Design and the Creation of Representational Artefacts for Interactive Social Problem Solving

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Abstract: This paper highlights the role of design and designers in the creation of visual artefacts as *boundary objects* to be used to facilitate social problem solving. Many problems in human service systems can only be solved by purposive action amongst the stakeholders of the system but each stakeholder has only a partial view of the system. Boundary objects that present a multi-stakeholder perspective can facilitate problem solving by creating representations of the system that are meaningful to all stakeholders. In this study we used sensemaking (often a textual practice) and visualisation to create a high complexity representational artefact to enable shared understandings of an occupational rehabilitation system.

Keywords: visual sensemaking; social problem solving; complex multi-stakeholder service system; boundary objects

1. Introduction

Designers have recently become interested in the contribution that design can make to the solution of a wide range of social problems. This development has been facilitated by managers and organisational development practitioners turning to design in their search for new methods of service improvement. Design has entered into the search for innovation in service delivery and, in particular, innovation in the delivery of health and education services. Design methods – such as ethnographic approaches to understanding *user* needs and the rapid prototyping of designs – have been employed to develop co-creation and co-production with *users* in human service delivery (Bessant & Maher 2009, Bevan et al. 2007, Ehn, Nilsson & Topgaard 2014).

Much work in human service delivery has focused upon service system functionality, but there exists a role for designers in the creation of *boundary objects* that can communicate systemic properties. Carlile (2002, 2004) describes the role of *boundary objects* as that of

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representing, learning about, transferring, negotiating, altering and creating new knowledge to resolve the boundary issues that arise in complex systems.

Human service systems are multi-stakeholder systems. Stakeholders are all those individuals and groups that affect or are affected by a service system. This definition covers a broad range of individuals and groups, many of whom have differing roles at different points of the system. Stakeholders are thus often sub-divided into those with a primary or direct interest and those with a secondary or indirect interest. Amongst the first group, 'users' of the system are those directly providing or receiving service, whilst the broader group of primary stakeholders may include service regulators and others. Secondary stakeholders may include employee unions and advocacy groups. In what follows we prefer the broader term 'stakeholder' to cover the divergent roles of the groups that we study (Freeman, Harrison & Wicks 2007).

In multi-stakeholder and multi-user service systems no single stakeholder and no single user is central to the functioning of the system. Social problems in such service systems are usually resolved by interaction amongst the stakeholders. This interaction may be in a political process as stakeholders negotiate the policies and procedures of service provision (e.g. service charters) or it may be focused upon negotiating individual pathways for direct users of the system (e.g. a treatment plan). This interactive problem solving occurs when problems arising in the service system can only be solved by the purposive action of stakeholders collectively, rather than by expert study and expert decision (Kelman, 2010).

In multi-stakeholder service systems where interactive problem solving constitutes a core part of service delivery, representational artefacts that are meaningful to the stakeholders of the system can play an important role in problem solving. The representation of problems in diffuse service systems frequently overlooks the differences between the systemic conceptualisations of different stakeholders. Thus, creating a meaningful artefact can act to generate convergence in representation. This convergence aids participation in social problem solving, facilitating the co-production of service and co-design of system improvements (Morrison & Dearden, 2013).

To create representational artefacts that are meaningful to the diverse stakeholders of a service system, the various meanings of the system for stakeholders must be explored. This paper outlines the value of sensemaking for this task and the way in which sensemaking and visualisation can be used jointly to create a meaningful representational artefact. The paper then employs a case study from the occupational rehabilitation service system and reports on the design methods used in the creation of the representational artefact as a boundary object.

2. Sensemaking and Design

Sensemaking is a broad term that refers to the ways in which people construct meaning from experience. It refers to the cognitive elements associated with the interpretation of

experience but also to the socio-psychological elements of the invention of meaning, such as the construction of identity. Sensemaking is concerned with social practice in the creation of understanding and the enactment of social realities based upon that understanding (Brown et al. 2015, Weick 1995).

The practice of sensemaking has much in common with that of designers, and though perhaps unrecognised, has traditionally been a key aspect of design practice. Sensemaking takes examples grounded in experience and – through the use of abductive processes – seeks patterns of social behaviour and generalisations about motivations.

In the case examined here, sensemaking and the design practice of visualisation were combined to create a meaningful artefact of an occupational rehabilitation system. Stakeholders in the occupational rehabilitation system often have only a partial view of the system, making the practice of sensemaking useful to this research. Occupational rehabilitation is delivered through interactive social problem solving, with the employer and the treating health professional, for example, attending jointly to the medical and psycho-social factors entailed in returning an injured worker to the workplace and reintegrating them to work. Purposive action is required in the interactions between the parties, but each stakeholder only sees action within their action domain. The challenge for the research was to construct the multiple meanings of the rehabilitation system for stakeholders and develop a representation of the system that would communicate multiple viewpoints. The endemic problems in the system – such as miscommunication between employers and health professionals, which we describe in more detail below – could only be understood once the stakeholders could understand their systemic misrepresentations of ‘rehabilitation’ beyond their individual action domain.

Much of the practice of sensemaking is based in social discourse through the use of verbal and textual narratives of experience. For the purposes of the research team, however, the construction of a single narrative was problematic since it would likely be appropriated or ignored by each of the stakeholders as a representation or misrepresentation of their experience. Rather, a visualisation of the system of interactions in rehabilitation was required so that each of their stakeholders could identify their location in the system and identify the interactions that were preparatory to, or the consequence of, the interactions in their own domain. In other words the visualisation supported multiple viewpoints and narratives of the occupational rehabilitation service system.

Sensemaking through visualisation is an iterative process. The sensemaking informs the construction of the visualisation, and the visualization itself informs the dialogue around the sensemaking. This work became integral to the work of the research team, informing their construction of the system of interactions in the rehabilitation service system. In this sense, design can be said to aid the visualisation of the perspectives of different stakeholders, promote dialogue about the social problem and lead to a shared problem statement ahead of the work on solutions.

2.1 The role of Visualisations

Visualisation is central to design practice and there exists substantial work on the role of visual representation in the design literature. Ewenstein and Whyte (2007, 2009) highlight the cognitive role of visual representations. These representations can overcome the limits to an individual's cognitive capacity, reducing cognitive load. Using multiple representations side by side can elucidate different aspects of a problem that lead to unexpected discoveries in the process of interacting with representation. The modes of expression in visual representation can range from highly detailed and concrete to ambiguous and deliberately vague. Lengler and Eppler (2007) describe visualisation studies as an emergent field, with research emanating from scholars within diverse disciplinary practices such as human computer interaction, graphic design, management and architecture. As yet this research remains un-integrated across these practices, and the field risks further fragmentation and loss of valuable insights that might be gained from such diverse disciplines (Ewenstein & Whyte 2007, 2009, Whyte et al 2007, Segelstrom 2009).

Lengler and Eppler (2007) and Eppler and Burkhard (2004) are interested in the potential of visualisations for the transfer and creation of knowledge and make a distinction between knowledge visualisation, information visualisation and visual communication. They believe that managers and organizational development practitioners – outside of advertising and corporate identity visualisation – make very little use of visualisation methods in their work. Managers have little awareness of other uses of visualisation methods, their requirements, benefits and application areas. The widely accepted forms of visualisation in business are internally focused, such as those that show achievement against performance measures (cost, time etc.); show formal business processes and procedures (activity flow charts, organisational charts, etc.), or; show process status (such as visual factory methods). Eppler and Burkhard (2004) believe that the potential for visual representation is often lost because there is little assistance for non-professional visualisers to make use of the power of complex visualisations.

Ewenstein & Whyte (2007, 2009) and Whyte et al (2007) show the important roles that visual materials play in project based work leading to the creation of new knowledge. They explored how engineering and architectural project teams use visuals in their practice, how these support different modes of decision making, and how different forms of visual representation change the focus of the conversation with materials. They found that visualisations are used extensively in both cases, but the nature of visual practice (types of representations used, owners of the visual material, foci of attentions, and patterns of interactions) differs significantly between the two contexts. The authors conceptualise this as the difference between exploitation, where project visualisation is largely in commercial and process terms (time and resources) and exploration, where the project uses a wide range of visual materials to understand physical interdependencies and to create new knowledge. The authors' findings suggest that managers can make more deliberate choices about how knowledge is made visible, thus shaping the nature of their project and the

desired trajectories of learning within and across projects. Key to this work is understanding how visuals can be used to shape meaning and transfer knowledge (Ewenstein & Whyte 2007, 2009, Whyte et al. 2007).

This use of visualisation to create knowledge is less understood in many organisations because of the extensive use of visualisation to represent quantitative data. The representation of more qualitative data and the construction of meaning from that data is less explored.

In the case explored here, visualisation was used to represent new knowledge about the properties of the occupational rehabilitation system, knowledge that was then used to develop shared understandings of this complex service system that has shared ownership.

Visualisation, in this project, fits well with more interpretative design practice. Visualisation has been examined as a design activity for problem solving (Mendel & Yeager 2010) that encompasses all phases of the design cycle, from understanding what is; deconstructing what is; exploring what could be; and making what could be. Kolko (2011) discusses how important it is for designers to make the design synthesis side of their work explicit, in order for it to be valued by their more logical and linear thinking clients, and that visualisation methods can help them do this.

Visualisation practice thus offers a good fit with sensemaking practice. This experimental practice of sensemaking through visualisation enabled the research team to synthesise qualitative data and abstract from the multiple narratives of the service system. This produced what might be termed a high complexity representation of that service system. High complexity representations highlight systemic properties that are not visible to the stakeholders in the system, thus promoting further action to improve the overall performance of the system.

3. Case Study: Occupational rehabilitation through a Workers' Insurance Agency

The research was commissioned by the agency responsible for workplace safety in the state of Victoria, Australia – WorkSafe Victoria. The agency has a dual role in the promotion of workplace safety in Victoria. The agency is firstly the regulator of workplace health and safety practice, with responsibility for accident investigations, the investigation of workplace safety breaches and the launching of prosecutions against employers arising from these investigations. Secondly, the agency is the regulator of the workers' insurance scheme in Victoria, with responsibility for the compensation and occupational rehabilitation of injured workers.

In the first role the agency works with employers and employees to improve safety practice. In the second role it works with a range of stakeholders – employers, injured employees, insurance agents, treating health professionals and rehabilitation providers – to ensure the Return to Work (RTW) and continuation in employment of those suffering a disability as the

result of a workplace injury. In each role the agency has promotional but also important compliance and regulatory functions. These compliance and regulatory functions tend to dominate the work of the agency, as they are the activities more closely specified in the legislation governing the agency.

WorkSafe Victoria has been very successful in its first role of harm reduction. It has overseen a continual reduction of the rate of workplace accidents and injuries, to provide Victoria with the lowest accident rate of any state in Australia; this despite the economic significance of industries (such as manufacturing and construction) with traditionally high rates of accidents. The agency has been less successful in its second role of rehabilitation, however, with limited improvement evident in rates of Return to Work of injured workers following a workplace incident. Around 20% of injured workers have not yet returned to work after six months of absence from the workplace (WorkSafe 2015).

The research was commissioned by WorkSafe Victoria to better understand the wide variation in RTW performance between employers. The proposal was to study the rehabilitation practices of high performing employers, so that some insight might be gained into reasons for such high performance. Qualitative research methods, drawing upon the insights of grounded theory into the analysis of social phenomena (Glaser 1998) were used to examine this, and involved the conduct of semi-structured interviews with key officers involved in workplace RTW. These included: Human Resource Managers; Workplace Return-To-Work Coordinators and Supervisors.

Six Victorian organisations that have successfully implemented beneficial RTW practices were chosen. Participating organisations were identified by WorkSafe Victoria on the grounds that they had a substantial drop in their insurance premium in the past two years and/or had won WorkSafe awards for their RTW practice.

Medium and large organisations were approached, as these are the organisations that tend to have formal written policies, standard procedures and organisational systems for RTW. They were also more likely to have current claims. No particular industries were targeted and participating organisations came from the hospitality, manufacturing, building and construction, health care and professional services industries.

Data was collected by means of:

1. Semi-structured interviews with responsible officers in the workplace (RTW Coordinators, O.H.&S. Managers, HR Managers);
2. Interviews with other stakeholders (insurance agents, treating health professionals, trade union officers and officers of the responsible authority);
3. Workplace observations; and
4. The collection and analysis of workplace documents (e.g. policies and procedural manuals).

Injured workers were not interviewed as part of this project and this is one of the limitations of our approach. Our focus was on employers, their policies and procedures for occupational

rehabilitation and not upon the progress of individual cases. Examining individual histories and medical records raised many complex privacy issues and would have made for a larger and more extensive research project. Our focus was on the aggregate performance of the employer in occupational rehabilitation and this is what is reflected here.

4. The social problem statement

The experience of workplace injury is traumatic for employees. Injury and rehabilitation from injury can have significant health and social-psychological effects for the injured worker. These effects are the more significant where workplace injury results in the loss of employment. The loss of employment following a work disability is associated with a decline in living standards and a rise in psychological disorders, such as depression, affecting workers and their families. Re-entry to the labour market for such workers is made difficult due to the loss of skills, the loss of work capacity and employer discrimination against the claimants of workers' compensation insurance. Over 12% of Australians experiencing a work related injury or illness cease work each year and so there are a significant group of workers exposed to such risks to their social and economic well-being (ABS, 2011; Harrison & Allen, 2003; Purse, 2000; Quinlan & Mayhew, 1999).

Occupational rehabilitation following a workplace injury covers the stages of treatment, work re-entry and employment continuance. Most rehabilitation fails at the continuance stage and this highlights the importance of re-integrative work for successful rehabilitation. It is often not failures in treatment that lead to a loss of employment but rather failures in the provision of re-integrative work (Berecki-Gisolf et al., 2012; Hodges et al., 2013; Young, 2010).

Occupational rehabilitation implies access to continuance of employment, but this is most successful where absence from work is of relatively short duration. The longer the absence from work, the more difficult is the re-entry to the workplace in the absence of re-integrative employment. The length of absence following work related disability is not significantly related to the condition leading to disability, but is closely related to organisational policies and procedures for the provision of re-integrative work and the psycho-social factors in employment continuation (Friesen, Yassi & Cooper, 2001; Hunt et al., 1993; MacKenzie et al., 1998; Tjulin, MacEachen & Ekberg, 2010).

5. Our Approach

The following section describes the process we took, from storytelling and iterative mapping used for sensemaking, to developing visualisations that highlighted the key stories from multiple viewpoints.

5.1 Visual sensemaking of the service system: storytelling and mapping

Sensemaking commenced with a four-hour workshop where the research team took on the roles of *narrator* and *audience*. The *narrator* detailed the stories of the best practice of six

firms and the *audience* aided sensemaking by listening, mapping, questioning, seeking clarification, and comparing the narratives.

The narratives were mapped against a *service blueprint* as an initial framework, which was chosen primarily to capture events occurring over time. The *service blueprint* is a common methodology of service design practice. While there is hesitation in pinning down a single definition of service design practice (Stickdorn & Schneider 2010, pp. 28–33) service design literature generally focuses upon a *user* or *consumer* of a service where ‘...people enter into relationships with professionals and service providers...’ (Polaine, Løvlie, & Reason, 2013, p.36) and so the service experience is co-produced through the interactions between them. Service blueprints and customer journey maps are usually constructed from the point of view of the *user* of a service and their interactions with touchpoints over time (Kimbell, 2014, pp.86–89; Kolko, 2011, p.102; Stickdorn & Schneider, 2010, pp.158–161). This type of mapping helps designers build an empathic understanding of needs to then inform redesign of the system. Polaine et al (2013) draw attention to how staff support service delivery as either touchpoint or as *users* of the system from the *backstage* or *offstage* (p.131–132). They also discuss how blueprints should convey the essence of the service and specific details of the touchpoints, but caution that:

“If you add other people interacting in roles, such as patient, nurse, doctor, and administrative staff, you will find the blueprint becomes very complex very quickly.”
(Polaine et al 2013, p.102).

For the purposes of our research, we found it essential to engage directly with the complexity of interaction between multiple *users* which we refer to as stakeholders in order to visualise the complex system of occupational rehabilitation.

In our move from spoken and text sensemaking to a visual form of sensemaking we found that the service blueprint model, with a focus upon a single *user*, addressed only one part of the story. Rather than being bound to the conventions of the service blueprint, we let the conversations and stories shape the visualisation. As seen in figure 1 below, we listed the stakeholders of the system down the left hand side of the chart and along the RTW journey we mapped the interactions of the various agents, systems and processes. We used Post-it notes on the service blueprint frameworks to capture stories, the thoughts and feelings of stakeholders in their engagement with each other in particular the emotional well-being of injured employees and their relationship with managers, supervisors and co-workers all contributed to the fears, concerns and psychological well-being of the injured employee.

Figure 1 This photograph of the service blueprint mapping features additional explanations that help communicate our sensemaking process. The grey blocks on the left highlight the multi-stakeholder nature of the system, and the blue speech bubbles across the map highlighted key quotes and insights that helped us understand the relationships between stakeholders.

5.2 Individual and collaborative sensemaking: answering 'so what'

The map created from our first workshop was translated into digital form and considered by the research team for individual sensemaking and iterative questioning over a week. The subsequent digital diagram was then reviewed in a second workshop, which allowed the team to make sense of the insights and synthesise their understanding. In this workshop, the team reflected on the map, checked their understanding and asked questions to elaborate on the stories they had heard in the first workshop.

Colour coding was an important conceptual step that revealed a clustering of activities, and helped to identify patterns in the structure of the system (see figure 2). Red was used to flag RTW compliance activities and helped reveal the boundary (shown as a red border) around what a company is required to do in managing workplace incidents. Blue highlighted best practice activities by employers, many of which occurred outside the boundary of RTW compliance activities. Black was used to flag 'blackspots' where the system would break down, such as progress on claims being delayed, or stopped altogether.

Figure 2 As sensemaking continued in digital form, colour coding helped reveal patterns in the system: Red blocks are compliance activities, revealing a clear boundary between what a company is required to do and the activities of best practice companies (marked in blue). Black indicates 'blackspots' in the system.

Through the colour coding, a more complex picture emerged, illustrating details that could not otherwise be seen by the regulator, WorkSafe. Under a regulation framework, problems are seen as 'non compliance' with regulations; yet during interviews it became clear that problems emerged even where employers were compliant. The mapping was not about detailing touchpoints that need to be improved; instead it was about less tangible relationships between stakeholders.

We needed to accommodate the different perspectives of the multiple stakeholders, the interactions and relationships between them, and how these multiple stakeholders interacted with different parts of the system. Boundaries were questioned and the role of the employer was reframed. There was no 'back end' or 'behind the scenes' of the service system, and the boundaries of the system, originally taken for granted as being those defined by WorkSafe, were challenged. Through this a multitude of problems were revealed. There was not just one problem, because different stakeholders are affected in different ways, and the different problems are solved by different combinations of stakeholders.

Working with the visualisation, it became clear to the research team that there were three main systemic problems. The first problem was that best practice within organisations demonstrated attention to areas beyond the boundary of the work safe regulatory domain. Secondly, there were multiple delays and recursive loops in the system that kept injured people away from work longer than necessary. Lastly, there was a lack of attention from government or business to what happens after RTW compliance activities are complete but an employee has not returned to work fully. With these insights, the team developed ways to draw attention to these problems within a visualisation of the RTW journey.

5.3 Selecting the stories to tell: keeping both the whole and the parts of the system in mind

The final visualisations focused upon categories of events rather than a detailed micro sequence of step-by-step activities normally featured in service blueprints or customer journey maps. Iterations of the visualisation took us from the concrete details to the abstract, enabling a more conceptual visual artefact. The visualisation shows that best practice employers are proactive in managing employee well-being, whether the employee is injured at work or has other, non-compensable injuries. If there is a compensable injury under the workers' insurance scheme then these employers are also pro-active in developing relationships with health professionals and insurance agents, to progress rehabilitation quickly. The best practice employers do much more than is expected of them in the compliance framework and hence, simply focusing upon compliance missed much of what made employer practice effective.

Once the map was fine-tuned the key findings became clear. We found that there were four main phases in the RTW journey, represented in a set of finished visualisations (figures 3, 4, 5):

1. Culture of health & well-being:
Employers worked to create a culture of health and well-being in the workplace, focused on prevention of injury and well-being of employees at an everyday level (see figure 4, left);
2. Managing incident & injury:
Employers cultivated and managed relationships with multiple agents, including doctors, insurance agents and rehabilitation providers, not just during a claims process but long before any injury occurred (figure 4, right);
3. Return to Work coordination:
Employers reduced or removed delays in the system, such as insurance processing and recursive loops in the issue of certificate of capacity to return employees to the workplace (figure 5, left).
4. Outcomes:
Better RTW outcomes and reduced insurance premiums

Figure 3 The Return to Work experience map overview shows the four phases of the Return to Work system from left to right: 1. Culture of health and well-being; 2. Managing incident and injury; 3. Return to work coordination; 4. Outcomes. Within the grey space were the key activities and below the grey space we wrote the best practice solutions and stories.

RTW compliance activities defined the boundary of the WorkSafe system (see figure 3, framed in orange) and overlaps two phases: Managing incident & injury (phase 2); and Return to Work Coordination (phase 3). Figure 3 shows the overview of the Return to Work experience map, and each of the phases shown there are presented in more detail in figures 4 and 5.

Because the boundary of the WorkSafe system did not capture the full picture of employer practice, much of what made a successful RTW outcome took place outside WorkSafe compliance activities.

Figure 4 (left) detailed view of Culture of health and well-being, (right) detailed view of the Managing incident and inquiry.

Figure 5 (left) detailed view of Return to Work coordination, (right) detailed view of Outcomes.

6. Conclusion: The final visualisation as boundary object

Meaningful representational artefacts of complex human service systems have an important role to play in interactive social problem solving. In multi-stakeholder service systems, representations cannot rely on the viewpoint of one stakeholder. To create representational artefacts that are meaningful to multiple stakeholders in the system we needed to adapt our design practice towards sensemaking and engage with the visualisation of relationships between multiple stakeholders. Sensemaking is best done through visualisation rather than textual analysis, as the visual highlights the different conceptions of service system boundaries and service system interactions of different stakeholders.

While the service blueprint and journey map can be useful, and initiated our sensemaking process, we found that they can also keep important dynamics hidden. As researchers we needed to ask ourselves what was being kept hidden and what was being revealed through the tools we use. We needed to allow the specifics of the occupational rehabilitation context to emerge. In complex, multi-stakeholder systems, both the whole and its parts need to be revealed in order to initiate the required conversations that lead to collaborative problem sharing and solving. In the closing chapter of their book, Polaine et al. (2013) begin to discuss the potential of service design practice to address complex social, economic and ecological issues, thanks to its ability to break down complexity while still showing the bigger picture

(Polaine et al., 2013, p.189). Our research is an example of how to engage with and communicate this complexity by moving beyond the primarily single *user* perspective normally seen in service design, and related practice, to aid understanding of the complex relationships of multiple stakeholders.

Through iterations of visualisation our process allowed for collective sensemaking – something that is often hidden when completed visuals are presented to clients. The visualisation becomes a boundary object that allows important conversations to take place with multiple stakeholders. It does not point the finger at any one stakeholder or problem, but focuses upon communicating relationships between multiple stakeholders, the importance of social problem solving and reviewing how the boundaries are drawn around the system. This promotes stakeholder ownership of the problems identified which leads to action by the stakeholders to address those problems. This places design in a different role; instead of designing the service system or solving the problems, the designer helps facilitate discussion and action by making the complex simple to understand. The visualisation facilitates dialogue between stakeholders by providing a common starting point and helps initiate stakeholder improvement actions for better social outcomes from the service system such as reduction in the time of return to work of injured workers.

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Dr Richard Cooney (PhD Melb.) studies occupational skill development, employee safety and well-being. Richard has over 20 research publications and his most recent book, *Trade Unions and Training*, examines the union role in workplace training. Richard is currently studying service innovation in attendant care.

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Dr Neal Haslem's practice-led research involves one-to-one relationships with people, enabling futures through communication design action. Ultimately he aims, through design research, education and discourse, to initiate an 'intersubjective turn' within communication design action and research.