

Computational case-based redesign for people with ability impairment: Rethinking, reuse and redesign learning for home modification practice

by

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Except where otherwise indicated, this thesis is
my own original work.

Catherine Bridge

A handwritten signature in black ink that reads "C Bridge". The "C" is large and loops around the "B", which is also large and loops around the "r". The "d" is smaller and loops around the "g". The "e" is a simple horizontal stroke.

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Abstract

Home modification practice for people with impairments of ability involves redesigning existing residential environments as distinct from the creation of a new dwelling. A redesigner alters existing structures, fittings and fixtures to better meet the occupant's ability requirements. While research on case-based design reasoning and healthcare informatics are well documented, the reasoning and process of redesign and its integration with individual human functional abilities remains poorly understood. Developing a means of capturing redesign knowledge in the form of case documentation online provides a means for integrating and learning from individual case-based redesign episodes where assessment and interventions are naturally linked.

A key aim of the research outlined in this thesis was to gain a better understanding of the redesign of spaces for individual human ability with the view to computational modelling. Consequently, the foundational knowledge underpinning the model development includes design, redesign, case-based building design and human functional ability. Case-based redesign as proposed within the thesis, is a method for capturing the redesign context, the residential environment, the modification and the transformational knowledge involved in the redesign.

Computational simulation methods are traditionally field dependent. Consequently, part of the research undertaken within this thesis involved the development of a framework for analysing cases within an online case-studies library to validate redesign for individuals and a method of acquiring reuse information so as to be able to estimate the redesign needs of a given population based on either their environment or ability profile.

As home modification for people with functional impairments was a novel application field, an explorative action-based methodological approach using computational modelling was needed to underpin a case-based reasoning method. The action-based method involved a process of articulating and examining existing knowledge, suggesting new case-based computational practices, and evaluating the results. This cyclic process led to an improvement cycle that included theory, computational tool development and practical application.

The rapid explosion of protocols and online redesign communities that utilise Web technologies meant that a web-based prototype capable of acquiring cases directly from home modification practitioners online and in context was both desirable and achievable.

The first online version in 1998-99, encoded home modification redesigns using static WebPages and hyperlinks. This motivated the full-scale more dynamic and robust HMMinfo casestudies prototype whose action-based development is detailed within this thesis. The home modification casestudies library results from the development and integration of a novel case-based redesign model in combination with a Human-Activity-Space computational ontology. These two models are then integrated into a relational database design to enable online case acquisition, browsing, case reuse and redesign learning.

The application of the redesign ontology illustrates case reuse and learning, and presents some of the implementation issues and their resolution. Original contributions resulting from this work include: extending case-based design theory to encompass redesign and redesign models, distinguishing the importance of human ability in redesign and the development of the Human-Activity-Space ontology. Additionally all data models were combined and their associated inter-relationships evaluated within a prototype made available to redesign practitioners.

Reflective and practitioner based evaluation contributed enhanced understanding of redesign case contribution dynamics in an online environment. Feedback from redesign practitioners indicated that gaining informed consent to share cases from consumers of home modification and maintenance services, in combination with the additional time required to document a case online, and reticence to go public for fear of critical feedback, all contributed to a less than expected case library growth. This is despite considerable interest in the HMMinfo casestudies website as evidenced by web usage statistics. Additionally the redesign model described in this thesis has practical implications for all design practitioners and educators who seek to create new work by reinterpreting, reconstructing and redesigning spaces.

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List of Abbreviations

Abbreviation	Explanation
ABS	Australian Bureau of Statistics
AIP	Ageing In Place
A-V pair	Attribute-Value pair
CBR	Case-Based Reasoning
CBdR	Case-Based design Reasoning
CBrR	Case-Based redesign Reasoning
CGI	Common Gateway Interface
DACS	Disability, Ageing and Carers Survey
DBMS	Database Management System
DDA	Disability Discrimination Act
DNT	Data Networking Technologies
DVA	Department of Veterans Affairs
E-R diagram	Entity Relation diagram
EMR	Electronic Medical Records
HACC	Home and Community Care Program
H-A-S	Human-Activity-Space model
HMM	Home Modification and Maintenance
HMMinfo	Home Modification and Maintenance Information Clearinghouse
HMMS	Home Modification and Maintenance Services
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
ICD	International Classification of Diseases
ICF	International Classification of Function
IT	Information Technology
LISP	List processing language (a computational language for list manipulation)
KBS	Knowledge Based System
NSW	New South Wales
PADP	Program of Aids for Disabled People
POMR	Problem Oriented Medical Record
SBF	Structure-Behaviour-Function model
SHA	State Housing Authority
SQL	Structured Query Language
SSIs	Server Side Includes
WHO	World Health Organisation
WI	Web Intelligence
Web	World Wide Web