Human-Centred Design: Effective and Efficient Tools For Evidence-Based Management of the National Health Service

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Dr Foster Intelligence (DFI) is a leading provider of health and social care information for improving clinical effectiveness and efficiency in the UK. DFI develops **web-based data analysis tools** which give National Health Service (NHS) managers and clinicians access to a national database of admitted patient care and outpatient attendance data. Such tools can assist the NHS to remain affordable whilst costs rise. Previous research, however, suggests poor usability has hindered uptake and the extent to which they support healthcare managers in analysing and managing large volumes of data. This work presents an **action research** collaboration to introduce a **User-Centred Design** approach at DFI over six years with methods from **Usability Engineering**.

PROJECT 1: Requirements/Evaluation Population Health Manager

Population Health Manager (PHM) provides information to **understand** populations and **model** their health needs, **identify/analyse** health inequalities to target unmet needs, **monitor** admissions and **forecast** future trends locally.

An **online survey** elicited potential users' preferences for how data should be mapped. Questions asked them to use maps (e.g. Figure 1) to locate new services, state which they preferred and which made it easier to answer the question.

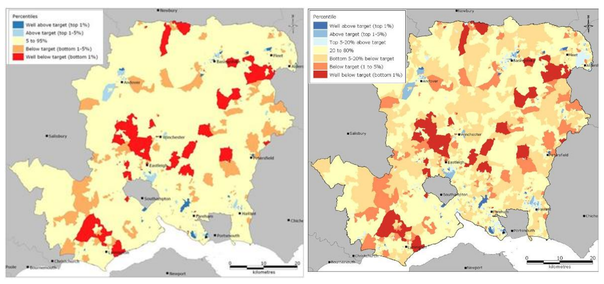

Figure 1: Number of smokers shaded in five and seven groups

This is important because users' cartographic choices can affect how data is interpreted (Figure 2).

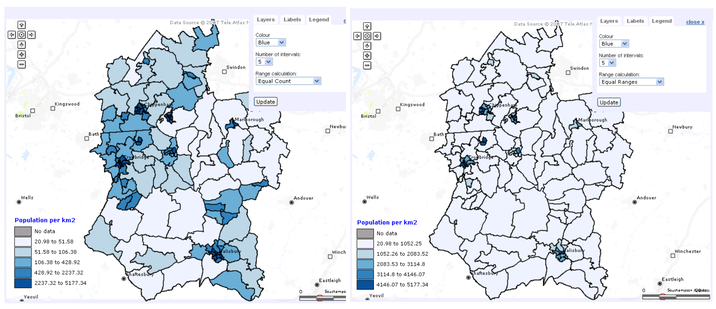

Figure 2: Data grouped by number of data points and equal data range

PROJECT 2: Developing Personas Dr Foster Intelligence

Personas are fictional people who represent groups of real users with mutual goals and behaviours. DFI personas were created to help developers understand users' diverse needs. **Log files** revealed usage data and job titles (Figure 3).

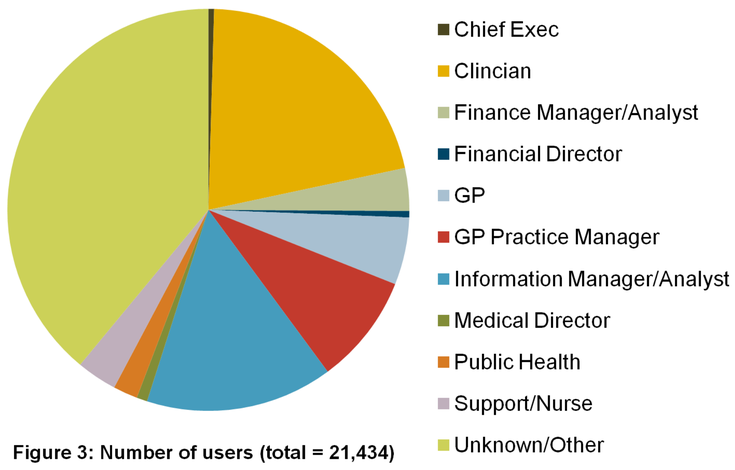

Figure 3: Number of users (total = 21,434)

Screen captures from users and **interviews** with key users enriched this data to create personas with Figure 4's template.

Michael: Medical Director
- Personal Information
- Goals
- Behaviour Patterns
- Attitudes
- Skills
- Environment

Figure 4: Template for personas

PROJECT 3: User Testing Quality Investigator

Three years after PHM, Quality Investigator (QI) was developed to **monitor** clinical performance, processes and data coding. It assesses death, length of stay, re-admission and day case rates: indicators of **care quality/efficiency**.

A **dashboard** (Figure 5) alerts users when data suggests a systematic problem and allows them to dig deeper into the data to explore potential reasons for these trends.

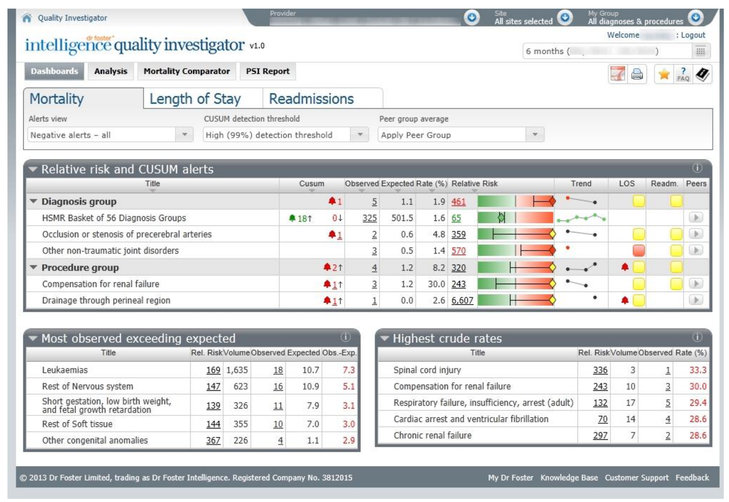

Figure 5: QI's dashboard interface

Existing users were contacted to participate in **user testing**. Each session elicited first impressions before 8-10 tasks were performed. Finally, participants completed a **usability questionnaire** to summarise their experience.

USABILITY ENGINEERING APPROACHES USED

Resources	Map Survey	Heuristic Evaluation	Cognitive Walkthrough	Database Server Log File Analysis	User-Generated Screen Captures	Interviews / Rapid Contextual Evaluation (RCE)	User Testing	System Usability Scale Questionnaire
Participant Recruitment	Emails to colleague contact.	N/A	N/A	N/A	Email to users within previous six months.	Customer Service Managers approached interviewees first.	Account managers approached first, before they were emailed.	Same as user testing.
Task Selection	Expert advice.	Job descriptions. Client-facing colleagues.		Expert advice.	Screenshots taken when users were logged in.	Interviewees chose their most common task to demonstrate.	Based on requirements analysis from the early stages of the tool's development.	A questionnaire that previous research shows can usefully rate a system's ease of use.
Problem Identification	N/A	Structured checklist (296 items).	Structured questions at each subtask.	N/A	Analysis of images received.	Self-report and demonstration of common task.	Self-report during tasks, and observation of unreported problems.	In the participants' responses.
Reporting Format	Bug reporting software.	Formal report of findings and redesign suggestions. Close collaboration.		Tables and charts presented to department heads.	Spreadsheet of screen resolutions, applications open etc.	Report of key themes and presentation to developers.	Spreadsheet for project leads presentation of key findings and video to developers.	Colour-coded in a spreadsheet given to project leads that summarised testing results.

KEY FINDINGS

- Preferences challenged **cartographic conventions**.
- Participants requested **simplicity** and **flexibility** in presentation format as it depends on the map's purpose.
- The underlying database architecture limited the implementation of some preferences.
- **Expert evaluation** identified 32 usability problems: 12 irritants, ten moderate, nine severe and one unusable.

- The extent to which **users combine DFI data** with other sources using other software was striking.
- Insight into users' **working environment** e.g. slow network speeds, outdated software, data requirements.
- Unexpected usability problems were found when users demonstrated their most common task.

- **False assumptions** were made about users' ability to use new functionality.
- **Redesign suggestions** and **usability problems** were prioritised based on frequency and resources.
- **Bonus benefits** of new functionality e.g. engaging more users within hospitals already using DFI tools.
- **Challenges** specific to the health domain e.g. jargon.

DISCUSSION

- Method resources were adapted due to internal/external business changes and stakeholders' perspectives and aims.
- **Client needs/expectations**, **corporate culture and values**, **cognitive resources** and **development context** influenced how well methods moved from theory to practice (Figure 6).
- These **local resources** were more influential than those associated with the methods as prescribed in textbooks e.g. cost.

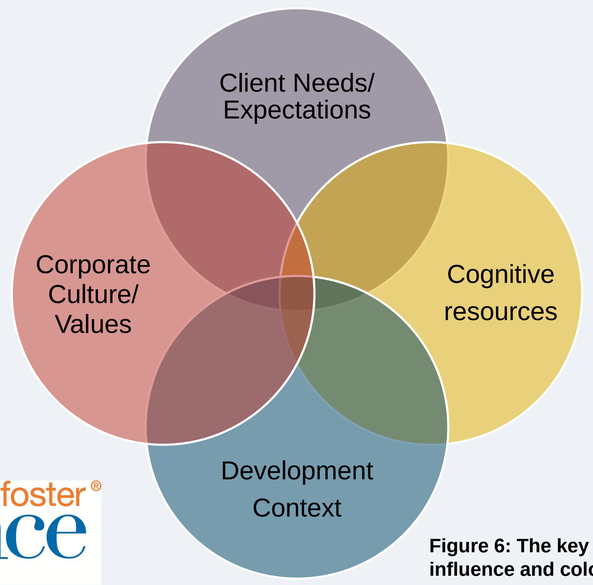

Figure 6: The key resources found to influence and colour design work at DFI

CONCLUSIONS

- Awareness and **status of usability was raised** at DFI and methods were integrated into design and development processes.
- **Challenges/opportunities** presented by rapid changes in the **business environment** on UCD introduction are highlighted.
- The extent that basic **usability engineering methods** can resolve non-trivial design problems in this context is illustrated.
- Methods can have **additional benefits** e.g. fostering customer relations, introducing UCD concepts beyond development teams.

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