Institution: The Open University

Unit of Assessment: B11 Computer Science & Informatics

Title of case study: Increasing society's capacity to tackle complex, socio-technical dilemmas
1. Summary of the impact (indicative maximum 100 words) The OU's *Compendium* software is used for mapping dialogue and information networks around complex socio-technical dilemmas, contributing to economic, public policy, educational and health impacts. In Australia, urban planners attribute a breakthrough in securing diverse stakeholder buy-in to a city development, to Dialogue Mapping with Compendium. In the US, a deadlocked environmental planning process moved forward with Dialogue Mapping with Compendium, while the energy company Southern California Edison has used it for over a decade for environmental policy management, investing in the codebase, and folding back their improvements to the open source release. An NHS pilot demonstrated unique ways to evidence therapeutic group dynamics, while a journalist used it to present to the German Parliament the summary of a complex national debate on medical ethics, in his view more effectively summarising expert opinions than conventional means. Over 170 SMEs and individuals, almost all of whom are strangers to us, have publicly endorsed the tool in our user survey, a striking example being a user who uses it to control his Attention Deficit Hyperactivity Disorder at work.
2. Underpinning research (indicative maximum 500 words) In Computer Science/Informatics, research into *sensemaking* focuses on computational support for human interpretation and action, when confronted by overwhelmingly complexity. Research at the OU led by Prof. Simon Buckingham Shum (1995-present) investigates the human and technical factors that promote (and impede) the adoption of software tools to assist in this. Specifically, our focus is on the design and use of visual software that combines formal modelling, information management, informal conversation, careful argumentation and visual 'knowledge cartography'. Our research into hypermedia discourse, design rationale and argument visualization underpins a software tool called *Compendium*, and associated methodologies for its effective use. Embodying insights from 20 years' research, it can be thought of as a form of "mind-mapping", but typically only one mind is expressed in such approaches. Compendium and the visual modelling methods it supports capture different 'minds' when deliberating over a complex dilemma. Hypertext features and many user interface refinements help manage the myriad connections between ideas and information elements. It is this attention to holding in one place multiple perspectives across many conversations, about complex, multimedia information, which underpins Compendium distinctiveness, and impact. Our research integrates Compendium with other advanced tools (e.g. a NASA multi-agent workflow system; Access Grid video conferencing; semantic web services) and we conduct empirical studies of both novices and experts as they use Compendium. Our informatics perspective emphasises that there are cognitive, social and political ramifications to capturing and visualizing conversational contributions. Critically, there is a craft skill to using the tool effectively in meetings — a craft skill without which the tool is far less valuable, and which has been the object of close analysis. Methodologically, this is not the story of a single 'breakthrough discovery'. This has been action research, in which an evolving prototype is deployed by ourselves and many others in authentic contexts, enabling us to refine both the underlying assumptions and the software. The body of knowledge is distinctive in HCI/CSCW/Requirements Engineering research, fields in which many of the early design rationale researchers moved on to other challenges as it became clear that exciting

hypermedia software on its own was not enough to secure adoption. The evidence base has not only been documented academically, but embodied in many others' skillsets through training. There is thus a set of validated practices for effective use of the tool.

Through design-based research, always working with a client group confronting real world challenges, Compendium has evolved from a proof of concept e-Science project demonstrator in 2002, to usage across education, government, business and civic society. The research input has been critical. Reflective practice, combined with video analyses of users provided a detailed account of not only the initial learning curve [i], but since 2010, an account of the nature of fluency and expertise with the tool [ii], which is only possible with a longitudinal research programme studying a robust tool in authentic usage. The *"Visualizing Argumentation"* book included several chapters on Compendium, establishing the field, and becoming the standard reference [iii]. NASA invested significantly in the software as part of its field trials into multiagent science workflow for manned-missions to Mars, resulting in ground-breaking human-agent mapping [iv]. Following funding from the EPSRC/e-Science and JISC Virtual Research Environments programmes (2002-06), our research excited digital humanities researchers who saw the potential for multimedia choreographic research, attracting a joint AHRC/EPSRC/JISC grant 2007-09, and new ways for choreographic researchers to design and communicate their work [v]. This longitudinal research programme enabled us to reflect on lessons learnt over 15 years in a chapter for the primary source on Software Engineering Design Rationale [vi], with the editorial concluding that Compendium was the most mature tool available in terms of real-world deployment.

3. References to the research (indicative maximum of six references)

i. Buckingham Shum, S., MacLean, A., Bellotti, V., & Hammond, N. (1997). **Graphical Argumentation and Design Cognition.** Human-Computer Interaction, 12, (3), pp. 267-300

ii. Selvin, A.M., Buckingham Shum, S. and Aakhus, M. (2012). **The Practice Level in Participatory Design Rationale: Studying Practitioner Moves and Choices.** In: John M. Carroll (Ed.), Creativity and Rationale: Enhancing Human Experience by Design. Springer: London. ISBN 978-1-4471-4111-2. Reprinted from Human Technology, 2010, 6, (1), pp. 71-105. Eprint: http://oro.open.ac.uk/20948

iii. P. Kirschner, S. Buckingham Shum & C. Carr (2003). **Visualizing Argumentation: Software Tools for Collaborative and Educational Sense-Making.** London: Springer-Verlag. www.VisualizingArgumentation.info.

iv. Sierhuis, M. and Buckingham Shum, S. (2008). **Human-Agent Knowledge Cartography for e-Science: NASA Field Trials at the Mars Desert Research Station**. In: Okada, et al. (Eds.), *Knowledge Cartography: Software Tools and Mapping Techniques.* Springer: London.

v. Bailey, H., Bachler, M., Buckingham Shum, S., Le Blanc, A., Popat, S., Rowley, A. and Turner, M. (2009). **Dancing on the Grid: Using e-Science Tools to Extend Choreographic Research.** *Philosophical Transactions of the Royal Society A,* 13 July 2009, Vol. 367, No. 1898, pp. 2793-2806. Eprint: http://oro.open.ac.uk/12901

vi. Buckingham Shum, S., Selvin, A., Sierhuis, M., Conklin, J., Haley, C. and Nuseibeh, B., (2006). **Hypermedia Support for Argumentation-Based Rationale: 15 Years on from gIBIS and QOC.** In: Dutoit, A.; McCall, R.; Mistrik, I. and Paech, B. (Eds.) Rationale Management in Software Engineering, pp.111-132. Springer-Verlag: Berlin. Eprint: http://oro.open.ac.uk/3032

4. Details of the impact (indicative maximum 750 words)

As detailed below, Compendium is impacting real lives across diverse sectors: health, business, public sector and education.

Software Adoption: With each release the software serves as the primary means to disseminate hypermedia research concepts to a broad audience. Compendium has >100,000 unique downloads since 2003, with an active user community (1867 members, Jul.13) supported by the *Compendium Institute* (compendium.open.ac.uk/institute)*. The open source developer community took ownership of the software in early 2013, and maintain the software on their own CompendiumNG website (compendiumng.org) independent of the OU: *"Compendium is considered so valuable by its user community, that it has self-organised to ensure that it remains a living software application. The community has been discussing the possibility of driving the development of Compendium through a community effort. […] Based on these developments a small group of dedicated users and developers started the development of CompendiumNG, with NG standing for 'next generation'."* [1].

Our user survey [2] launched Jan. 2011 has elicited >170 public endorsements of its importance in the personal and professional lives of many people who testify to its impact, with the primary impact being more efficient information management and deliberation processes for small businesses. The testimonials database shows the sector breakdown: Business: 17%, Education: 27%, Government: 1%, Not for Profit: 14%, Personal: 32%, Other: 8%.

Economic impact (SMEs): Compendium sits at the heart of several consulting firms. CogNexus Group (California) reports: *"CogNexus Group has used Compendium software exclusively to support Issue Mapping and Dialogue Mapping services and training since 2008.   During this time we have trained over 80 people in the art of Issue Mapping using Compendium; people who are working in the international community in areas as diverse as public health, energy production, water usage issues, education, and consulting. Although the specifics are proprietary, we have assisted many clients, including five from the Fortune 100, in increasing their effectiveness and productivity, through the use of Issue Mapping and Dialogue Mapping. We see Compendium as the premier tool for the type of IBIS-based mapping that supports the large maps that are typical of the real-world use of Issue Mapping and Dialogue Mapping. Because Compendium supports capabilities that no other software does, our work would not be possible without it!"*

Two of many public testimonials on the Compendium Institute website attest to its importance for SMEs: *"Compendium means more than a tool for our project; it is a full work philosophy when choosing options in our complex decision trees while designing projects, developing research discussions, following academic debates, planning activities and evaluating alternatives." "Compendium is a powerful tool that supports the thinking and disciplined creativity of its users. I use if routinely in my consulting practice for dialogue, knowledge and issue mapping as well as for process mapping. My clients, who are founders and owners of small businesses, often carry around the jpg maps because they find then so useful."* (Jan. 2011)

Public policy impact: Compendium was used 2010-11 for participatory urban planning in Perth, Australia, and numerous other examples are documented in a practitioner handbook on project management, written by consultants completely independent of the OU: *"The Stirling Alliance utilised dialogue mapping to help resolve the long standing Stephenson Reserve issue that could not be*

resolved using traditional methods. Dialogue mapping significantly shortened the time frames to discuss multiple options, ensuring that repetition on contentious issues did not recur. After participants were familiar with the process, meetings followed a much smoother format with a lot less tension. The Stirling Alliance found that dialogue mapping, together with value management and enquiry by design helped us achieve a preferred option to deal with Stephenson Reserve." [3].

Southern California Edison uses Compendium for environmental policy management. The first decade's deployment 1993-2003 was documented [4] and a decade later they continue to use it to capture the rationale behind decisions, and index documents in flexible ways. They hired their own developer to add data scaleability and local area networking to the codebase, returning these improvements to the open source release.

Compendium was the key software used to support Dialogue Mapping which led to breakthroughs in planning the future of the Sacramento-San Joaquin Delta, as evidenced in the meeting maps and report from the *Delta Dialogues* [5].

Health impact: Group psychotherapists struggle to find ways to evidence the impact of their practice in the increasingly quantitative terms required by the NHS. Compendium has been piloted successfully by psychotherapists, who convert their usual written notes from analytic group sessions, into interactive maps that reflect the group dynamics and enable the data to be interrogated. This work attracted interest at the professional conference, subsequently published in and leading practitioner journal [6] and led to the formation of a clinical interest group in 2011 who have piloted Compendium in several other contexts.

The user survey shows that Compendium also serves to support many individuals' personal lives, for instance, vital cognitive planning support for one user (unknown to us) with attention deficit hyperactivity disorder: *"IBIS has changed my life. […] I have ADHD and mapping out problems with IBIS helps me to slow down, orientate and stay focused. […] I use Compendium in meetings and in GTD (Getting Things Done) weekly reviews."* [2].

Education and public understanding of science: Compendium has been adopted by several university courses as the official tool. Swinburne University of Technology (Australia) used it for supervision of design practice research students, and Imperial College London, Dept. Mechanical Engineering required its use in student design projects [8].

Compendium was selected for the British Library's *Growing Knowledge* foyer exhibition, communicating to the public how digital tools are transforming scholarly research (Oct.2010 - Jul.2011) [7].

Compendium enables professionals like journalists to gather data in a much faster time, for example, here is a quote from a journalist who used Compendium to engage the public in a topical debate on synthetic biology, presented at a Parliamentary evening event in Berlin in November 2010 [6]. *"Within just a few weeks, we were able to involve about two dozen experts in the discussion and collect their arguments. The online-maps did a great job in organizing and guiding the conversations with our experts, which in turn advanced the map further. Our goal (which was accomplished) was to create a map that all contributors agreed upon (in terms of fair and thorough representation of arguments). We are confident, that at least in those areas of the debate that we covered, the gathered material is much more detailed than what can be found in most of the literature that existed beforehand. The results were*

presented at a Parliamentary evening event in Berlin in November 2010."

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5. **Sources to corroborate the impact** (indicative maximum of 10 references)

    1. "**CompendiumNG: Dev community takes the codebase forward" (March 2013).** News story on Compendium Institute by the external lead developer http://bit.ly/1aQ08tU
Contact: CompendiumNG lead developer

    2. User community testimonials (Jan 2011-present): Search for ADHD (12 Jan, 2011): http://bit.ly/NXQbfl
Contact: ADHD sufferer

    3. Urban Planning: Senior Strategic Planning Officer, Stirling City Planning, Perth, on Seven Sigma's use of Compendium for Dialogue Mapping: http://bit.ly/1aQ0pNu
Towards a Long Term Transport Plan for Stirling. SevenSigma case study: http://bit.ly/1aQ0pNu
Documented in detail by: Paul Culmsee and Kailash Awati (2011). *The Heretic's Guide to Best Practices: The Reality of Managing Complex Problems in Organisations.* iUniverse. A search of the online text for "Compendium" demonstrates its impact: http://bit.ly/1asso27
Contact: Book Authors

    4. Southern California Edison use of Compendium for environmental policy management: Conklin, J. (2003). Dialogue Mapping: Reflections on an Industrial Strength Case Study. In: P. A. Kirschner, S. Buckingham Shum and C. Carr (Eds.), *Visualizing Argumentation.* Springer-Verlag, London. http://bit.ly/14e3djQ
Contact: Chapter Author

    5. Delta Dialogues, Groupaya (2012). http://bit.ly/14e5fjS
See specifically the public Dialogue Maps produced in Compendium: http://bit.ly/110g4Dn
and the Compendium examples in the final report (pages 10-11, 16) http://bit.ly/1astJ8V
Contact: Groupaya Consultant

    6. "Compendium for mapping group dynamics" (March, 2010). Compendium news story http://bit.ly/15GxuV0
Contact: Lead NHS Clinician

    7. University adoption: News stories on Compendium Institute
Swinburne University of Technology: Supervision of design practice research students: http://bit.ly/17IgEfU
Imperial College London, Dept. Mechanical Engineering: Student design projects: http://bit.ly/12VreH9
Contact: Lead Academics

    8. "e-Dance@BL's Growing Knowledge Exhibition". *Growing Knowledge* exhibition website no longer live, but documented as a news story on project website: http://bit.ly/16LXXF5
Contact: Exhibition Curator

    9. "Argument Visualization in Online Science Debates". News story on Compendium Institute by journalist: http://bit.ly/17Igt44
Contact: Journalist