Channel Shift - using data analysis to improve service delivery at the City of Edinburgh Council

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Abstract

This doctoral thesis will present the results of my work into the reanimation of lifeless human tissues.

Acknowledgements

Many thanks to my mummy for the numerous packed lunches; and of course to Igor, my faithful lab assistant.

Declaration

I declare that this thesis was composed by myself, that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification except as specified.

(*Michal Wasilewski*)

Table of Contents

Chapter 1

Introduction

Over the last few years, the School of Informatics has been collaborating with the City of Edinburgh Council in the area of open data in initiatives such as the Smart Data Hack and the Council's EdinburghApps hackathons. In the context of Edinburgh Living Lab, this relationship has broadened into investigating other areas of data science, and new kinds of collaboration. My MSc project is taking place within this context, and is focussing on bringing analytic techniques to bear on Customer Relationship Management (CRM) data that has been collected by the Council over the last year.

1.1 Context

As one of the fastest growing local authority areas in Scotland, Edinburgh is facing an ever increasing demand for Council services, outstripping the funds available to meet this demand. There are a number of projects on-going in the Council that try to address the resulting challenges, one of which aims to improve the way that Council interacts with residents, particularly in terms of dealing with complaints and reports of problems. At the moment, citizens can communicate with the Council using multiple 'channels': email, web forms, mobile apps, phone, post and face-to-face conversation. So-called "Channel Shift" is the policy of encouraging residents to use web forms in preference to other communication channels. Some other objectives include informed design of interfaces and web-forms, increase in the use of digital channels and decrease in traditional channels for selected transactions. The Council has been recently building capacity to collect data and use sophisticated tools for managing and integrating it. This project is hoping to contribute to internal resources for extracting business insights from analysing this data. More broadly, I hope that my research will help the Council

to ensure that transactions initiated via digital channels are dealt with effectively, as well as contribute to creating success stories and know-how within the Council.

1.2 Objective of the project

Using analysis of CRM data provide insights about the delivery of CEC services to the residents of Edinburgh. These insights should serve as guidelines for improvement of existing interactions between the Council and citizens as well as help in implementation of transactions for services which are not supported over digital channels yet.

1.3 Thesis structure

The first part of this thesis is devoted to providing a theoretical background to the work undertaken. User Centred Design is a concept in design that has played a major role in building interfaces to computational systems over the last three decades. It is described providing a historical context and modern developments in related fields. Data-driven design is a practice of designing with the use of data driven rather than human driven (ethnographical) methods. Double Diamond methodology is a model of practicing design (conducting design related activities) which is claimed to be describing a universal framework for a design process, not limited to any particular field.

The second part is describing the work undertaken and is divided into 4 phases in accordance to the Double Diamond model.

The last two parts are dedicated to evaluating the project and drawing conclusions.

Chapter 2

Background

2.1 User Centred Design

2.1.1 Introduction to User Centred Design

User Centred Design (UCD) is a broad term that describes both a philosophy and a set of tools used during the design process (Norman and Draper, 1986; Norman, 2013). At its core, it gives central role to the needs and limitations of the user. The level of involvement of the user in the design process may vary, but the fundamental difference compared to other approaches is that decisions are driven by a very deep understanding of users needs (or even by users themselves). It is not limited to interface optimisation and often means working closely with users already at definition stage where they help in the problem identification. Fundamentally, UCD tries to focus on usability throughout the entire development process and further throughout the system life cycle (Gulliksen et al., 2003).

The term User Centred Design was coined and popularized by Donald Normans research group in the 1980s. Two influential books were published in that time which he co-authored: User centered system design (Norman and Draper, 1986) and The psychology of everyday things (Norman, 1988).

User Centred Design is sometimes referred to as User Centred System Design (UCSD). This ambiguity comes from the definition of UCD not being agreed upon for many years (Gulliksen et al., 2003).

Concepts behind UCD did not arise in vacuum. The need for people oriented computers was already recognized in the early days of computers (Ritter et al., 2014; Nickerson, 1969). Voices of concern were raised that product development methods used

at the time were more suitable for big, labour intensive projects and were failing with sophisticated devices which focus on usability (Greenbaum, 1993; Robert, 1965). In 1960s and 1970s there were a number of fields in academia concerned with designing more human friendly devices and processes, but they were applied with varied success. What made UCD so effective was that it focused on the needs of the user, on activity/task analysis as well as a general requirements analysis, carrying out early testing and evaluation, and designing iteratively. (Ritter et al., 2014). It also emphasized the involvement of the user in the design process instead of treating him purely as a consumer of the product. This has been a paradigm shift that was particularly uncomfortable for managers in the United States who were reluctant to hand over the decision making power (Greenbaum, 1993).

UCD has changed over the years. Initially UCD was focused on command-line tools, but as computers got more widespread and their interfaces became more sophisticated, it started growing in importance and played a different role. With Graphical User Interfaces (GUI) it was focused on layouts and optimisation and with nowadays proliferation of computational systems, UCD design is considering things like personal preferences or social and cultural impact of the device (Ritter et al., 2014).

2.1.2 Human Centred Design

Human Centred Design (HCD) is a broader term that puts humans at the centre (Ritter et al., 2014; Earthy et al., 2001; ISO, 1999; Kurosu, 2011). This means taking into consideration the entire context of the situation in which the product will be used and the human aspects of it. It is considered more interdisciplinary than UCD and is described in many standards (Bevan, 2001) such as ISO 13407:1999 (ISO, 1999) and more recently 9241-210: 2010 (DIS, 2009). UCD is considered by some as being too much focused on solving a goal-directed, technological problem and limited by considering people solely as users of the system without looking at the organisational goal or counteracting possible adverse effects of use on human health, safety and performance (Gasson, 2003; Gill, 1996; Bevan, 2001). UCD and HCD are not synonyms and HCD does not necessarily imply using UCD methods (Earthy et al., 2001; Maguire, 2001; Kurosu, 2011; Ritter et al., 2014).

2.1.3 Design Driven Innovation

A recent perspective that is broadening the definition of design to include a reconstructionist (Chan and Mauborgne, 2005) or social-constructionist (Prahalad and Ramaswamy, 2000) view of the market is Design Driven Innovation (Liem and Sanders, 2011; Verganti, 2013).

In his book Design driven innovation: changing the rules of competition by radically innovating what things mean Roberto Verganti introduces the concept of Design Driven Innovation (Verganti, 2013). In his opinion, most organisations understand and use design in two ways: making things beautiful and stylish and having a profound (and thus accurate) understanding of user needs. Innovations coming from these two, beauty of the product and user needs (which is an embodiment of User Centred Design), are in his opinion insufficient for market differentiation and have become so common that they are a norm rather than exception. Verganti argues that what is needed (together with the first two) is a third use for design which is a radical innovation in meaning.

His research reveals that recent management literature focuses on technological innovation and what effect it has on an industry. What is also very well covered is looking beyond features and understanding the meanings behind them - what emotions drive people to buy products. However, the silent assumption is, he continues, that meanings are not a subject of innovation. He proposes a third strategy for design which is innovation in what meaning things can carry.

The author brings and analyses dozens of examples to help better understand design-driven innovation such as:

- Artemide, Italian lamp manufacturer, created a lamp that is no longer a source of light, but an object that has influence on peoples mood. Effectively, by providing a device that can change intensity and colour of the light you are enabling people to control their mood and the product becomes an element of well-being.

- The MP3 players were present before iTunes, but it was a change in how to think about music brought by Steve Jobs that revolutionised the industry. Many executives and lobbing groups stubbornly focused on enforcing copy-protection, whereas Apple enabled users to buy a single song instead of an entire album, taste and mix music, create personal playlists.

- Anthropomorphism in the shape of kitchen appliances brought by Alessi, turned equipment into objects of affection, things you bond with, teddy bears for adults

(Verganti, 2013).

- Apples move to release a notebook without an optical drive was considered a bold one, but Steve Job had an understanding of what cloud computing and wireless connectivity meant constant access to vast amounts of data and thus no use for CDs/DVDs.

The author also provides a structured framework for thinking about innovation in meaning and deploying it in an organisation. Design Driven Innovation extends beyond User Centred Design, but does not discredit it.

2.2 Data-driven design

Data-driven design is an emerging field of study that gained popularity with the digitization of our world and in particular with what is known as big data. The premise of data-driven design is an additional layer of perception provided by data collection and processing, previously unavailable to humans. Although the practices of data-driven design are far from being well established, more and more voices are being raised that consider it a very viable tool when used properly with other methods (Neirotti et al., 2014).

2.2.1 What would a cup say if it could speak?

Data can be used to drive the design of many things. Common areas of use of data-driven design in Informatics include websites (web analytics) or mobile apps. A designer can change the layout of a website and in real time analyse what impact on the behaviour of the user it has (CSIRO, 2015a).

However, computational systems are being used for much more than just reading websites. Vizie is a tool analysing social media feeds and it is able to inform government institutions about a failure of a service, provide situational awareness in emergencies or simply help being in touch with citizens by informing about major topics of the day (CSIRO, 2015b). In one case, social media is actually the main, preferred way of communicating with a government institution for better or for worse (MIT Media Lab, 2015).

The Internet of Things (IoT) is another case of digitization entering our lives. We are instrumenting objects in our surroundings giving them a voice. IoT devices will

generate a lot of data about their users and the devices themselves. Vessyl is an IoT cup designed to be part of a bigger health and wellness ecosystem. It traces the nutritional value of liquids consumed by the user (Mark One, 2014). Interesting questions arise from the designers perspective with the emergence of such devices. What impact on the design of the cup do the consumption habits of its users have? If the cup could capture detailed data about its usage patterns location, acceleration, angle of tilt could it suggest a better design (e.g. thinner, taller, rounded edges)? Maybe the cup would tell us something else, unrelated to the drink, something that we cannot think of simply because we are humans?

This vast amount of data captured in different areas of peoples lives provides a lot of opportunities for generating design insights. It is important to stress that having data by itself is not sufficient. It is what follows data analysis that makes all the difference and that is where uncharted territories are.

2.2.1.1 What is big data?

There are many definitions of what Big Data is and in some cases not only do they differ, but even stand in contradiction. This might be due to the fact that early cases of use of the term happened in different fields (Demchenko et al., 2014; Ward and Barker, 2013). Most commonly, Big Data is associated with data storage and data analysis, which in themselves are not new concepts at all. A description that is widely accepted as fundamental in coining the term Big Data is the 3 Vs definition provided by Gartner in 2001 (Douglas, 2001; Ward and Barker, 2013). Since then, the Vs description has been used and expanded (to 5 Vs) by many (McAfee and Brynjolfsson, 2012; Minelli et al., 2012; Demchenko et al., 2014; NIST, 2015).

The 5Vs of big data are as follows:

- Volume 90% of worlds data was generated over the last 2 years; by some, big data is considered when dealing with volumes over peta bytes (10^{15})
- Velocity more data being received than can be processed using traditional data analysis approach; you receive more information than you can process before a decision has to be made; processing of real-time data streams is becoming essential
- Variety different types of data are being accessible (structured data, sensory data, social media data, voice recordings, photos, videos)

- Veracity (validity) lack of control over quality and accuracy which leads to inconsistencies and incompleteness
- Value how to get value out of data

2.2.2 Data Analysis

2.2.2.1 Artificial Intelligence

The proliferation of Artificial Intelligence has changed the landscape of many fields in science.

Genetic Algorithms (GA) are one example of it. In some cases, they can give remarkable results outperforming humans. In one experiment, which was trying to optimise the design of an integrated circuit, GA generated solution which was much better than the one created by humans (Harvey et al., 1997). At the current level of complexity, chips are not designed by humans placing transistors one by one. Instead, humans describe the desired logical functions which are then translated by (sub-optimal) algorithms into a mask work. What was done in the experiment in Sussex, was to skip the entire process altogether and using GA holistically promote chips which were more desirable. This was achieved by either keeping a design for the next iteration or removing it based on specific criteria. The result was a very difficult to understand design there were gates that seemed to do nothing, but when removed the behaviour of the entire chip changed (Harvey et al., 1997). Moreover, it used fewer resources (transistors) and made use of the grey states (undefined states experienced in an integrated circuit immediately after a clock signal, when a transistor is switching from one state to another). GA are mostly used for optimisation purposes.

Fields of AI that are more often used for data analysis include Machine Learning (ML) and Pattern Recognition (PR) (Bishop, 2006). They have many uses with structured and unstructured data. Some of the those relevant in this context include: text/speech recognition, customer choices analysis, usage patterns analysis, decision support systems involving judgment, load forecasting, marketing and sales (Witten and Frank, 2005).

2.2.2.2 Business Intelligence

The term Business Intelligence (BI) has been coined by Howard Dresner from Gartner Group in 1989. It describes a set of data-driven tools (tools that use data analysis

in their workings) and practices that emerged from Decision Support Systems (DSS) which went through a time of intense development in 1980s (Power, 2008). BI has been a very popular and dynamic field in the last few years which is attributed to, among many others, more turbulent business environments and higher demands for profitability (Sacu and Spruit, 2010; Power, 2008; Baars and Kemper, 2008). A range of BI tools that are becoming popular recently are the user-driven solutions which promote self-service as opposed to dependence on IT departments involvement (IBM, 2015; Qlik, 2015; Microsoft, 2015; Imhoff and White, 2011).

The goal of BI is to unveil valid risks and performance indicators, through the means of interpretation (processing) of large volumes of data, in order to support managers on all levels: strategic, tactical and operational (Baars and Kemper, 2008).

There are numerous models describing BI maturity. In general, they take into consideration the following concepts: deployment, use and impact of BI in an organisation (Lahrmann et al., 2011).

Currently most widely used tools within BI are reporting, data mining and Online Analytical Processing (OLAP). In many areas this is insufficient as a lot of data is not numerical or otherwise referred to as unstructured, e.g. voice transcripts, comments, e-mails, documents. This is especially true for analysing data about interactions with customers such as data from Customer Relationship Management (CRM) systems (Baars and Kemper, 2008). There are different approaches and frameworks for building systems that incorporate both data types. In general, they can either process unstructured data to extract from it information in a more structured way (e.g. text processing), present both data types next to each other without processing unstructured data (e.g. show all e-mails relevant to a performance indicator to allow human to understand the situation) or anything in between.

2.2.3 Smart Cities

Smart Cities (SC) try to improve the lives of citizens by creating more sustainable and more efficient urban environment for people to live in (Geertman et al., 2015). Using technology-based solutions they try to address some of the challenges faced by metropolitan areas (Neirotti et al., 2014). Although there is no clear definition yet of what a SC is, it is widely accepted that Information and Communications Technologies (ICT) play a major role in SC by acting as their nervous system (Neirotti et al., 2014; Geertman et al., 2015). However, ICT capabilities by themselves are not sufficient and

have to be matched with adequate human and organisational capital in order to enable cities to act accordingly. Some research suggest that globally, initiatives within SC are highly diverse and depend heavily on the cultural and socio-economic background of the geographical region making it non trivial to find commonalities, but with time a few archetype models will emerge (Neirotti et al., 2014; Geertman et al., 2015). The highest number of initiatives in area of SC has been observed in Natural resources and energy and Transport and mobility (Neirotti et al., 2014).

Transportation in Nairobi, Kenya using semi-formal mini-buses has been a subject of a project that used GPS data to improve route planning and way finding (Klopp et al., 2015). The location data was not acquired through telecommunications operators, but was willingly shared by users via a smartphone app. It was made public in GTFS format and processed using open-source tools such as Open Trip Planner (Klopp et al., 2015). It is an example of bottom-up approach in which citizens are empowered (Open Data) and supported by local authorities to act and improve their city (Neirotti et al., 2014).

In 2012 the New York City Council has approved a law requiring all city agencies to open their data by 2018. One of the agencies helping in this process is Mayors Office of Data Analytics (MODA). MODA is responsible for initiatives within five categories: Supporting Operations, Citywide Data Sharing, Disaster Response and Resiliency, Economic Development, Open Data. They are offering courses to other City government employees about data and tools available to them and are also promoting data driven decision making (NYC MODA, 2014). One interesting project in New York City is called Hudson Yards Redevelopment Project in which an entire part of the city will be built from scratch. It will be collecting information about air quality, pedestrian traffic, energy production and consumption. It will have a trash-disposal system to remove waste via underground pneumatic tubes.

2.3 Double Diamond

Double Diamond is a model of the design process developed by the UK Design Council (Design Council, 2007, 2005). It is a result of a qualitative study of practices in companies focused on innovation and it describes the commonalities in the creative activities that can be observed among designers regardless of the field they are working in. The model divides the design process into 4 phases as pictured in the diagram below. Each of those phases is focused on a different objective and involves methods

which are characteristic to that stage.

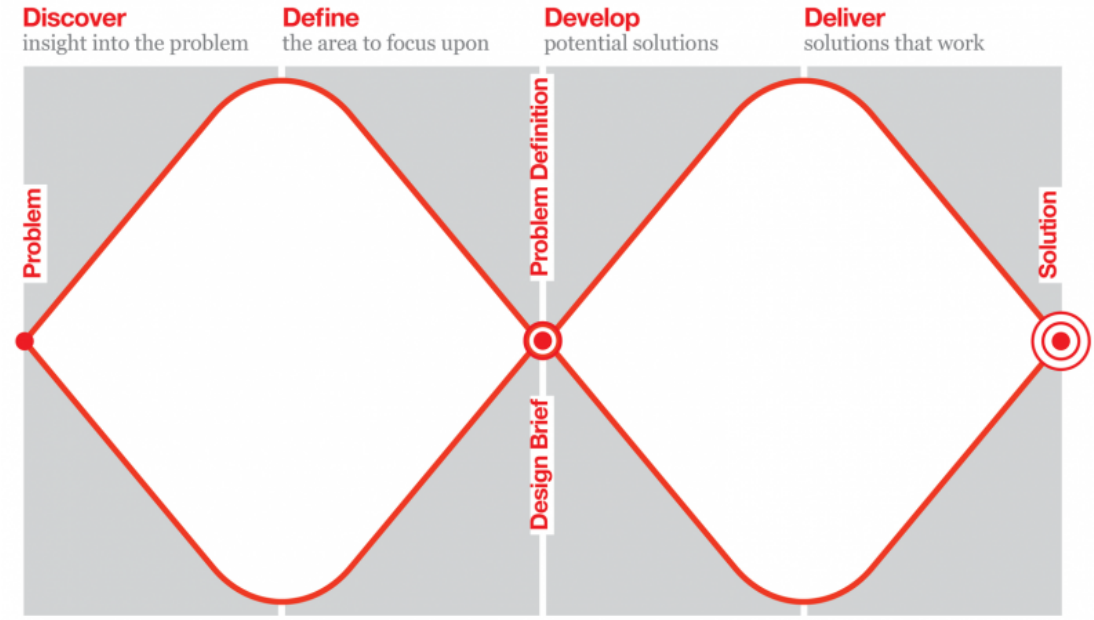

Figure 2.1: Double Diamond model (Design Council, 2005)

2.3.1 Discover

At this stage the attitude adopted is of openness in terms of thoughts and ideas. All ideas are welcome, different perspectives are nurtured and every direction has the potential to be valid. This thinking is typical at the beginning of the project. Designers try to remain as open as possible so that their own perspectives do not limit creativity. This helps in noticing things that might matter, clues about what would make the situation better especially that it might be something unexpected or not identified.

Some of the activities used at this stage include:

- Observation
- User diaries
- Being your users
- Brainstorming
- Choosing a sample
- Quantitative surveys

- Fast visualisation
- Secondary research
- Hopes and fears
- Market research
- User research
- Managing information
- Design research groups

2.3.2 Define

Second phase is trying to make sense out of all the information collected. It is focused on identifying causalities, narrowing down insights and establishing the main challenge which will be addressed. It takes into consideration limitations of the project in terms of what is feasible given the time and resources. Selection and discarding of ideas takes place here as well. It starts with numerous concepts and ideas and finishes with a clear definition of the problem and a list of actionable tasks.

Activities at this stage often involve:

- Focus groups
- Assessment criteria
- Comparing notes
- Drivers and hurdles
- Customer journey mapping
- Project development
- Project management
- Project sign-off

2.3.3 Develop

This stage involves intense creation, prototyping and testing. It takes the results of the previous phase as a design brief and uses it as a framework for the development process. Iterating is very important in order to improve and refine the prototypes as well as concepts. Attitude of trying and failing ensures the space for testing different implementations using different techniques and thus finding the best one. Some of the tools used are similar to Define stage, but here they are focused on bringing a product ready for production.

Typical to this stage are:

- Character profiles
- Scenarios
- Role-playing
- Service blueprints
- Physical prototyping
- Multi-disciplinary working
- Visual management
- Development methods
- Testing

2.3.4 Deliver

The last phase is when the product is being finalised, produced and launched. Here it is mass produced, checked before release and delivered to the user. Feedback mechanisms should be in place which will improve the product itself, but also methods and practices used in the process of creation of it.

Characteristic to this phase are the following activities:

- Phasing
- Final testing
- Evaluation

- Feedback loops
- Methods banks
- Approval
- Launch
- Targets

Chapter 3

Description of the work undertaken

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3.1 Discover

During the discovery phase of the project the objective was to become familiar with the CEC environment, i.e. find out what tools are available and how they are being used and gather information about how to best contribute to the organisation. This was to be done while staying as open as possible, allowing any influences or ideas.

At the beginning of the project I had no knowledge about the operations within the Council or which departments would be involved. Some of the questions I wanted to answer included:

- Are there any activities in the Council similar to the scope of the project (or were there any in the past)?

- Who would benefit from it and how to give those stakeholders an opportunity to be involved?
- What questions (in terms of channel shift) are not answered in the Council? At what level of abstraction should the analysis be conducted?
- What IT systems/tools can be used in the project?
- Who has the necessary understanding of the infrastructure and activities on the architectural level?
- What else do I not know?

3.1.1 Meetings at the Council

Initially the contact person from the Council was Sally Kerr. In response to my questions she arranged a meeting with an enterprise architect Neil Dumbleton. The purpose of the meeting was to give me an opportunity to ask questions regarding organisational structure as well as context of the project.

As it turned out, it was a first meeting in a series. There was no formalised documentation or central place with knowledge about on-going projects that was made available to the author. As a result, personal meetings were the only way to understand activity in the Council. Moreover, it was only thanks to good will of many employees at the City of Edinburgh Council that this was possible.

The diagram below shows all the people who I interacted with during the entire project. Connections between different actors represent how I got to know them. Circles with coloured backgrounds highlight people who I spoke with in this phase. Orange colour marks people related with University of Edinburgh, blue is for CEC employees. Level of a circle does not reflect a position in the Councils structure - it is used solely for increasing legibility of the diagram.

3.1.2 CRM data

3.1.3 Mosaic UK Consumer and Demographic data

3.1.4 IBM Cognos

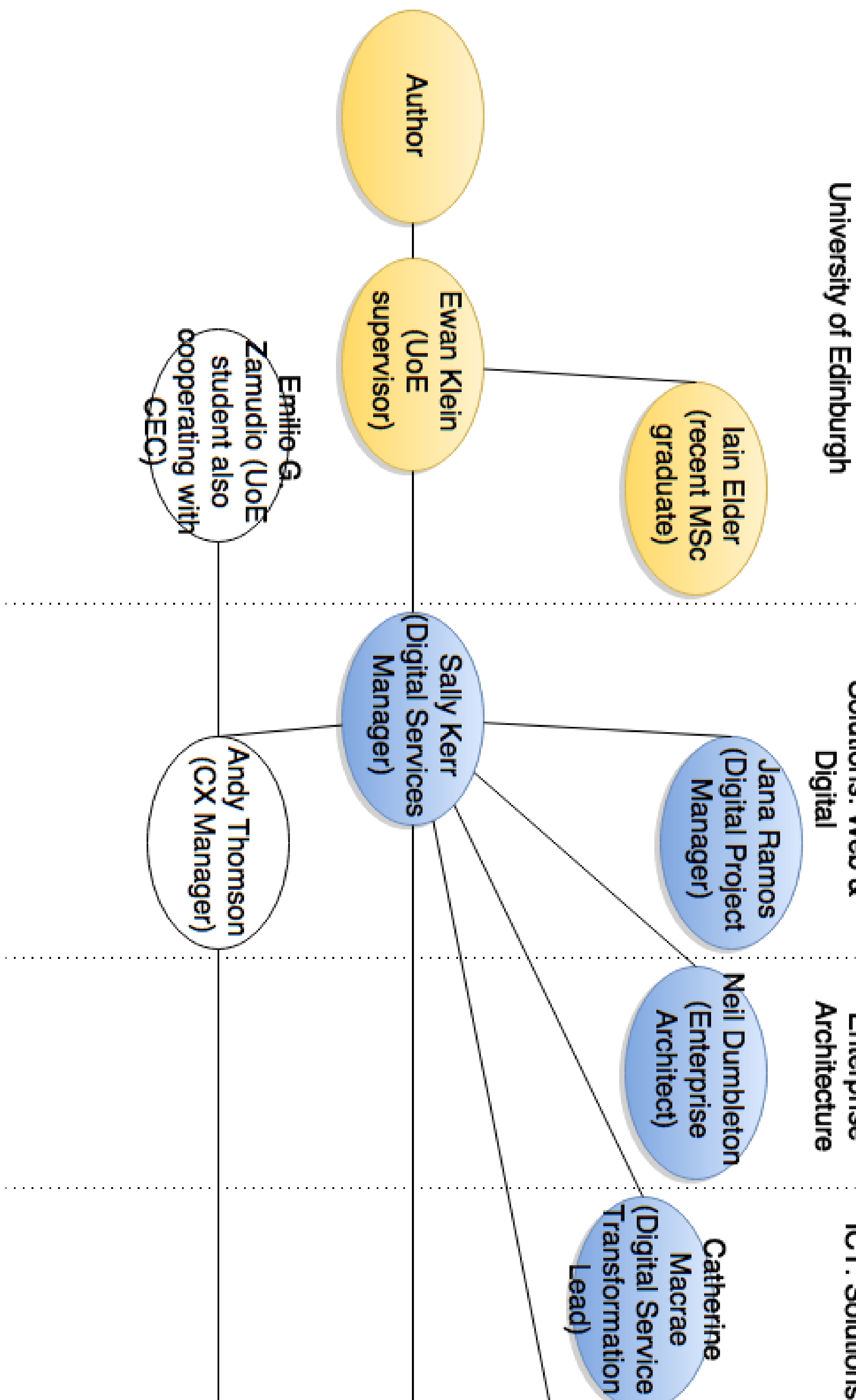
3.1.4.1 Introduction

3.1.4.2 Working with IBM Cognos BI

3.2 Define

3.3 Develop

3.4 Deliver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Iain Elder (recent MSc graduate)
Emilio G. Zamudio (UoE student also cooperating with CEC)
Digital
Sally Kerr (Digital Services Manager)
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Andy Thomson (CX Manager)
Architecture
Neil Dumbleton (Enterprise Architect)
Catherine Macrae (Digital Service Transformation Lead)

Chapter 4

Analysis and evaluation

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4.1 Evaluation of the tools used

4.1.1 CRM data

4.1.2 IBM Cognos

4.2 Evaluation of the work undertaken

4.2.1 Report 1

4.2.2 Report 2

4.2.3 Report 3

4.3 Evaluation of methodology used

The double diamond approach seems to reflect very well the dynamism of real life projects. The model describes a rhythm of activities that comes naturally. It includes a very open, exploratory first stage which leaves space for flexibility in adapting to what would be useful to the client.

The Discovery phase was extremely helpful in understanding the context of the problem and establishing ground before the next phases. Having such an open attitude requires a lot of persistence. The responsibility for the entire project rests on the designer and this causes a creative stress. In the early stages, it is desired to not be limited by having a concrete idea of what to do in the project (which is not synonym with not having a path of action). The designer is exposing himself to the unknown and at many points the project could completely change direction or a path could be closed unexpectedly. It is critical to maintain composure, agility and be able to quickly adjust to the new conditions. It is also important to mention that it exposes the project to the will of people across the entire organisation. The more the involved people are open and willing to help the better the outcome of the project will be. In terms of this particular project, the Council employees were very helpful and open-minded and their support has helped tremendously.

The three objectives that came from the Define phase (design brief) were developed in close cooperation with the beneficiaries (and at the same time the requesting party).

The Develop phase managed to address all questions from the previous stage. Having clear, measurable objectives, which were thought through, helped in planning the

rest of the process and designing the technical aspects of it. The extent to which implementations were able to solve those problems was described in sections above (Evaluation of work undertaken).

The key outcome of Deliver stage was feedback from clients. It was very helpful to understand the extent to which it addressed actual needs and whether it succeeded in contributing to the on-going efforts in the Council (being in line with the current ICT strategy at the Council).

Chapter 5

Conclusion

Out of this project come many open questions and potential for further study. This dissertation gives a lot of details about the context of the project which were not available before. They can be of significant help in future endeavours.

The double diamond approach was particularly good at enabling cross department activity and flexibility in adjusting the scope of the project to the needs of the Council. Given the experience gained, a further study could try and evaluate different methods used at each stage of the process.

It is also important to stress that such projects are very agile in nature and depend heavily on the organisation in which they are run, i.e. on the knowledge of people involved and their willingness to share it. This project is a great example of how open-mindedness of employees can help.

The timescale of the project was extremely short given its complexity. Many parts of it could easily take months to be properly developed. However, it was not aiming at delivering a fully-fledged product. Instead, the objective was to help the Council with evaluating new ways of thinking and working and looking at the design process in its entirety. As a result in many cases compromises had to be made.

BI reports like the ones generated in this project, should be treated as part of a bigger transformation project. Identifying cases where users struggled with a web interface by CRM data analysis should be one of many tools in the repertoire of a service manager. For example, they can be used to identify the demographics of people to invite for participation in a focus group.

Reports like these often raise further questions, e.g. when conducting analysis other things start emerging which could be objects of investigation themselves. There is a vast amount of possible insights coming from the CRM data.

The reports can be used by CEC employees on other data sets (it is a matter of pointing to a different source file).

Coming up with insights and recommendations is only one step. Another question is how to manage a change in an organisation in order to benefit from those analyses. Ability to adapt to user needs and learn from the feedback is actually executed when such insights are followed by tangible actions such as a decision to deploy a change or a confirmation that current efforts are not misplaced.

Appendix A

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(If you're wondering what all this weirdness is, check out
http://www.subterrane.com/loremipsum.shtml)

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A figure.

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