, Tools, and Experiences), 33(3), pp. 444–452. doi: 10.1016/j.giq.2016.05.006.

Goldman, K., Gross, P., Heeren, C., Herman, G., Kaczmarczyk, L., Loui, M. C. and Zilles, C. (2008) 'Identifying important and difficult concepts in introductory computing courses using a delphi process', in *Proceedings of the 39th SIGCSE technical symposium on Computer science education*. Portland, Oregon, USA, 12-15 March, pp. 256–260. doi: 10.1145/1352135.1352226.

Google Developers (2018) *Creating a persona: what does your product sound like? (Google I/O '18)*. Available at: https://www.youtube.com/watch?v=tUbB_FbIqPw (Accessed: 2 January 2020).

Gorgoglione, M., Panniello, U. and Tuzhilin, A. (2019) 'Recommendation strategies in personalization applications', *Information & Management*, 56(6), p. 103143. doi: 10.1016/j.im.2019.01.005.

Government Digital Service (2018) *Technology innovation in government survey*. Available at: https://www.gov.uk/government/publications/technology-innovation-in-government-survey/technology-innovation-in-government-survey (Accessed: 11 September 2019).

gqpzhang (2013) *User Centered Design Don Norman*. Available at: https://www.youtube.com/watch?v=Wl2LkzIkacM (Accessed: 2 November 2019).

Greenhoot, A. F. and Dowsett, C. J. (2012) 'Secondary Data Analysis: An Important Tool for Addressing Developmental Questions', *Journal of Cognition and Development*, 13(1), pp. 2–18. doi: 10.1080/15248372.2012.646613.

Grennan, T. (2015) 'Personalization for Beginners: Hi, {{${first_name}}}', *Braze Magazine*, 2 December. Available at: https://www.braze.com/blog/personalization-for-beginners-hi-first_name/ (Accessed: 2 March 2019).

Grimaldi, S., Fokkinga, S. and Ocnarescu, I. (2013) 'Narratives in Design: A Study of the Types, Applications and Functions of Narratives in Design Practice', in *Proceedings of the 6th International Conference on Designing Pleasurable Products and Interfaces*. Newcastle upon Tyne, UK, 3-5 September, pp. 201–210. doi: 10.1145/2513506.2513528.

Grime, M. M. and Wright, G. (2016) 'Delphi Method', in Brandimarte, P., Everitt, B., Molenberghs, G., Piegorsch, W., and Ruggeri, F. (eds) *Wiley StatsRef: Statistics Reference Online*. New York: John Wiley & Sons, pp. 1–6. doi: 10.1002/9781118445112.stat07879.

Guest, G., Namey, E., Taylor, J., Eley, N. and McKenna, K. (2017) 'Comparing focus groups and individual interviews: findings from a randomized study', *International Journal of Social Research Methodology*, 20(6), pp. 693–708. doi: 10.1080/13645579.2017.1281601.

Gunter, U. and Önder, I. (2016) 'Forecasting city arrivals with Google Analytics', *Annals of Tourism Research*, 61, pp. 199–212. doi: 10.1016/j.annals.2016.10.007.

Hamilton, F., Pavan, P. and McHale, K. (2011) 'Designing Usable e-Government Services for the Citizen - Success Within User Centred Design', *International Journal of Public Information Systems*, 7(3). Available at: http://www.ijpis.net/index.php/IJPIS/article/view/93 (Accessed: 1 November 2019).

Hammarberg, K., Kirkman, M. and de Lacey, S. (2016) 'Qualitative research methods: when to use them and how to judge them', *Human Reproduction*, 31(3), pp. 498–501. doi: 10.1093/humrep/dev334.

Hartson, R. and Pyla, P. S. (2012) 'Chapter 11 - Prototyping', in *The UX Book*. Boston, US: Morgan Kaufmann, pp. 391–425. doi: 10.1016/B978-0-12-385241-0.00011-7.

Hay, L. (2017) 'Google Analytics: How to Perform User Research', *SitePoint*. Available at: https://www.sitepoint.com/google-analytics-how-to-perform-user-research/ (Accessed: 2 January 2020).

Hayes, R., Kyer, B. and Weber, E. (2015) 'The Case Study Cookbook'. Available at: https://web.wpi.edu/Pubs/E-project/Available/E-project-121615-164731/unrestricted/USPTO_CookbookFinal.pdf (Accessed: 20 December 2019).

Herlihy, P. (2015) 'Status tracking - making it easy to keep users informed', *Government Digital Service*, 5 October. Available at: https://gds.blog.gov.uk/2015/10/05/status-tracking-making-it-easy-to-keep-users-informed/ (Accessed: 2 March 2019).

Hermawati, S. and Lawson, G. (2016) 'Establishing usability heuristics for heuristics evaluation in a specific domain: Is there a consensus?', *Applied Ergonomics*, 56, pp. 34–51. doi: 10.1016/j.apergo.2015.11.016.

Hertel, H. and Dittmar, A. (2017) 'Design Support for Integrated Evolutionary and Exploratory Prototyping', in *Proceedings of the ACM SIGCHI Symposium on Engineering Interactive Computing Systems*. Lisbon, Portugal, 26-29 June, pp. 105–110. doi: 10.1145/3102113.3102145.

Hesse-Biber, S. N., Rodriguez, D. and Frost, N. A. (2015) 'A Qualitatively Driven Approach to Multimethod and Mixed Methods Research', in Hesse-Biber, S. N. and Johnson, R. B. (eds) *The Oxford Handbook of Multimethod and Mixed Methods Research Inquiry*. Oxford, UK: Oxford University Press, pp. 3–20. Available at: https://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199933624.001.0001/oxfordhb-9780199933624-e-3.

Hijikata, Y., Kai, Y. and Nishida, S. (2014) 'A Study of User Intervention and User Satisfaction in Recommender Systems', *Journal of Information Processing*, 22(4), pp. 669–678. doi: 10.2197/ipsjjip.22.669.

Holgersson, J. and Karlsson, F. (2014) 'Public e-service development: Understanding citizens' conditions for participation', *Government Information Quarterly*, 31(3), pp. 396–410. doi: 10.1016/j.giq.2014.02.006.

Hollan, J., Hutchins, E. and Kirsh, D. (2000) 'Distributed cognition: toward a new foundation for human-computer interaction research', *ACM Transactions on Computer-Human Interaction*, 7(2), pp. 174–196. doi: 10.1145/353485.353487.

Holmes, D. (2018) *Activity Centred Design*, *Medium*. Available at: https://medium.com/dermot-holmes/activity-centred-design-dd28ed1eec59 (Accessed: 20 June 2020).

Homburg, V., Dijkshoorn, A. and Thaens, M. (2014) 'Diffusion of Personalised Services among Dutch Municipalities: Evolving Channels of Persuasion', *Local Government Studies*, 40(3), pp. 429–450. doi: 10.1080/03003930.2013.795892.

Hornsby, P. (2010) *Hierarchical Task Analysis*. Available at: https://www.uxmatters.com/mt/archives/2010/02/hierarchical-task-analysis.php (Accessed: 28 February 2019).

Hsu, C. C. and Sandford, B. A. (2007) 'The Delphi Technique: Making Sense Of Consensus', *Practical Assessment, Research & Evaluation*, 12(10). Available at: https://pareonline.net/pdf/v12n10.pdf (Accessed: 7 May 2018).

Iivari, J. and Iivari, N. (2011) 'Varieties of user-centredness: an analysis of four systems development methods', *Information Systems Journal*, 21(2), pp. 125–153. doi: 10.1111/j.1365-2575.2010.00351.x.

International Standard Organisation (2019) *ISO 9241-210:2019(en) Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems*. Available at: https://www.iso.org/obp/ui/#iso:std:iso:9241:-210:ed-2:v1:en (Accessed: 20 October 2019).

Issa, N. (2014) *How Data Leads to Better Personalization*, *Optimizely Blog*. Available at: https://blog.optimizely.com/2014/10/29/how-data-leads-to-better-personalization/ (Accessed: 7 August 2019).

Jabareen, Y. (2009) 'Building a Conceptual Framework: Philosophy, Definitions, and Procedure', *International Journal of Qualitative Methods*. SAGE Publications Inc, 8(4), pp. 49–62. doi: 10.1177/160940690900800406.

Jannach, D., Naveed, S. and Jugovac, M. (2017) 'User Control in Recommender Systems: Overview and Interaction Challenges', in *Proceedings of the 17th International Conference E-Commerce and Web Technologies (EC-Web) 2016*. Porto, Portugal, 5-8 September 2016, pp. 21–33. doi: https://doi.org/10.1007/978-3-319-53676-7_2.

Jooa, J., Bangb, S. and Parka, G. (2016) 'Implementation of a Recommendation System Using Association Rules and Collaborative Filtering', *Procedia Computer Science*. (Promoting Business Analytics and Quantitative Management of Technology: 4th International Conference on Information Technology and Quantitative Management (ITQM 2016)), 91, pp. 944–952. doi: 10.1016/j.procs.2016.07.115.

Joslin, R. and Müller, R. (2016) 'Identifying interesting project phenomena using philosophical and methodological triangulation', *International Journal of Project Management*, 34(6), pp. 1043–1056. doi: 10.1016/j.ijproman.2016.05.005.

Ju, J., Liu, L. and Feng, Y. (2019) 'Public and private value in citizen participation in E-governance: Evidence from a government-sponsored green commuting platform', *Government Information Quarterly*, 36(4), p. 101400. doi: 10.1016/j.giq.2019.101400.

Juicebox (2015) *A Guide to Creating Dashboards People Love to Use*. Available at: https://static1.squarespace.com/static/52f42657e4b0b3416ff6b831/t/55b9117ae4b060a0d84fef15/1438191994754/Dashboards_People_Love_To_Use_Whitepaper_v2.pdf (Accessed: 28 February 2019).

Kane, L. (2019) *Usability for Seniors: Challenges and Changes*, *Nielsen Norman Group*. Available at: https://www.nngroup.com/articles/usability-for-senior-citizens/ (Accessed: 10 April 2020).

Kaneko, K., Kishita, Y. and Umeda, Y. (2018) 'Toward Developing a Design Method of Personalization: Proposal of a Personalization Procedure', *Procedia CIRP*. (25th CIRP Life Cycle Engineering (LCE) Conference, 30 April – 2 May 2018, Copenhagen, Denmark), 69, pp. 740–745. doi: 10.1016/j.procir.2017.11.134.

Kang, M., Choo, P. and Watters, C. E. (2015) 'Design for Experiencing: Participatory Design Approach with Multidisciplinary Perspectives', *Procedia - Social and Behavioral Sciences*, 174, pp. 830–833. doi: 10.1016/j.sbspro.2015.01.676.

Karlsson, F., Holgersson, J., Söderström, E. and Hedström, K. (2012) 'Exploring user participation approaches in public e-service development', *Government Information Quarterly*, 29(2), pp. 158–168. doi: 10.1016/j.giq.2011.07.009.

Kaushik, V. and Walsh, C. A. (2019) 'Pragmatism as a Research Paradigm and Its Implications for Social Work Research', *Social Sciences*, 8(9), p. 255. doi: 10.3390/socsci8090255.

Kaygin, B. and Demir, M. (2017) 'A Research on the Importance of User-Centered Design in Furniture', *Journal of Bartin Faculty of Forestry*, 19(2). Available at: https://journals.indexcopernicus.com/search/article?articleId=2100993 (Accessed: 2 November 2019).

Kazmer, M. M. and Xie, B. (2008) 'QUALITATIVE INTERVIEWING IN INTERNET STUDIES: Playing with the media, playing with the method', *Information, Communication & Society*, 11(2), pp. 257–278. doi: 10.1080/13691180801946333.

Kieboom, M. (2017) *Five things to think of when personalizing digital government services*, *Medium*. Available at: https://medium.com/@marli_k/five-things-to-think-of-when-personalizing-digital-government-services-81b70b578efb (Accessed: 2 November 2019).

Koh, M. (2016) *A guide to conducting a heuristic evaluation*, *Optimal Workshop*. Available at: https://blog.optimalworkshop.com/guide-conducting-heuristic-evaluation/ (Accessed: 7 August 2019).

König, C., Hofmann, T. and Bruder, R. (2012) 'Application of the user-centred design process according ISO 9241-210 in air traffic control', *Work*. IOS Press, 41(Supplement 1), pp. 167–174. doi: 10.3233/WOR-2012-1005-167.

Kotamraju, N. P. and Van der Geest, T. M. (2012) 'The tension between user-centred design and e-government services', *Behaviour & Information Technology*, 31(3), pp. 261–273. doi: 10.1080/0144929X.2011.563797.

Kramer, J., Noronha, S. and Vergo, J. (2000) 'A User-centered Design Approach to Personalization', *Communications of the ACM*, 43(8), pp. 44–48. doi: 10.1145/345124.345139.

Krueger, R. A. and Casey, M. A. (2014) *Focus Groups: A Practical Guide for Applied Research*. Fifth edition. Thousand Oaks, California: SAGE Publications, Inc.

Kučera, J., Chlapek, D. and Nečaský, M. (2013) 'Open Government Data Catalogs: Current Approaches and Quality Perspective', in Kő, A., Leitner, C., Leitold, H., and Prosser, A. (eds) *Technology-Enabled Innovation for Democracy, Government and Governance*. Prague, Czech Republic, 26-28 August (Lecture Notes in Computer Science), pp. 152–166. doi: 10.1007/978-3-642-40160-2_13.

Kulahcioglu, T., Fradkin, D. and Palanivelu, S. (2017) 'Incorporating Task Analysis in the Design of a Tool for a Complex and Exploratory Search Task', in *Proceedings of the 2017 Conference on Conference Human Information Interaction and Retrieval*. Oslo, Norway, 7-11 March: Association for Computing Machinery (CHIIR '17), pp. 373–376. doi: 10.1145/3020165.3022156.

Küpper, S., Rausch, A. and Andelfinger, U. (2018) 'Towards the systematic development of hybrid software development processes', in *Proceedings of the 2018 International Conference on Software and System Process*. Gothenburg, Sweden, 26-26 May, pp. 157–161. doi: https://doi.org/10.1145/3202710.3203158.

Lambert, S. D. and Loiselle, C. G. (2008) 'Combining individual interviews and focus groups to enhance data richness', *Journal of Advanced Nursing*, 62(2), pp. 228–237. doi: 10.1111/j.1365-2648.2007.04559.x.

Lechner, B., Fruhling, A., Petter, S. and Siy, H. (2013) 'The Chicken and the Pig: User Involvement in Developing Usability Heuristics', in *Proceedings of the Nineteenth Americas Conference on Information Systems*. Chicage, Illinois, US, 15-17 August. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.662.87&rep=rep1&type=pdf (Accessed: 27 February 2019).

Lee, J. and Rao, H. R. (2009) 'Task complexity and different decision criteria for online service acceptance: A comparison of two e-government compliance service domains', *Decision Support Systems*, 47(4), pp. 424–435. doi: 10.1016/j.dss.2009.04.009.

Lim, Y.-K., Stolterman, E. and Tenenberg, J. (2008) 'The anatomy of prototypes', *ACM Transactions on Computer-Human Interaction (TOCHI)*, 15(2). doi: 10.1145/1375761.1375762.

Linders, D., Liao, C. Z.-P. and Wang, C.-M. (2015) 'Proactive e-Governance: Flipping the service delivery model from pull to push in Taiwan', *Government Information Quarterly*, 35(4, Supplement), pp. S68–S76. doi: 10.1016/j.giq.2015.08.004.

Lira, W., Ferreira, R., de Souza, C. and Carvalho, S. (2014) 'Experimenting on the cognitive walkthrough with users', in *Proceedings of the 16th international conference on Human-computer interaction with mobile devices & services*. Toronto, ON, Canada, 23-26 September (MobileHCI '14), pp. 613–618. doi: 10.1145/2628363.2628428.

Liu, Q., Durán-Sáez, R., Ferré, X. and Zhu, H. (2017) 'Task Analysis-Based User Event Logging for Mobile Applications', in *2017 IEEE 25th International Requirements Engineering Conference Workshops (REW)*. Lisbon, Portugal, 4-8 September, pp. 152–155. doi: 10.1109/REW.2017.45.

Liu, S. M., Pan, L. and Lei, Y. (2019) 'What is the Role of New Generation of ICTs in Transforming Government Operation and Redefining State-citizen Relationship in the Last Decade?', in *Proceedings of the 12th International Conference on Theory and Practice of Electronic Governance*. Melbourne, VIC, Australia, 03-05 April, pp. 65–75. doi: 10.1145/3326365.3326374.

Lokhande, P. S. and Meshram, B. B. (2015) 'Analysis and Design of Web Personalization Systems for E-Commerce', *International Journal of Web Technology*, 4, pp. 40–46. doi: 10.20894/IJWT.104.004.002.003.

Lu, J., Shambour, Q. and Zhang, G. (2009a) 'Recommendation technique-based government-to-business personalized e-services', in *NAFIPS 2009 - 2009 Annual Meeting of the North American Fuzzy Information Processing Society*. Cincinnati, OH, USA, 14-17 June. doi: 10.1109/NAFIPS.2009.5156456.

Lu, J., Shambour, Q. and Zhang, G. (2009b) 'Recommendation technique-based government-to-business personalized e-services', in *NAFIPS 2009 - 2009 Annual Meeting of the North American Fuzzy Information Processing Society*. Cincinnati, OH, USA, 14-17 June, pp. 1–6. doi: 10.1109/NAFIPS.2009.5156456.

Lyons, M. (2019) *PERSONALISATION IN GOVERNMENT SERVICES – HOW DO YOU GET THE BALANCE RIGHT?*, *Voices from Accenture Public Service*. Available at: https://voicesfrompublicservice.accenture.com/australia/personalisation-in-government-services (Accessed: 24 June 2020).

Magain, M. (2013) *What Does a User-Centred Design Process Look Like?* Available at: https://uxmastery.com/what-does-a-user-centred-design-process-look-like/ (Accessed: 2 November 2019).

Maguire, M. (2001) 'Methods to support human-centred design', *International Journal of Human-Computer Studies*, 55(4), pp. 587–634. doi: 10.1006/ijhc.2001.0503.

Maguire, M. and Isherwood, P. (2018) 'A Comparison of User Testing and Heuristic Evaluation Methods for Identifying Website Usability Problems', in Marcus, A. and Wang, W. (eds) *Design, User Experience, and Usability: Theory and Practice*. Cham: Springer International Publishing (Lecture Notes in Computer Science), pp. 429–438. doi: 10.1007/978-3-319-91797-9_31.

Maguire, M., Kirakowski, J. and Vereker, N. (1998) *RESPECT: User centred requirements handbook*. Available at: https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/2651/1/PUB493.pdf (Accessed: 8 March 2019).

Mahajan, N. (2015) 'E-Governance : Its Role, Importance And Challenges', *International Journal of Current Innovation Research*, 1(10), pp. 237–243.

Mahmoud-Jouini, S. B., Fixson, S. K. and Boulet, D. (2019) 'Making Design Thinking Work', *Research-Technology Management*, 62(5), pp. 50–58. doi: 10.1080/08956308.2019.1638485.

Malamed, C. (2009) ‘Characteristics of Adult Learners’, *The eLearning Coach*. Available at: http://theelearningcoach.com/learning/characteristics-of-adult-learners/ (Accessed: 11 April 2020).

Marine, L. (2014) *Task Analysis: The Key UX Design Step Everyone Skips*, *Search Engine Watch*. Available at: https://searchenginewatch.com/sew/how-to/2336547/task-analysis-the-key-ux-design-step-everyone-skips (Accessed: 8 March 2019).

Marsden, N. and Pröbster, M. (2019) ‘Personas and Identity: Looking at Multiple Identities to Inform the Construction of Personas’, in *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. Glasgow, Scotland, UK, 04-09 May: Association for Computing Machinery (CHI ’19), pp. 1–14. doi: 10.1145/3290605.3300565.

Marshall, C. (2016) *Face-to-Face Interviews - Advantages and Disadvantages*. Available at: https://www.linkedin.com/pulse/face-to-face-interviews-advantages-disadvantages-charlie-marshall/ (Accessed: 8 March 2020).

Marshall, R., Cook, S., Mitchell, V., Summerskill, S., Haines, V., Maguire, M., Sims, R., Gyi, D. and Case, K. (2015) ‘Design and evaluation: End users, user datasets and personas’, *Applied Ergonomics*. (Special Issue: Inclusive Design), 46, pp. 311–317. doi: 10.1016/j.apergo.2013.03.008.

Mathias, D., Snider, C., Hicks, B. and Ranscombe, C. (2019) ‘Accelerating product prototyping through hybrid methods: Coupling 3D printing and LEGO’, *Design Studies*, 62, pp. 68–99. doi: 10.1016/j.destud.2019.04.003.

Matuszewska, K. (2018) ‘6 Key Questions About Rule-Based Content Personalization, Answered’, *Piwik PRO*, 2 August. Available at: https://piwik.pro/blog/6-key-questions-rule-based-personalization-answered/ (Accessed: 8 March 2019).

Mazenko, E. (2016) *How to Create Effective Dashboards: 3 Best Practices*. Available at: https://www.betterbuys.com/bi/dashboard-best-practices/ (Accessed: 2 March 2019).

McCarthy, P. (2008) ‘Customisable websites - the definitive guide’, *webcredible*, 1 February. Available at: https://www.webcredible.com/blog/customisable-websites-definitive-guide/ (Accessed: 2 March 2019).

McGinn, J. (Jen) and Kotamraju, N. (2008) ‘Data-driven persona development’, in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Florence, Italy, 5-10 April: Association for Computing Machinery (CHI ’08), pp. 1521–1524. doi: 10.1145/1357054.1357292.

McIlveen, C. (2017) ‘Marketing Personas, Personalization, and How to Make Your Strategy a Success’, *Brandwatch*. Available at: https://www.brandwatch.com/blog/marketing-personas-personalization/ (Accessed: 2 January 2020).

Meacham, T. (2017) ‘Keep the End (User) in Mind in Dashboard Design’, *iDashboards*, 7 June. Available at: https://www.idashboards.com/blog/2017/06/07/keep-end-user-in-mind-dashboard-design/ (Accessed: 2 March 2019).

Microsoft (2017) *The next phase in public sector digital transformation*, *Microsoft Industry Blogs - United Kingdom*. Available at: https://cloudblogs.microsoft.com/industry-blog/en-gb/government/2017/01/16/the-next-phase-in-public-sector-digital-transformation/ (Accessed: 2 November 2019).

Molich, R. and Nielsen, J. (1990) 'Improving a Human-computer Dialogue', *Communications of the ACM*, 33(3), pp. 338–348. doi: 10.1145/77481.77486.

Moon, M. D. (2019) 'Triangulation: A Method to Increase Validity, Reliability, and Legitimation in Clinical Research', *Journal of Emergency Nursing*, 45(1), pp. 103–105. doi: 10.1016/j.jen.2018.11.004.

Morgan, D. L. (2014) 'Pragmatism as a Paradigm for Social Research':, *Qualitative Inquiry*, 20(8). doi: 10.1177/1077800413513733.

Mortensen, D. (2019) *How to Do a Thematic Analysis of User Interviews*, *The Interaction Design Foundation*. Available at: https://www.interaction-design.org/literature/article/how-to-do-a-thematic-analysis-of-user-interviews (Accessed: 12 January 2020).

Mourby, M., Mackey, E., Elliot, M., Gowans, H., Wallace, S. E., Bell, J., Smith, H., Aidinlis, S. and Kaye, J. (2018) 'Are "pseudonymised" data always personal data? Implications of the GDPR for administrative data research in the UK', *Computer Law & Security Review*, 34(2), pp. 222–233. doi: 10.1016/j.clsr.2018.01.002.

Mullin, S. (2016) 'Why Content Personalization Is Not Web Personalization (and What to Do About It)', *CXL*, 25 February. Available at: http://conversionxl.com/blog/web-personalization/ (Accessed: 2 March 2019).

Mulwa, C., Lawless, S., Sharp, M. and Wade, V. (2011) 'The Evaluation of Adaptive and Personalised Information Retrieval Systems: A Review', *International Journal of Knowledge and Web Intelligence*, 2(2/3), pp. 138–156. doi: 10.1504/IJKWI.2011.044120.

Netimperative (2016) *Brands "leaving consumer's in the dark" over data*. Available at: http://www.netimperative.com/2016/09/brands-leaving-consumers-dark-data/ (Accessed: 2 March 2019).

Nielsen, J. (1994) *How to Conduct a Heuristic Evaluation*, *Nielsen Norman Group*. Available at: https://www.nngroup.com/articles/how-to-conduct-a-heuristic-evaluation/ (Accessed: 6 August 2019).

Nielsen, J. (1997) 'The use and misuse of focus groups', *IEEE Software*, 14(1), pp. 94–95. doi: 10.1109/52.566434.

Nielsen, J. and Molich, R. (1990) 'Heuristic Evaluation of User Interfaces', in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Seattle, Washington, USA, 01-05 April, pp. 249–256. doi: 10.1145/97243.97281.

Nielson, J. (1994) *10 Usability Heuristics for User Interface Design*. Available at: https://www.nngroup.com/articles/ten-usability-heuristics/ (Accessed: 6 March 2019).

Nielson, J. (1998) *Personalization is Over-Rated*, *Nielsen Norman Group*. Available at: https://www.nngroup.com/articles/personalization-is-over-rated/ (Accessed: 2 March 2019).

Nikpay, F., Ahmad, R. B. and Rouhani, B. D. (2015) 'Current Issues on Enterprise Architecture Implementation Evaluation', *International Journal of Economics and Management Engineering*, 9(1), pp. 112–115.

Nishant, R., Srivastava, S. C. and Teo, T. S. H. (2019) 'Using Polynomial Modeling to Understand Service Quality in e–Government Websites', *MIS Quarterly*, 43(3), pp. 807–826. doi: 10.25300/MISQ/2019/12349.

Norman, D. A. (2005) 'Human-centered Design Considered Harmful', *Interactions*, 12(4), pp. 14–19. doi: 10.1145/1070960.1070976.

Norman, D. A. (2008) *HCD harmful? A Clarification*. Available at: https://jnd.org/hcd_harmful_a_clarification/ (Accessed: 8 December 2019).

Nyumba, T. O., Wilson, K., Derrick, C. J. and Mukherjee, N. (2018) 'The use of focus group discussion methodology: Insights from two decades of application in conservation', *Methods in Ecology and Evolution*, 9(1), pp. 20–32. doi: 10.1111/2041-210X.12860.

Office for National Statistics (2019) *Dataset: Internet access - households and individuals*. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/datasets/internetaccesshouseholdsandindividualsreferencetables (Accessed: 11 September 2019).

Ooi, Y. (2010) 'Personas - the definitive guide', *webcredible*. Available at: https://www.webcredible.com/blog/personas-definitive-guide/ (Accessed: 2 January 2020).

Organisation of Economic Co-operation and Development (2014) *Recommendation of the Council on Digital Government Strategies*. Available at: https://www.oecd.org/gov/digital-government/Recommendation-digital-government-strategies.pdf (Accessed: 11 September 2019).

Organisation of Economic Co-operation and Development (2016) *Digital Government Strategies for Transforming Public Services in the Welfare Areas*. Available at: http://www.oecd.org/gov/digital-government/Digital-Government-Strategies-Welfare-Service.pdf (Accessed: 10 July 2019).

Packaging Gateway (2019) 'Three emerging trends in personalised packaging', *Packaging Gateway*. Available at: https://www.packaging-gateway.com/innovation-in-packaging/three-emerging-trends-in-personalised-packaging (Accessed: 31 December 2019).

Pansiri, J. (2005) 'Pragmatism: A methodological approach to researching strategic alliances in tourism', *Tourism and Hospitality Planning & Development*, 2(3), pp. 191–206. doi: 10.1080/14790530500399333.

Paramythis, A., Weibelzahl, S. and Masthoff, J. (2010) 'Layered evaluation of interactive adaptive systems: framework and formative methods', *User Modeling and User-Adapted Interaction*, 20(5), pp. 383–453. doi: 10.1007/s11257-010-9082-4.

Pasanen, J. (2019) *Human centred design considered harmful*. Available at: https://www.jussipasanen.com/human-centred-design-considered-harmful/ (Accessed: 8 December 2019).

Pasman, G. and Wieringa, E. (2011) 'Landing Design Thinking in Industry: "Making Software for Bookkeeping, but Not in a Bookkeeping Way"', in *Proceedings of the 2011 Conference on Designing Pleasurable Products and Interfaces*. Milano, Italy, 22-25 June: ACM (DPPI '11), p. 47:1–47:4. doi: 10.1145/2347504.2347555.

Pepe, M. (2017) *Personalisation and privacy: can old enemies unite?* Available at: https://www.thedrum.com/opinion/2017/07/14/personalisation-and-privacy-can-old-enemies-unite (Accessed: 2 March 2019).

Pereira, J. C. and Russo, R. de F. S. M. (2018) 'Design Thinking Integrated in Agile Software Development: A Systematic Literature Review', *Procedia Computer Science*, 138, pp. 775–782. doi: 10.1016/j.procs.2018.10.101.

Pieterson, W., Ebbers, W. and van Dijk, J. (2007) 'Personalization in the public sector: An inventory of organizational and user obstacles towards personalization of electronic services in the public sector', *Government Information Quarterly*, 24(1), pp. 148–164. doi: 10.1016/j.giq.2005.12.001.

Pilemalm, S. (2018) 'Participatory Design in Emerging Civic Engagement Initiatives in the New Public Sector: Applying PD Concepts in Resource-Scarce Organizations', *ACM Transactions on Computer-Human Interaction*, 25(1), p. 5:1–5:26. doi: 10.1145/3152420.

Pilemalm, S., Lindgren, I. and Ramsell, E. (2015) 'Fourth Generation of User-centered Design – Developing for E- government and Cross-sector Collaborations', in *Electronic Government and Electronic Participation: Joint Proceedings of Ongoing Research, PhD Papers, Posters and Workshops of IFIP EGOV and EPart 2015*. Thessaloniki, Greece, 30 August - 2 September, pp. 178–192. doi: 10.3233/978-1-61499-570-8-178.

Porter, J. (2008) 'Activity-Centered Design', *bokardo*. Available at: http://bokardo.com/archives/activity-centered-design/ (Accessed: 14 December 2019).

Pretorius, M. and Calitz, A. (2011) 'The use of focus groups to improve an e-Government website', in *2011 3rd Symposium on Web Society*. Port Elizabeth, South Africa, 26-28 October, pp. 88–94. doi: 10.1109/SWS.2011.6101276.

Promann, M. and Zhang, T. (2015) 'Applying Hierarchical Task Analysis Method to Discovery Layer Evaluation', *Information Technology and Libraries*, 34(1), pp. 77–105. doi: 10.6017/ital.v34i1.5600.

Quiñones, D., Rusu, C. and Rusu, V. (2018) 'A methodology to develop usability/user experience heuristics', *Computer Standards & Interfaces*, 59, pp. 109–129. doi: 10.1016/j.csi.2018.03.002.

Quintana, R. M., Haley, S. R., Levick, A., Holman, C., Hayward, B. and Wojan, M. (2017) 'The Persona Party: Using Personas to Design for Learning at Scale', in *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems*. Denver, Colorado, USA, 6-11 May: Association for Computing Machinery, pp. 933–941. doi: 10.1145/3027063.3053355.

Rekand, T. (2014) *Personalisation in E-Government Portals. The Case of the Estonian State Portal eesti.ee*. Master's thesis. Tallinn University. Available at: http://www.cs.tlu.ee/teemad/get_file.php?id=298 (Accessed: 5 December 2015).

Renjith, S., Sreekumar, A. and Jathavedan, M. (2019) 'An extensive study on the evolution of context-aware personalized travel recommender systems', *Information Processing & Management*. doi: 10.1016/j.ipm.2019.102078.

Researchscape International and Evergage Inc. (2019) *2019 Trends in Personalization*. Available at: https://www.evergage.com/wp-content/uploads/2019/04/2019_Trends_in_Personalization_Report.pdf (Accessed: 10 December 2019).

Rigas, D. and Al-Omar, K. (2010) 'A Controllability and Customisation Approach to Personalised Web Content', *International Journal of Education and Information Technologies*, 4(1), pp. 33-40. Available at: http://www.naun.org/main/NAUN/educationinformation/19-268.pdf (Accessed: 2 March 2019).

Roller, M. R. and Lavrakas, P. J. (2015) *Applied Qualitative Research Design: A Total Quality Framework Approach*. New York: Guilford Publications.

Roulston, K. (2014) 'Analysing Interviews', in Flick, U. (ed.) *The SAGE Handbook of Qualitative Data Analysis*. London: SAGE Publications, Inc., pp. 297–312. doi: 10.4135/9781446282243.

Rowland, F. (2013) 'Activity-centered design – some thoughts', *EBI Interfaces*. Available at: https://ebiinterfaces.wordpress.com/2013/03/13/activity-centered-design-some-thoughts/ (Accessed: 2 May 2020).

Rusu, C., Roncagliolo, S., Rusu, V. and Collazos, C. (2011) 'A Methodology to Establish Usability Heuristics', in *The Fourth International Conference on Advances in Computer-Human Interactions*. Gosier, Guadeloupe, France, 23-28 February, pp. 59–62. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.684.7653&rep=rep1&type=pdf (Accessed: 3 January 2019).

Ryan, G. (2018) 'Introduction to positivism, interpretivism and critical theory', *Nurse Researcher*, 25(4), pp. 41–49. doi: https://doi.org/10.7748/nr.2018.e1466.

Saia, R., Boratto, L., Carta, S. and Fenu, G. (2016) 'Binary sieves: Toward a semantic approach to user segmentation for behavioral targeting', *Future Generation Computer Systems*, 64, pp. 186–197. doi: 10.1016/j.future.2016.04.006.

Santos, O. C., Boticario, J. G. and Pérez-Marín, D. (2014) 'Extending web-based educational systems with personalised support through User Centred Designed recommendations along the e-learning life cycle', *Science of Computer Programming*. (Software Development Concerns in the e-Learning Domain), 88, pp. 92–109. doi: 10.1016/j.scico.2013.12.004.

Sarwar, S. and Hall, L. (2017) 'Task Based Segmentation in Personalising e-Government Services', in *Proceedings of the 31st British Computer Society Human Computer Interaction Conference*. Sunderland, UK, 3-6 July (HCI '17), p. 9:1–9:4. doi: 10.14236/ewic/HCI2017.9.

Saunders, M., Lewis, P. and Thornhill, A. (2009) *Research Methods for Business Students*. Fifth edition. Essex, England: Pearson Education.

Sauro, J. and Lewis, J. R. (2012) *Quantifying the User Experience: Practical Statistics for User Research*. Waltham, Massachusetts, US: Elsevier.

Schade, A. (2016a) *Customization vs. Personalization in the User Experience*, *Nielsen Norman Group*. Available at: https://www.nngroup.com/articles/customization-personalization/ (Accessed: 2 March 2019).

Schade, A. (2016b) *6 Tips for Successful Personalization*, *Nielsen Norman Group*. Available at: https://www.nngroup.com/articles/personalization/ (Accessed: 2 March 2019).

Scholl, H. J., Barzilai-Nahon, K., Popova, and O. H. and Re, B. (2009) 'E-Commerce and E-Government: How Do They Compare? What Can They Learn from Each Other?', in *2009 42nd Hawaii International Conference on System Sciences*. Big Island, HI, USA, 5-8 January, pp. 1–10. doi: 10.1109/HICSS.2009.169.

Scholta, H., Mertens, W., Kowalkiewicz, M. and Becker, J. (2019) 'From one-stop shop to no-stop shop: An e-government stage model', *Government Information Quarterly*, 36(1), pp. 11–26. doi: 10.1016/j.giq.2018.11.010.

Seybert, H. and Reinecke, P. (2013) *Three quarters of Europeans used the internet in 2013*. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/Archive:Internet_use_statistics_-_individuals (Accessed: 2 January 2020).

Shepherd, A. (2001) *Hierarchical task analysis*. London, UK: Taylor & Francis.

Shewan, D. (2016) 'How to Create Buyer Personas That Are Scary Accurate', *The WordStream Blog*. Available at: https://www.wordstream.com/blog/ws/2015/09/23/buyer-personas (Accessed: 16 February 2020).

Shields, P. M. (1998) 'Pragmatism as a Philosophy of Science: A Tool for Public Administration', *Research in Public Administration*, 4. Available at: https://digital.library.txstate.edu/handle/10877/3954 (Accessed: 8 March 2020).

Simonofski, A. (2019) *Citizen Participation in e-Government: Management Tools Development*. PhD thesis. University of Namur. Available at: https://limo.libis.be/primo-explore/fulldisplay?docid=LIRIAS2874145&context=L&vid=Lirias&search_scope=Lirias&tab=default_tab&lang=en_US&fromSitemap=1 (Accessed: 26 June 2020).

Six, J. M. (2018) *UX Design for Personalization*. Available at: https://www.uxmatters.com/mt/archives/2018/07/ux-design-for-personalization.php (Accessed: 3 May 2020).

Smaradottir, B. and Fensli, R. (2016) 'User-centred Design of Health Information Technology', *International Journal of Integrated Care*, 16(5). doi: 10.5334/ijic.2587.

Smith, N. (2015) 'Designing and Building Great Dashboards - 6 Golden Rules to Successful Dashboard Design', *Geckoboard*, 21 October. Available at: https://www.geckoboard.com/blog/building-great-dashboards-6-golden-rules-to-successful-dashboard-design/ (Accessed: 2 March 2019).

Somervell, J. P., Wahid, S. and McCrickard, D. S. (2003) 'Usability Heuristics for Large Screen Information Exhibits', in *Proceedings of the Ninth IFIP TC13 International Conference on Human Computer Interaction (INTERACT'03)*. Zürich, Switzerland, 1-5 September. Available at: http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.4.7613 (Accessed: 16 February 2020).

Spaulding, E. and Faste, H. (2013) 'Design-driven narrative: using stories to prototype and build immersive design worlds', in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Paris, France, 27 April-02 May: Association for Computing Machinery (CHI '13), pp. 2843–2852. doi: 10.1145/2470654.2481394.

Srihari, R. (2015) 'Amazon and the age of personalised marketing', *Econsultancy*. Available at: https://econsultancy.com/amazon-and-the-age-of-personalised-marketing/ (Accessed: 11 September 2019).

Stanton, N. A. (2006) 'Hierarchical task analysis: Developments, applications, and extensions', *Applied Ergonomics*. (Special Issue: Fundamental Reviews), 37(1), pp. 55–79. doi: 10.1016/j.apergo.2005.06.003.

Summers, B. (2014) 'How to Make Proto-Personas and Get Everyone on the Same Page', *Telepathy*. Available at: https://www.dtelepathy.com/blog/philosophy/how-to-make-proto-pesonas (Accessed: 8 March 2020).

Sutton, J. and Austin, Z. (2015) 'Qualitative Research: Data Collection, Analysis, and Management', *The Canadian Journal of Hospital Pharmacy*, 68(3), pp. 226–231. doi: 10.4212/cjhp.v68i3.1456.

Tan, W., Liu, D. and Bishu, R. (2009) 'Web evaluation: Heuristic evaluation vs. user testing', *International Journal of Industrial Ergonomics*. (Special issue: Felicitating Colin G. Drury), 39(4), pp. 621–627. doi: 10.1016/j.ergon.2008.02.012.

Tashakkori, A. and Teddlie, C. (1998) *Mixed Methodology: Combining Qualitative and Quantitative Approaches*. Thousand Oaks, California: SAGE, 46.

TaskArchitect (2017) *The 7 Steps of Hierarchical Task Analysis: Part 1*. Available at: https://www.taskarchitect.com/blog/the-7-steps-of-hierarchical-task-analysis-part-1 (Accessed: 8 March 2019).

Taye, M. M. (2010) 'Understanding Semantic Web and Ontologies: Theory and Applications', *Journal of Computing*, 2(6), pp. 182–192.

Thanh, N. C. and Thanh, T. T. L. (2015) 'The Interconnection Between Interpretivist Paradigm and Qualitative Methods in Education', *American Journal of Educational Science*, 1(2), pp. 24–27.

The Audiopedia (2017) *What is COGNITIVE WALKTHROUGH? What does COGNITIVE WALKTHROUGH mean? COGNITIVE WALKTHROUGH meaning*. Available at: https://www.youtube.com/watch?v=a3niUbFJlEw (Accessed: 5 August 2018).

Thomas, V., Remy, C. and Bates, O. (2017) 'The Limits of HCD: Reimagining the Anthropocentricity of ISO 9241-210', in *Proceedings of the 2017 Workshop on Computing Within Limits*. Santa Barbara, California, USA, 22-24 June: ACM, pp. 85–92. doi: 10.1145/3080556.3080561.

Thorat, P. B., Goudar, R. M. and Barve, S. (2015) 'Survey on Collaborative Filtering, Content-based Filtering and Hybrid Recommendation System', *International Journal of Computer Applications*, 110(4), pp. 31–36. doi: 10.5120/19308-0760.

Tran, T. and Park, J. Y. (2015) 'Development of a Strategic Prototyping Framework for Product Service Systems Using Co-creation Approach', *Procedia CIRP*, 30, pp. 1–6. doi: 10.1016/j.procir.2015.02.102.

Trinh, Q.-D. (2018) 'Understanding the impact and challenges of secondary data analysis', *Urologic Oncology: Seminars and Original Investigations*, 36(4), pp. 163–164. doi: 10.1016/j.urolonc.2017.11.003.

Twizeyimana, J. D. and Andersson, A. (2019) 'The public value of E-Government – A literature review', *Government Information Quarterly*, 36(2), pp. 167–178. doi: 10.1016/j.giq.2019.01.001.

United Nations (2014) *UNITED NATIONS E-GOVERNMENT SURVEY 2014, E-Government for the Future We Want*. Available at: https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2014-Survey/E-Gov_Complete_Survey-2014.pdf (Accessed: 4 May 2019).

United Nations (2018) *UNITED NATIONS E-GOVERNMENT SURVEY 2018, GEARING E-GOVERNMENT TO SUPPORT TRANSFORMATION TOWARDS SUSTAINABLE AND RESILIENT SOCIETIES*. Available at: https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2018-Survey/E-Government%20Survey%202018_FINAL%20for%20web.pdf (Accessed: 10 September 2019).

Usability Body of Knowledge (2012) *Task Analysis*. Available at: http://www.usabilitybok.org/task-analysis (Accessed: 8 March 2019).

Van Dijk, J., Ebbers, W. and Wijngaert, L. van de (2015) 'e-Government', in *The International Encyclopedia of Digital Communication and Society*. New Jersey:John Wiley & Sons, pp. 1–10. doi: 10.1002/9781118767771.wbiedcs109.

Van Velsen, L. S. (2011) *User-Centered Design for Personalization*. PhD thesis. University of Twente. Available at: https://ris.utwente.nl/ws/portalfiles/portal/6066451/thesis_L_van_Velsen.pdf (Accessed: 3 June 2017).

Van Velsen, L., Van der Geest, T. and Steehouder, M. (2010) 'The contribution of technical communicators to the user-centered design process of personalized systems', *Technical communication*, 57(2), pp. 182–196.

Van Velsen, L., Van der Geest, T., Ter Hedde, M. and Derks, W. (2009) 'Requirements engineering for e-Government services: A citizen-centric approach and case study', *Government Information Quarterly*, 26(3), pp. 477–486. doi: 10.1016/j.giq.2009.02.007.

Van Velsen, L. van, Van der Geest, T., Van de Wijngaert, L., Van den Berg, S. and Steehouder, M. (2015) 'Personalization has a Price, Controllability is the Currency: Predictors for the Intention to use Personalized eGovernment Websites', *Journal of Organizational Computing and Electronic Commerce*, 25(1), pp. 76–97. doi: 10.1080/10919392.2015.990782.

Veiseth, M., Magnus Hegglund, P., Wien, I., Olsson, N. O. E. and Stokland, Ø. (2011) 'Development of a punctuality improvement method', *The TQM Journal*, 23(3), pp. 268–283. doi: 10.1108/17542731111124334.

Volchko, J. (2017) 'Prototyping Methodology: Steps on How to Use It Correctly', *Lumitex*. Available at: https://www.lumitex.com/blog/prototyping-methodology (Accessed: 14 April 2019).

W3C Web Accessibility Initiative (2008) *Notes on User Centered Design Process (UCD)*. Available at: https://www.w3.org/WAI/redesign/ucd.html (Accessed: 8 March 2019).

Walker, A. E. (2018) *The ultimate guide to Google Analytics for UX designers*, *Medium*. Available at: https://uxdesign.cc/google-analytics-ux-alice-emma-walker-958d6f0f0af3 (Accessed: 30 December 2019).

Waller, P. and Weerakkody, V. (2016) *Digital Government: overcoming the systemic failure of transformation*. Brunel University Press. Available at: http://bura.brunel.ac.uk/handle/2438/12732 (Accessed: 25 November 2019).

Wang, V. and Shepherd, D. (2020) 'Exploring the extent of openness of open government data – A critique of open government datasets in the UK', *Government Information Quarterly*, 37(1), pp. 1–10. doi: 10.1016/j.giq.2019.101405.

Wei, C. and Xing, F. (2010) 'The comparison of user-centered design and goal-directed design', in *2010 IEEE 11th International Conference on Computer-Aided Industrial Design Conceptual Design 1*. Yiwu, China, 17-19 November, pp. 359–360. doi: 10.1109/CAIDCD.2010.5681336.

Weibelzahl, S. (2002) *Evaluation of Adaptive Systems*. PhD thesis. University of Education Freiburg. Available at: http://ub-dok.uni-trier.de/diss/diss11/20030428/20030428.pdf (Accessed: 4 November 2018).

Who is eligible for garden waste collections? - Durham County Council (no date). Available at: https://www.durham.gov.uk/article/4686/Who-is-eligible- (Accessed: 28 February 2019).

Wilkinson, C. R. and De Angeli, A. (2014) 'Applying user centred and participatory design approaches to commercial product development', *Design Studies*, 35(6), pp. 614–631. doi: 10.1016/j.destud.2014.06.001.

Williams, A. (2009) 'User-centered Design, Activity-centered Design, and Goal-directed Design: A Review of Three Methods for Designing Web Applications', in *Proceedings of the 27th ACM International Conference on Design of Communication*. Bloomington, Indiana, USA, 05-07 October (SIGDOC '09), pp. 1–8. doi: 10.1145/1621995.1621997.

Wilson, C. (2014) 'Chapter 1 - Heuristic Evaluation', in Wilson, C. (ed.) *User Interface Inspection Methods*. Boston: Morgan Kaufmann, pp. 1–32. doi: 10.1016/B978-0-12-410391-7.00001-4.

Winke, P. (2017) 'Using focus groups to investigate study abroad theories and practice', *System*. (Special Issue: Study Abroad in Contemporary Times: Toward Greater Methodological Diversity and Innovation), 71, pp. 73–83. doi: 10.1016/j.system.2017.09.018.

Wu, W., He, L. and Yang, J. (2012) 'Evaluating recommender systems', in *Seventh International Conference on Digital Information Management (ICDIM 2012)*. Macau, China, 22-24 August, pp. 56–61. doi: 10.1109/ICDIM.2012.6360092.

Yin, R. K. (2009) *Case Study Research: Design and Methods*. Thousand Oaks, California: SAGE.

Yusof, N. N., Mohamed, A. and Abdul-Rahman, S. (2014) 'Reviewing Personalizing Filtering Approaches in Web', in *2014 4th International Conference on Artificial Intelligence with Applications in Engineering and Technology*. Kota Kinabalu, Malaysia, 3-5 December, pp. 63–68. doi: 10.1109/ICAIET.2014.20.

Zanker, M., Rook, L. and Jannach, D. (2019) 'Measuring the impact of online personalisation: Past, present and future', *International Journal of Human-Computer Studies*. (50 years of the International Journal of Human-Computer Studies. Reflections on the past, present and future of human-centred technologies), 131, pp. 160–168. doi: 10.1016/j.ijhcs.2019.06.006.

Zhang, B. and Sundar, S. S. (2019) ‘Proactive vs. reactive personalization: Can customization of privacy enhance user experience?’, *International Journal of Human-Computer Studies*, 128, pp. 86–99. doi: 10.1016/j.ijhcs.2019.03.002.

Zhao, S., Li, S., Ramos, J., Luo, Z., Jiang, Z., Dey, A. K. and Pan, G. (2019) ‘User profiling from their use of smartphone applications: A survey’, *Pervasive and Mobile Computing*, 59. doi: 10.1016/j.pmcj.2019.101052.

Zhou, X. and Rau, P.-L. P. (2019) ‘Determining fidelity of mixed prototypes: Effect of media and physical interaction’, *Applied Ergonomics*, 80, pp. 111–118. doi: 10.1016/j.apergo.2019.05.007.

Appendices

Appendix A: About Durham County Council

This research focuses on the personalisation of e-government services provided by Durham County Council (DCC), a local government authority in the North East of England. The main reason behind this research with Durham County Council was the author's work experience of over ten years in the local government sector and understanding of local e-government. Durham County Council voluntarily participated in the research and agreed to use their data in relation to the use of public e-services unless the data confidentiality is not violated.

UK government structure includes devolved and local governments (UK Government, no date). Devolved administrations are responsible for domestic policy issues and their parliaments/assemblies have law-making powers for those areas. Local government comprised of Local Authorities or Councils are responsible to make and carry out decisions on local services such as education, transport, planning, social care, libraries, waste management, trading standards, fire and public safety (UK Government, 2012).

Working along with a range of partners, Durham County Council is providing a majority of local services to a whole of County Durham. According to *About Us - Durham County Council*

(no date), which provides information about the structure, services and other statistical information, DCC is made up of an elected assembly of 126 councillors accountable to people living in County Durham. The council is made up of four service areas including 'Transformation and Partnerships', 'Children and Young People's Services', 'Adult and Health Services' and 'Regeneration and Local Services.', providing a wide range of services for the people of County Durham. County Durham covers an area of 2230 square kilometres (Office of National Statistics 2011 Census estimates) with population of over 523, 7000 (Office of National Statistics 2017 mid-year estimates), 268 schools (in 2018), 39 local libraries (2017) and two museums (2017). The average age of people in County Durham is about 42 years old (Office of National Statistics 2011 Census estimates). In the County, 76.7% of working people are employed in service industries in County Durham (Annual Population Survey July 2017 to June 2018).

Durham County Council has a main corporate website (https://www.durham.gov.uk), CRM portal (https://doitonline.durham.gov.uk/) and several partner websites linked to the corporate website. DCC website is cross platform, viewable and functional in different browsers and devices such as mobile, tablet, desktop and laptop. The website provides static web pages publishing information about various council web services, electronic forms and several useful web applications. Web forms are used by citizens or local businesses to contact council and generate service requests. Various web applications are integrated with Geographical Information System (GIS) maps and online payment engine where required. Figure 1 shows home page of DCC website, with live traffic information of Milburngate roundabout, a busy location by Durham city centre shown in Figure 2.

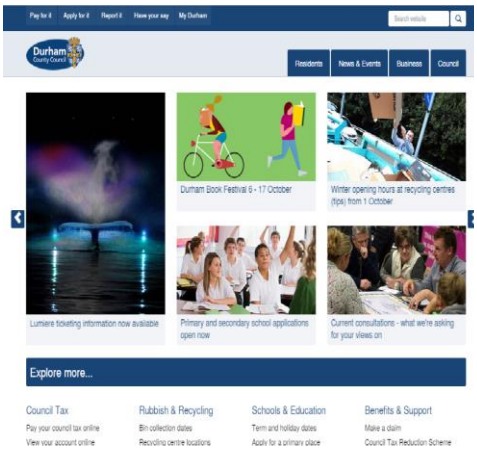


Figure 1 *Durham County Council website home page (http://www.durham.gov.uk/)*

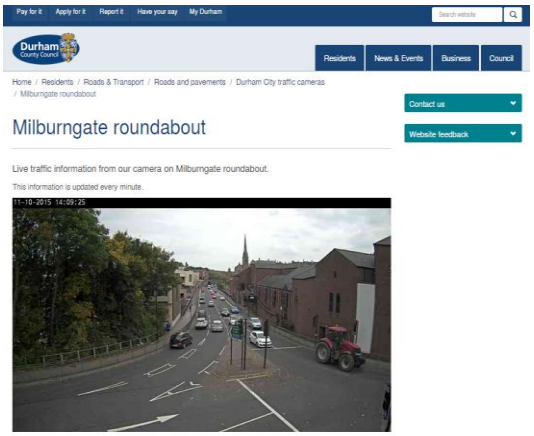


Figure 2 *Milburngate roundabout live traffic information page (http://www.durham.gov.uk/article/6135/Milburngate-roundabout)*

References

About Us - Durham County Council (no date). Available at: http://www.durham.gov.uk/aboutus (Accessed: 23 March 2019).

UK Government (2012) *Understand how your council works*, *GOV.UK*. Available at: https://www.gov.uk/understand-how-your-council-works (Accessed: 31 December 2019).

UK Government (no date) *How government works*. Available at: https://www.gov.uk/government/how-government-works (Accessed: 31 December 2019).

Appendix B: Focus Group Discussion

The participants' demographics and discussion of the focus group participants are listed below.

Participant P1: 25-55, male, employed, qualified to a degree level

Participant P1 used council services to pay his child monthly music tuition fee online. In order

to pay tuition fee, user had to enter school information, child details and payment details repeatedly every month while performing the transaction. P1 suggested simplifying the process to avoid entering repetitive details after the first transaction.

P1 also argued that council service to order a copy of birth, marriage, civil partnership and death certificate online does not perform any client validation checks and application can be made simply by entering certificate holder, contact details and payment details. In order to maintain confidentiality, this service can be further improved by checking client details to maintain confidentiality.

Participant P2: 25-55, male, employed, qualified to a degree level

Participant P2 used council website to pay/subscribe to the Garden Waste Collection (GWC) service for three years and had applied once for planning permission and building regulations. Even though P2 filled a few forms to subscribe for the GWC service but had no issues with the application process as user was happy not to apply for the same service again for three long years. While discussing his experience with application for planning permission and building regulations, P2 said that he applied for planning permission by post and then could track the application online later. P2 further added to his discussion that this could have been better if he could have applied online instead to send his application by post.

Based on the discussion with other users, P2 recommended a personalised citizen portal to access those services that users regularly use.

Participant P3: 25-55, female, employed, qualified to a degree level

Participant P3 explained two instances of her council interaction. P3 regularly use council web site to pay for her children school meals. P3 discussed that every time she pays for the school meals, she has to choose her children school first from a list of schools, enter children details, contact information and finally payment details. She suggested the system to store most of the details after the first transaction and use it for any future interactions unless some major information is changed which rarely happens.

Explaining her next interaction with council, P3 reported a stolen recycling bin tray to the council by phone after she could not find any specific online service to interact with council for this purpose. She preferred to apply online if the service was available on council website.

P3 agreed that a personalised citizen portal could have made school meals payment transaction much easier.

Participant P4: 25-55, male, employed, qualified to a degree level

Participant P4 regularly use council services to check bin types to be collected and pay council tax every month. P4 added that his local council collects household waste and recycling bins on alternative weeks, which can be confusing to remember. P4 suggested a system where personalised alerts can be set up to inform users about bin type to be collected a day before the collection date can avoid confusion.

Unlike other participants who set up direct debit for their council tax payment, P4 preferred to pay council tax online every month.

Participant P5: 25-55, male, employed, qualified to a degree level

Participant P5 used his local council services on many occasions. P5 explored his council experience with several services including application for a blue badge, Garden Waste Collection (GWC) service, reporting streetlights fault, fly tipping, traffic lights and bins collection dates. P5 further mentioned that he had been actively engaged with council services and would do so in the future. P5 indicated that his GWC transaction service went through successfully without any issues. It was further discussed that he applied for a blue badge but did not receive it on time as indicated by the service. Commenting on reporting services including streetlights fault, fly tipping and traffic lights, P5 proposed an enquiry status checking service. It was impossible to check the progress stage of online enquiry with council without telephonic contact, he added. P5 also mentioned that he used Microsoft outlook to set reminder alerts for bin types on bin collection dates.

Appendix C: Data Collected from Interviews' Participants

The following table displays the summary of the data collected from the interviews' participants.

Demographics	Technology awareness	What services used	Why services used	Usability issues
32 years, Male, Employed, Degree, no children	Computer games, smart devices, technology savvy	Bin collection service, council tax, local news and events	Services readily available online	Data entry for repetitive services
49 years, Male, Employed, Degree, 3 children	Social media, Netflix movies	Garden waste collection service, school services, events	Less effort to access public e-services	Not easy to find required services
50 years, Male, Employed, Degree, 2 adult children	Social media - Facebook, travelling blogs, e-government	Street lighting, Roads and footpath	easy to access services	No service request progress tracking
29 years, Male, Employed, Degree, 1 child	Smart devices, News	Council tax direct debit, Garden waste, Fly-tipping, Nursery school	Mobile phone access	Search does not always work
39 years, Female, Employed, Degree, 3 children	Facebook, twitter, local news	Waste permit, Pest control, Primary school	Competitive prices (pest control)	Service not delivered on time
44 years, Female, Employed, Degree, 4 children	Online discussion forums	Report Fly-tipping, potholes, School services, Bulky waste collection, traffic cameras during the winter	Detailed information available to read	Important information not highlighted
38 years, Female, Employed, Degree, 1 child	Twitter, News	Bus timetable service, building and planning, household bin collection, Nursey school information	Quickly find the required information	Complex navigation structure

25 years, Female, Employed, Degree, no kids	News, Twitter, Facebook,	Tree/Hedge removal service, Local events, roadworks	Quick service delivery	Service delivery delay
21 years, Female, Undergraduate student, No children	Instagram, Twitter, Facebook, Digital marketing	Health and wellbeing, local events, student finances	Make service requests on a mobile device	No adaptability to all screens
26 years, Male, Postgraduate student, part time job, No children	Facebook, News, smart devices	Council tax – student concession, bulky waste collection	Competitive pricing (for bulky waste collection)	Website was cluttered with too much details
22 years, Male, Undergraduate student, No children	Online games, YouTube, Facebook	Student finance, Council tax exemption	Proactive services	Service delivery was tedious
28, Male, Postgraduate student, No children	Facebook, Twitter, news, Netflix movies	Career opportunities, local news and events	Information readily available	Slow website response

Appendix D: Sample Heuristic Evaluation Document

This section includes the content of sample heuristic evaluation document including instructions to perform evaluation, details of the personalised heuristics, tasks they need to perform, and the results report. The following document sent to the evaluators to facilitate the heuristic evaluation of personalised e-government prototype.

A personalised system adapts to users depending on their characteristics and needs. The prototype to be evaluated is an e-government system intended for use by citizens. Heuristics provide best practice or 'rules of thumb' for personalised e-government systems.

The e-government prototype has been personalised for 3 citizen segments and personas: working adults with children (Mike); adult students (Sarah); and adults in the winter (David).

Instructions:

Read the heuristics, perform the tasks and complete the heuristic evaluation report.

Personalised e-government Heuristics

Heuristic Name	Personalised e-government Heuristic Description
Profile-based Personalisation	User profile changes should have immediate and satisfactory effect on the interactions provided by the personalised system.
Customisation	Users should be provided with the potential to customise their experience with the personalised system to increase their sense of ownership and control.
Service Availability and Access	Users should be able to access all services offered by the provider even if these are not part of their personalised dashboard giving the user access to both personalised and non-personalised services
Service request progress tracking	Users should be able to track interactions with e-government and view task progression online
Display the right data to right audience.	The system should provide a personalised view tailored for each user group that will access the system providing filtered, pertinent information.
Minimise Input Burden	Reduce text entry and simplify task completion using interactive Input approaches. Users should not have to duplicate information that has already been entered (e.g. in the profile)
Ownership	Name-based personalised messages should be used, addressing the user by name to increase sense of personalisation and ownership.
Grouping and Navigation	Related data should be grouped and placed together on a dashboard to help user find and navigate through the information easily.
Data and privacy statement	Organisations should clearly explain to customers how their data will be used and that data usage is in compliance with the privacy laws such as General Data Protection Regulation (GDPR). This information should be explicitly stated to the customers under a privacy statement.

Heuristic Evaluation Tasks

Using Google Chrome:

1. Go to: https://crmfileview.durham.gov.uk/Interactive/dashboardlogin.aspx

2. Login as Mike:

User Name: Mike

Password: Mike

3. Mike has recently moved to a house further up his, street. He needs to change his address from number 1 to number 10 Coronation Street, Chester-le-Street, Durham, DH3 3LA.
    a. Update Mike's address
    b. Mike's eldest son is just about to start school. Find the two nearest primary schools to his address for his son's admission to the reception class.
    c. Subscribe to the garden waste collection service and find out the next garden waste collection date.
    d. Logout

4. Login as Sarah:

    User Name: Sarah

    Password: Sarah

5. Sarah has just moved to Durham to do her Masters.
    a. She has noticed that the street light lamp outside of her house does not turn on at night. Report the problem to the council.
    b. Sarah needs to find out about her council tax discount now she is a student. Can she find this information through her dashboard?
    c. Sarah needs to report noise in her neighbourhood, can she find this service request through the personalised dashboard?
    d. Sarah is interested in Environmental Issues and wants to find out about meetings and events. Can she do this from her dashboard?
    e. Logout

6. Login as David:

   User Name: David

   Password: David

7. David has lived in Durham for many years. It is winter.
   a. David is wondering what he can do to keep himself well. Can he find that information from his dashboard?
   b. David reported a missed bin collection to the council and wants to know why his bin was not collected so he doesn't make the mistake again. Can you find out why David bin was not collected?
   c. David's children are now adults and he does not want Schools and Education on his dashboard. Can you remove Schools and Education information from David's dashboard?
   d. Logout

Personalised e-government heuristics evaluation report

Evaluator Name: Tammy Swanson-Surgey

1. Profile-based Personalisation

User profile changes should have immediate and satisfactory effect on the interactions provided by the personalised system.

Q1: Were you able to change the user profile for Mike?

Answer: Yes

Q2: Did this have immediate and satisfactory effect on the information you were provided with?

Answer: Yes – immediate

2. Customisation

Users should be provided with the potential to customise their experience with the personalised system to increase the sense of ownership and control.

Q1: Were you able to customise David's dashboard?

Q2: Was this customisation maintained in interactions (e.g. if you removed or added elements did they have an impact on information displayed?

Q3: Was this customisation sufficient or would more/less be more effective?

Answer: Yes, easily through the customise tab. It was consistent throughout the website and pages. I think this is the most effective way, did not cause any issues with layout or content

3. Service Availability and Access

Users should be able to access all services offered by the provider even if these are not part of their personalised dashboard giving the user access to both personalised and non-personalised services

Q1: Were you able to access other e-government services for example Sarah's noise complaint from the dashboard?

Q2: Did you think the e-government services provided on the dashboards were the most useful ones or would you have expected to see other services?

Answer: Yes, but had to go through the A-Z section which can take longer to find info. Noise complaint was under N, however I would have expected all complaint issues to be under R for report an issue. Dashboard content seems relevant for time of year also. Possibly would expect to see a disruptions or ongoing incidents section there too

4. Service request progress tracking

Users should be able to track interactions with e-government and view task progression online

Q1: Were you able to track David's missed bin collection and identify why it had happened?

Q2: Any other comments on service request progress tracking?

Yes, a simple notification system would be good for less competent users to let them know that there is an update on their request/complaint maybe?

5. Display the right data to right audience.

The system should provide a personalised view tailored for each user group that will access the system providing filtered, pertinent information.

Q: Did you think that the right services were offered to David, Sarah and Mike? Did you think enough information was provided?

Answer: Yes, I think services were all good and relevant. There could be a tab about rent and CT payments there if this is going to be the website for that service also as I know a lot of people still regularly pay manually online

6. Minimise Input Burden

Users should not have to duplicate information that has already been entered (e.g. in the profile)

Q: Did you have to input any information for your users that was already contained in the profile such as name, address etc.? Did you find any examples where profile information had been used to inform the system's presentation of services?

Answer: No, everything was already entered within the profile, and I didn't see anywhere else to enter information

7. Ownership

Name-based personalised messages should be used, addressing the user by name to increase sense of personalisation and ownership.

Q: Did you have a sense of ownership when interacting as Mike, Sarah or David? Did you feel more ownership in one user segment than in another?

Answer: Yes, it says Sarah's dashboard etc and hello Sarah next to account link.

8. Grouping and Navigation

Related data should be grouped and placed together on a dashboard to help user find and navigate through the information easily.

Q: Did you think that the services offered by the system were grouped in an appropriate way? Did you find it easy to find the services you needed? Was it more appropriate for some user segments than others?

Answer: Yes, grouped fine in dashboard, I think that the A-Z page should be grouped better though, more by need than alphabetical maybe as it is a lot of work reading through it all. I think there should be more tasks that you need regularly on the dashboard such as payments, disruptions, contact info in tabs rather than just the page footer

9. Data and privacy statement

Organisations should clearly explain to customers how their data will be used and that data usage is in compliance with the privacy laws such as General Data Protection Regulation (GDPR). This information should be explicitly stated to the customers under a privacy statement.

Q: Were you able to find the privacy statements and to understand what would be happening with the data you provided as Mike, Sarah or David. Did you feel data protection and privacy was easy to locate and understand.

Answer: Yes found them but expected them to be under a different name such as T&C's or Privacy rather than legal info. Information understood well.

Did find it strange that the news and events tabs be found through this link though

Appendix E: Invitation Email to Participate in Delphi Study

This section contains the invitation email sent to experts to participate in Delphi study for the validation of PeGS (Personalisation of eGovernment Services) method.

Subject: Invitation request to participate in PhD study validation (Delphi method)

Hi Joseph

My name is Sohail Sarwar and I am a final year PhD research student at the University of Sunderland. My PhD research aims to propose a User Centred Design approach for personalising e-government services.

Your article "A User Centred Design approach to Personalization" has guided this study to design a similar approach to personalise e-government services. At this stage, the PhD study is looking for User Centred Design experts to validate the proposed User Centred Design method to personalise e-government services.

As an active, experienced and published researcher in User Centred Design, I would very much like to hear your thoughts and would like to invite you to take part in a Delphi validation exercise of the proposed approach. Participation in the Delphi exercise involves questioning you on three separate occasions:

Round 1: Some general open-ended questions are submitted to you requiring your response.

Round 2: Your answers (and those from the other participants) from round 1 will be summarised and formulated into a series of more specific questions that you will be asked to respond to.

Round 3: Round 2's questions will be submitted to you again but this time you will also be able to see the average reply of the other participants and you will then be asked if you would like to adjust your answer from the second round or not. The identity of all participants will always remain confidential.

I will ask you to fill out three questionnaires, across three rounds of review. Each questionnaire will have a different focus and you will have a week to complete each one. Don't worry, they don't take a week to complete, I know people are very busy at this time of year and I want to make sure that my timelines are realistic for everyone involved.

Once the review is complete, you will be sent an anonymised summary of the results at each round of questions, thus providing you with an opportunity to see early findings of the study. The aim of the Delphi exercise is to iteratively build understanding and consensus.

Please let me know if you decide to take part in this validation exercise and I will send the questionnaire along with a document that briefly explains the proposed UCD method to personalise e-government services and how this method differs from the existing UCD methods.

Thanks

Sohail Sarwar

PhD student

University of Sunderland

Appendix F: PeGS (Personalisation of eGovernment Services) Validation Document

This section presents the content of the document including details of the PeGS and questionnaire sent to experts to validate the PeGS method.

Personalisation is the process of improving user experience by presenting users with the services or products tailored to their needs and expectation. eCommerce has greatly benefited by providing personalised experiences with targeted front end services provided to identified consumer segments with the goal of repeat business. eGovernment has different characteristics to e-commerce that impact on personalisation including:

a. A diverse range of services provided to the entire population.

b. eGovernment services are bound by the laws and regulations from government. Usually service rules are complicated and have many details and exceptions for particular groups of citizens.

c. Most e-government services are occasionally used, while commercial services such as buying or internet banking are used more frequently by the users. This makes e-government services far more difficult to learn and remember by the users.

d. Unlike e-commerce services usually provided by a single company, e-government services are provided by a chain of government departments. This has motivated the idea of an integrated one-stop shop web portal.

Existing methodologies for personalising e-commerce services with their focus on regular user interactions are not applicable for the personalisation of e-government services. Similarly, existing personalisation methodologies for e-government services are based on conceptual semantic technology and have limited real world relevance. Table 1 provides an overview of methodologies for personalisation.

Methodology	Steps, stages or main elements	Pros	Cons
Personalised design method based on engineering products and services, by Kaneko et al. (2018)	Read out (User requirements), Goal setting (System specs), Solution (recommendation engine), Production and realization (personalised product)	User feedback at each step, Suitable for both products and services	General method with no details how to perform each step, e-government services not discussed
A Dynamic Community-Based Personalisation for e-Government Services, by Abdrabbah et al. (2016)	User data collection from user service ratings or user interaction data, Semantic communities (groups) of static/dynamic e-government services, recommender system	Conceptual dynamic method to capture user behaviour from system interaction	User ratings not clearly explained for e-government services, Semantic internet technology (still not implemented)
Analysis and Design of Web Personalisation Systems for E-Commerce, by Lokhande and Meshram (2015)	Input data from the web usage logs, transaction database & user profiles, knowledge discovery by data mining, product recommendation engine using Collaborative Filtering	Highlighted the use of existing usage data sources, use of applied personalisation techniques	No emphasis on direct user involvement in the system design
A Framework for Delivering Personalised e-Government Services from a Citizen-Centric Approach, by Al-hassan et al. (2009)	Implicit/explicit user data collection, User profiling, Domain specific semantic e-government services ontology, Intelligent recommendation engine (Data matching analyser and recommendation generator)	User involvement, conceptual framework with clearly defined components	Based on semantic web technology (still not implemented)
Recommendation Technique-based Government-to-Business Personalised e-Services, by Lu et al. (2009)	Data collector collecting data from business profiles and business user preferences, Database builder to build user profile, product relevance and user rating databases, recommendation engine using CF (Collaborative Filtering) fuzzy & semantic similarity and recommendation generator	A framework suitable for Government-to-Business services, clearly defined framework components	No details of direct business user involvement mentioned
Layered approach to design personalised systems, by Van Velsen et al. (2010)	Identify target user groups, User data collection, data interpretation to design recommendations, users asses recommendations to form adaptations, Implementation of adaptations	User involvement in multiple stages	Lacking details of how to interpret user data and design adaptations

User Centred Design approach to personalisation, by Kramer et al. (2000)	Identify target user segment and profiling, Task analysis, Blue-sky exercise of Task analysis (personalised version), User domain modelling, Stepping through each task flow, Prototyping, Evaluation and Implementation	Suitable method for e-commerce, User involvement, Emphasis on tasks, Participatory design	No details to design e-government services on a single web portal

Table 1 *Existing methodologies to personalise e-commerce and e-government services*

PeGS (Personalisation of eGovernment Services) is a UX method that has been developed to enable the design of one-stop shop, personalised e-government portal, where e-government services are provided to all citizens. PeGS, see Figure 1, has 8 steps:

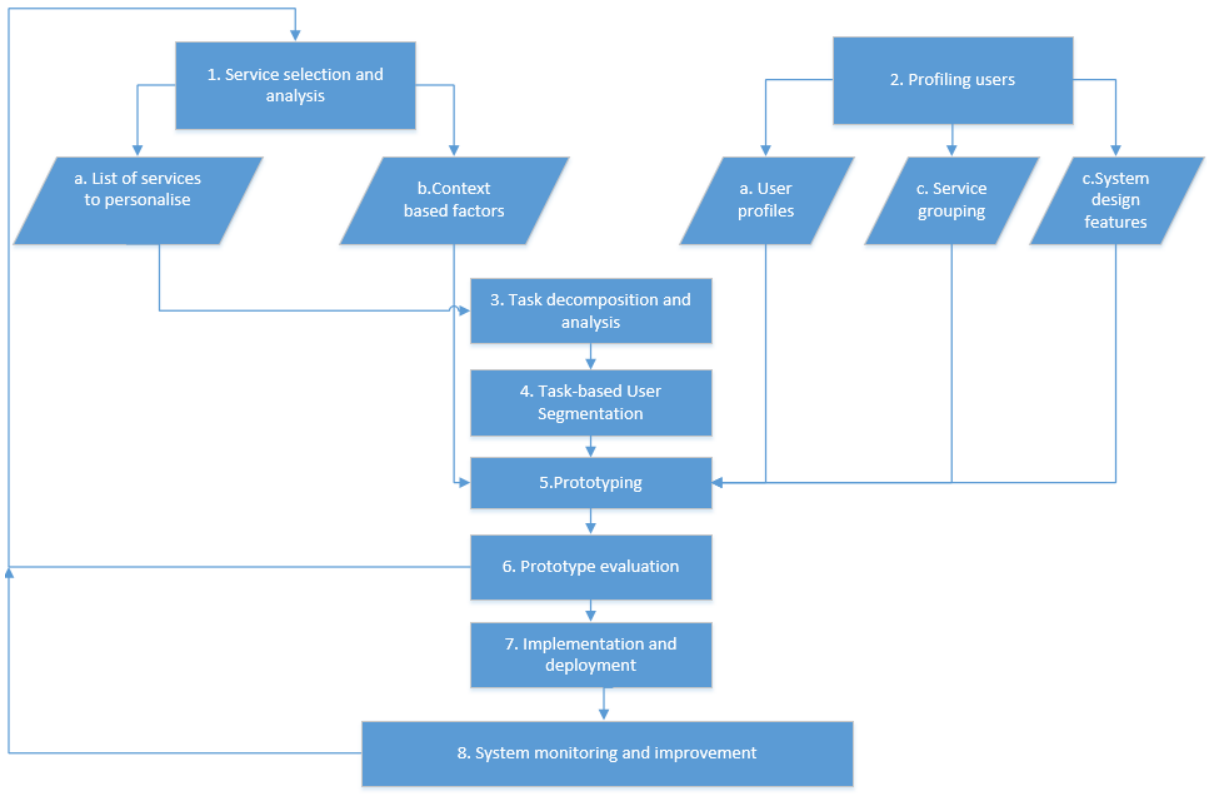


Figure 1 *PeGS method diagram*

1. Service selection and analysis

In this step, analysis of secondary data in relation to e-government service usage is performed to find the common services and their usage context. Here, this secondary data refers to the

data that is already collected and available from existing sources such as usage data, feedback from citizens, citizen studies etc. The data sources usually include CRM systems, Google analytics or other related systems.

Data analysis is performed by identifying the most commonly used services and their usage context. Ranking/Listing of the most commonly used services should be performed to identify personalise first services. The data usage context analysis will typically reveal opportunities to personalise services based on seasons of the year, events, incidents and other factors

Output:

3. List of services to personalise
4. List of context-based factors (e.g. season, events, etc.) that influence service selection

2. Profiling Users

User profile is a key element of any personalised system. In this step, user information of a target citizen group in relation to using and personalising e-government services, is collected to build user profiles and user's desired personalised features.

eGovernment serves a large base of users including all citizens living in a particular region or country. Therefore, census data with macro level analysis of population based on demographics helps in selecting target citizen groups. For example target citizen groups may include employed adults, adult students, senior citizens etc.

Qualitative data collection method such as Focus Group Plus with participants from the target citizen group is used at this stage. Focus Group Plus method not only covers a discussion about participant's experience with using e-government but also include walkthrough screens highlighting prospective personalised e-government features. Focus group discussion reveals user information such as user goals, needs, behaviour, paint points and expectations in relation to using e-government.

User information collected in the Focus Group Plus is structured in a design artefact called Persona. Persona lists demographics of target users, goals, needs, pain points and their behaviour of using e-government services.

Output:

3. User profiles, based on demographics of target citizen groups
4. User's desired features in personalised design
5. eGovernment services that the target citizen's group most likely to use. This helps in creation personalised adaptations for the target audience

3. Task decomposition and Analysis

This step focuses on the user tasks required to accomplish a specific service request e.g. report faulty streetlight, register for garden waste collection, pay for the council tax etc. Hierarchical Task Analysis (HTA) is performed for the selected personalise first tasks from step 1 by decomposing tasks into various level sub-tasks and exploring current user activities. HTA is further extended with the data/information flow represented in terms of decision points and actions, see Figure 2 in section "Extended Hierarchical Task Analysis of Garden Waste Collection Service" of this document. The decision points are the critical points where decisions are based on the input from user or system.

Output:

a. HTA (including decision points) of the personalise first list of services

4. Task-based user segmentation

The decision points in the extended HTA provide information that enable user segments to be derived. At each decision point, two opposite user segments derived and the relevant tasks for each derived user segment separates from that point onwards. As the tasks branch out

from the decision point, the basis for service adaptations is identified for the derived task-based user segments. Identifying user segments and service adaptations is required to for service personalisation.

This process is further explained and demonstrated in section “Extended Hierarchical Task Analysis of Garden Waste Collection Service” of this document by performing extended HTA of Garden Waste Collection Service.

Output:

a. Task-based user segments

5. Prototyping

Up until this point enough information should have been collected to build a personalised prototype. Output from step 1 and step 2 is used to build horizontal design elements required for the overall personalised web portal such as user profiles, services to display for the target users, user’s desired features etc. Output from step 3 and step 4 is used to build vertical design required to design individual e-government services.

A high-fidelity prototype of personalised web portal is built that adapts for each user profile and other context-based factors. Each user profile should have authenticated access to the prototype. High fidelity prototype enables remote access for evaluation and user testing.

Output:

a. A high-fidelity prototype of personalised web portal.

6. Prototype Evaluation

The prototype built in the previous step is evaluated using:

4) Heuristic / Expert evaluation with the experts,

5) User Evaluation where user activities should be recorded or monitored by expert, and/or
6) Other evaluation methods such as think-aloud method, focus group etc.

Usability, perceived usefulness, user satisfaction, appropriateness of adaptation etc. of a personalised prototype are evaluated at this stage. All possible adaptations of the prototype should be evaluated. Based on the user feedback, this process iterates back to the previous stages. Design is further evaluated and refined until it gets to an acceptable form.

Various evaluation methods can be used at this stage. However, PeGS recommends involving users in the evaluation process. Users belong to the target user groups should be involved in the evaluation of the web portal. For individual services, users belong to the task-based user segments (Step 4) should be involved in testing and evaluation of each service adaptation.

Output:

a. Explore errors and usability issues early in the design process

7. Implementation and deployment

Finally, the prototype is implemented as a fully functional system, tested and deployed. The deployed system should allow users to submit and capture user feedback about their interaction with the system.

Output:

a. System implemented and deployed

8. System monitoring and improvement

System monitoring and improvement is the post system deployment stage, where success is constantly measured, and system improved where required. System success is measured by

constantly monitoring the digital channel shift, customer feedback and responding constantly to the customer insights. Digital channel shift refers to the shift in customer communication to online medium from other media such as phone, face-to-face etc. Customer feedback data can be available from the CRM or other related systems. Customer insights can be found and viewed from web analytics.

If the system monitoring data does not show signs of improvement such as low rate of digital channel shift and customer dissatisfaction, then the process go back to the previous stages and improvements made.

Output:

a. Continuous system improvement by monitoring and responding to the customer insight

Questionnaire

Q1: Do you think secondary data analysis and profiling users help in creating web portal adaptations for the target user groups and designing improved system features? Please explain your thoughts about these steps.

Q2: Do you agree that the task analysis and task-based user segmentation methods are workable techniques to design individual personalised e-government services? Are there any alternative methods to personalise individual e-government services?

Q3: Do you recommend the user-based evaluation to evaluate personalised prototype and individual e-government services? Please state if there are any better alternative evaluation methods.

Q4: Please provide your comments about the feasibility of the PeGS method to personalise e-government services and state your concerns if any.

Extended Hierarchical Task Analysis of Garden Waste Collection Service

This section focuses on the task analysis of Garden Waste Collection Service (GWCS) provided by Durham County Council, a local government authority in the UK. GWCS is one of the most frequently searched for services, which offers a fortnightly garden waste collection for more than 190,000 properties across the County and charge a fee for this service.

Extended Hierarchical Task Analysis (HTA) of the existing system was carried out and the flow of information was analysed throughout the process as shown in Figure 2. A number of specialised services related to Garden Waste are offered, including the collection of additional bins, exchange bins (a scheme to provide larger bins) and to check garden waste collection dates.

The various decision points represented by diamond symbols in Figure 2 provide us with an approach to identify various user segments for which services could be personalised. The decision: “Is property eligible for GWCS” identifies three user segments i) Users with properties eligible for GWCS, ii) Users with properties not eligible for GWCS and a third segment iii) users appealing their current eligibility status. Further decision points indicate that some of these segments can be further divided into sub segments. For example eligible properties might have already been registered for the garden waste collection, speeding up subscription.

Through allocating users to a segment, they are then only presented with the tasks under the segment branch. Thus, the service rather than being generic and catch-all is tailored to the user with this task restriction providing the basis of service personalisation. Once tasks are fulfilled, for example “Subscribe to GWCS”, this becomes superfluous and is not displayed unless the subscription is cancelled or lapses. Similarly order additional bins, exchange bins, check collection dates, etc. tasks are displayed when the user property has already been registered for the GWCS. Along with other tasks, user profiling tasks are a key element of the personalised version. User profiles contain information about the individual users themselves. Here, we propose that the profiles are extended to include attributes that represent the segment(s) that the user is in. For example, using a rule-based approach, a

Boolean attribute “Garden waste eligibility” could be added to user profile to represent if a user property is eligible for GWCS.

Segmenting users based on the tasks influence the design of the personalised system by displaying only the relevant tasks to those user segments. For example, users who have subscribed to the GWCS will have collection dates and other garden waste collection tasks displayed. For those who do not have eligibility for GWCS, this service would not be displayed freeing up screen space for other, more useful information. Through segmenting at each decision point, users are provided with tailored information. However, this personalisation is not aimed at the individual users but rather to the tasks that the user segment aims to complete.

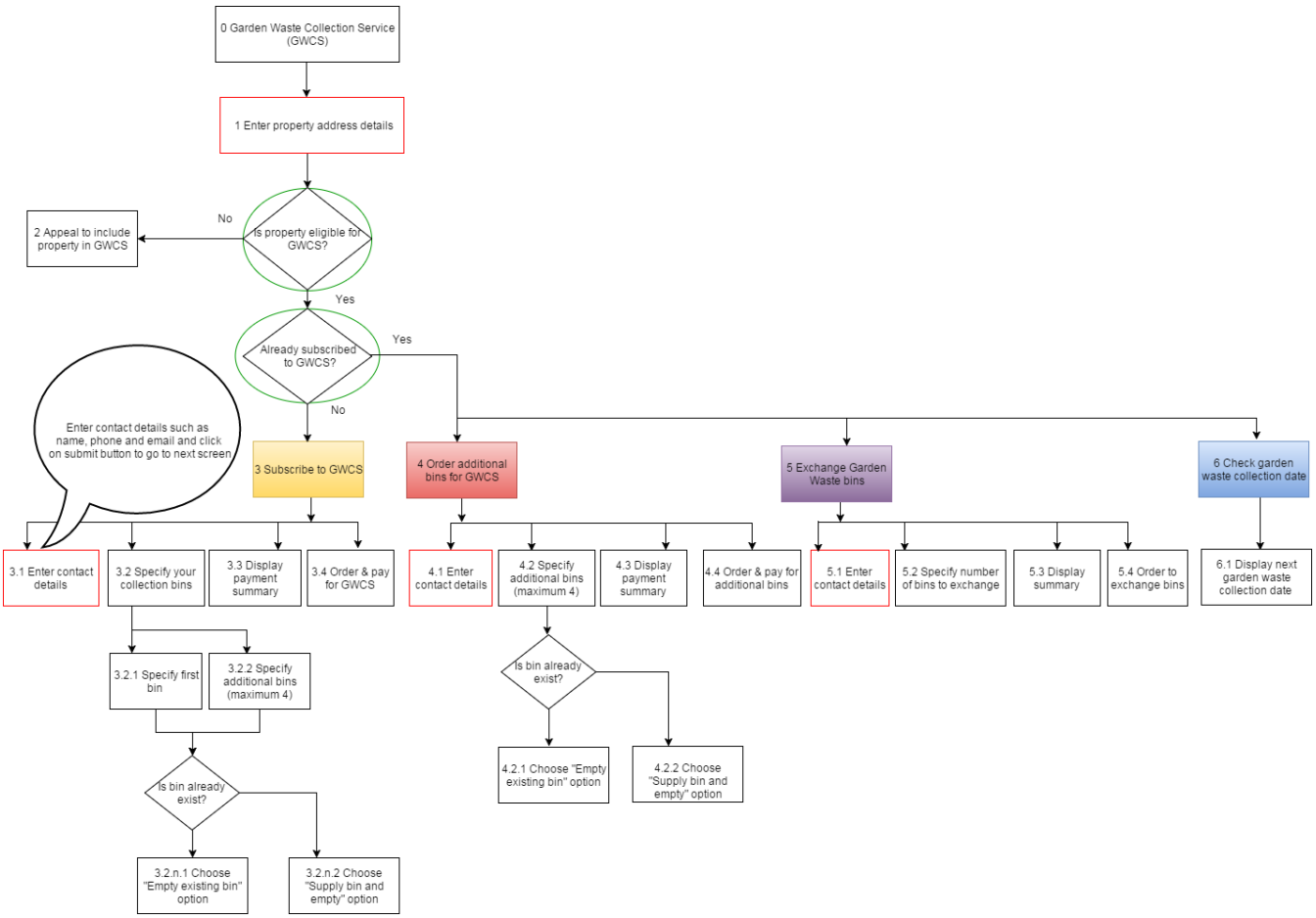


Figure 2 Extended Hierarchical Task Analysis diagram of Garden Waste Collection Service

References

Abdrabbah, S. B., Ayachi, R. and Amor, N. B. (2016) 'A Dynamic Community-Based Personalization for e-Government Services', in *Proceedings of the 9th International Conference on Theory and Practice of Electronic Governance*. Montevideo, Uruguay, 01-03 March, pp. 258–265. doi: 10.1145/2910019.2910050.

Al-hassan, M., Lu, H. and Lu, J. (2009) 'A Framework for Delivering Personalized e-Government Services from a Citizen-centric Approach', in *Proceedings of the 11th International Conference on Information Integration and Web-based Applications & Services*. Kuala Lumpur, Malaysia, 14-16 December, pp. 436–440. doi: 10.1145/1806338.1806419.

Kaneko, K., Kishita, Y. and Umeda, Y. (2018) 'Toward Developing a Design Method of Personalization: Proposal of a Personalization Procedure', *Procedia CIRP*. (25th CIRP Life Cycle Engineering (LCE) Conference, 30 April – 2 May 2018, Copenhagen, Denmark), 69, pp. 740–745. doi: 10.1016/j.procir.2017.11.134.

Kramer, J., Noronha, S. and Vergo, J. (2000) 'A User-centered Design Approach to Personalization', *Communications of the ACM*, 43(8), pp. 44–48. doi: 10.1145/345124.345139.

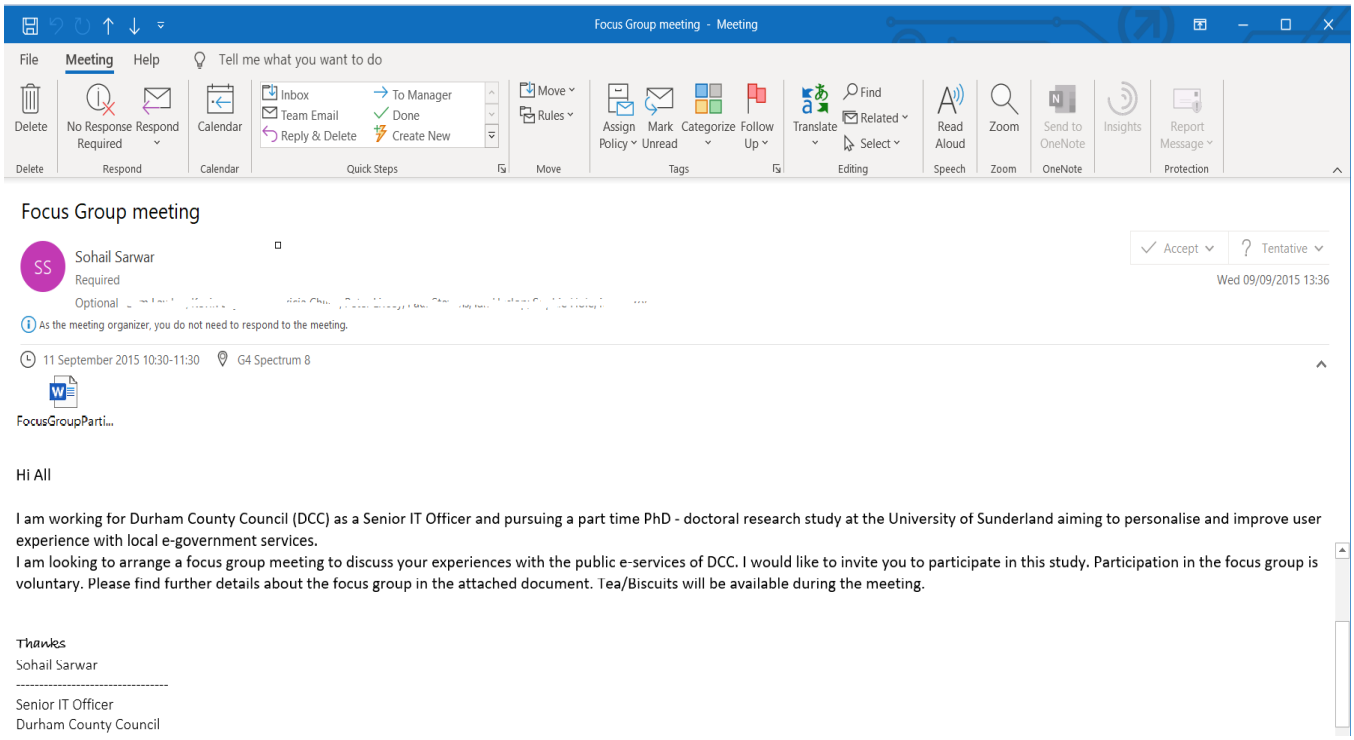
Lokhande, P. S. and Meshram, B. B. (2015) 'Analysis and Design of Web Personalization Systems for E-Commerce', *International Journal of Web Technology*, 4, pp. 40–46. doi: 10.20894/IJWT.104.004.002.003.

Lu, J., Shambour, Q. and Zhang, G. (2009) 'Recommendation technique-based government-to-business personalized e-services', in *NAFIPS 2009 - 2009 Annual Meeting of the North American Fuzzy Information Processing Society*. Cincinnati, OH, USA, 14-17 June, pp. 1–6. doi: 10.1109/NAFIPS.2009.5156456.

Van Velsen, L., Van der Geest, T. and Steehouder, M. (2010) 'The contribution of technical communicators to the user-centered design process of personalized systems', *Technical communication*, 57(2), pp. 182–196.

Appendix G: Focus Group Invitation Email

Email Screenshot



Email Attachment document

Focus group Participant Information Sheet

I am pursuing part time doctoral research study aiming to improve e-government service delivery at the University of Sunderland leading to research doctorate degree. This study is aimed to develop a design approach to improve e-government service delivery model that can be further used by future researchers.

I would like to invite you to participate in this study. The following information will give you a short overview of what this means to you and the information you decide to give me. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully.

1. Study title

Steps to personalise e-Government systems: Case study of Durham County Council website

2. Study overview

As more and more information and services are going online, data is growing at unprecedented rate. Due to information overload users find it difficult to locate their relevant information and services leading to user dissatisfaction. Most governments' agendas are aimed to provide user centric services. In order to avoid information overload and provide user centric services, technology can be used to filter and display the most relevant information to the users. Unlike one-size-fits-all approach, this study is aimed to propose a personalised service delivery model that tailors information according to user needs. This study will be based on case study of Durham County Council (DCC) website.

3. Why have I been invited?

In order to personalise services, user involvement is of utmost importance. In the first phase of this study volunteer users will be invited to collect data about the DCC service(s). Volunteer users must be employed, computer users, County Durham residents (or have understanding of services provided by DCC) and belong to 25-55 age group.

4. What would be involved?

You will be invited to take part in the focus group discussion, which would last no more than an hour. Participants will be invited to discuss their experience with the services of DCC website. Focus group discussion will be audio recorded for record keeping and better analysis

5. What will I do with the information?

The data collected from the focus group will be used in my doctoral research study and will not be used for any other purpose. Personal information will not be disclosed, and personal information will remain confidential.

I confirm that I have read and understood the purpose of this research study. I understand that my participation is voluntary, and I can withdraw any time without giving any reason

Name:- _____ Date:- _____ Signature:- _____

Appendix H: Interview Invitation Sample Email

Hi

I am working for Durham County Council as a Senior IT Officer and pursuing a part time PhD - doctoral research study at the supervision of the University of Sunderland, aiming to personalise and improve user experience with local e-government services.

I am very interested to know your experience, goals and objectives of using local public e-services of DCC. I would like to invite you for a one-off interview to participate in this study, which should not last more than 30 minutes. Participation in the interview is voluntary. If you agree to take part in this study, I'll send you an email with a calendar invitation to confirm the date and time.

Looking forward to hearing from you.

Thanks

Sohail Sarwar

Senior IT Officer

Durham County Council