

# Understanding problem framing through research into metaphors

***Citation for published version (APA):***

Pee, S. H., Dorst, C. H., & van der Bijl-Brouwer, M. (2015). Understanding problem framing through research into metaphors. In V. Popovic, A. Blackler, D.-B. Luh, N. Nimkulrat, B. Kraal, & Y. Nagai (Eds.), *IASDR 2015 Interplay : 2-5 November 2015, Brisbane, Australia* (pp. 1656-1671)

***Document status and date:***

Published: 01/01/2015

***Document Version:***

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

***Please check the document version of this publication:***

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

***General rights***

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

[www.tue.nl/taverne](http://www.tue.nl/taverne)

***Take down policy***

If you believe that this document breaches copyright please contact us at:

[openaccess@tue.nl](mailto:openaccess@tue.nl)

providing details and we will investigate your claim.

# Understanding Problem Framing through research into Metaphors

**Suat Hoon Pee**, University of Technology Sydney, Australia,  
Suat.H.Pee@student.uts.edu.au

**Kees Dorst**, University of Technology Sydney, Australia, Kees.Dorst@uts.edu.au

**Mieke van der Bijl-Brouwer**, University of Technology Sydney, Australia,  
Mieke.vanderBijl-Brouwer@uts.edu.au

## Abstract

In problem framing, designers produce frames, or a new perspective on a situation, that help to create a novel standpoint from which a problem situation may be tackled. Recently, there is an increase in the popularity of design as a problem solving and innovation approach outside of the traditional design field. This leads to new demands for explicit frame creation instructions and tools. However, most researchers studied the use of frames and processes around problem frames but not where frames come from. So, there is a need for a better understanding of problem framing. In this paper we propose the study of metaphor as a way to improve our understanding of problem framing. This approach opens up the rich knowledge base of metaphor research to help illuminate the ‘mysterious’ problem framing process. Base on this initial study of selected metaphor theories; we have developed a typology of metaphors that illuminates how metaphorical problem frames are created.

*problem framing; metaphors; problem frames; design thinking*

Kings Cross, the entertainment quarter in the City of Sydney attracts 30,000 people over the weekends. Much of the crowd activity is concentrated in the narrow 500-meter stretch of road. This influx of people into the small space has contributed to numerous problems including drunkenness, fights, theft and drug dealing. Problems escalate as intoxication increases late into the night, sometimes leading to sporadic violence resulting in deaths and serious injuries. This is not a new problem. Over the years, the local government has resorted to increasing police presence, hiring more security personnel and installing CCTV systems, but the problems have stubbornly persisted. In more recent times, stronger measures such as the alcohol lock down and more identity checks were legislated and enforced.

These measures have been successful in preventing violence but unfortunately, this rational way of problem solving has also turned away many partygoers. It has turned Kings Cross into a sterile place that is no longer appealing to visitors. Many shops are on the verge of closing down or have already closed down. The Sydney Morning Herald (New South Wales) announced the “death of Kings Cross” on 22 Sep 2014.

When the Designing Out Crime Centre (DOC) originally took on this project back in 2008, they moved away from usual law and order crime prevention and looked at the issues through a broader design lens (Dorst & Tomkin 2011). From their research, it became apparent that the majority of the 30,000 young people were not criminals; they simply wanted to have a good time. Unfortunately, some got themselves into trouble due to the lack of organization in managing the circulation of 30,000 young people. The designers quickly reframed the problem and approached it as if it were a large-scale musical festival. This new problem frame provided a different direction for exploration and action, and led to event management type solutions.

This above example demonstrates the huge impact problem frames impose on solutions. It is an exemplary case study to illustrate how design is increasingly applied outside the traditional design domain, in this case in the public sector. It also highlights the importance of understanding problem framing. Little is known about how frames come into existence in professional design practice. Problem framing seems to be mysterious and magical (Kolko 2010). Borah (2011) made an extensive analysis of framing research comprising 93 peer reviewed journals for a decade and concluded that there is a lack of understanding about the production of frames. There remains a need for fundamental knowledge as to how problem framing happens (Paton & Dorst 2010).

Problem framing has been investigated by many researchers (Casakin 2006; Cross 2011; Dong, Kleinsmann & Deken 2013; Dorst & Dijkhuis 1995; Hey 2008; Lawson 2009; Roozenburg & Dorst 1998; Schon & Martin 1995; Stumpf & McDonnell 2002; Valkenburg & Dorst 1998; Ylirisku 2014) using various approaches in research methods (interview, experimental, video, observation) and analysis (protocol analysis, linkography, video analysis). However, most of these researchers studied the use of frames and processes around problem frames (Gao 2006; Hey, Joyce & Beckman 2007) but not where frames come from.

In this paper, we put forth the proposal of exploring problem framing using the understanding of metaphors. From our research into the literature of metaphor and problem framing, we found that they both exhibit many similar characteristics, which we will elaborate upon later. Learning from metaphors may provide an avenue for understanding how problem frames are created. The body of knowledge about metaphors, covering the fields of linguistics, philosophy, psychology, anthropology and sociology is huge compared to that of problem frames and framing. Hence, it is beneficial for us to tap into the theories and constructs found in the domain of metaphors to further our understanding of problem framing.

In the next section, we will first present the existing understanding of problem framing. Then we will support this view by linking related metaphor theories that facilitate a deeper understanding of problem framing. Finally, we will draw out the similarities between metaphors and problem frames, concentrating on the origins of both metaphors and frames.

## **Present Understanding and Knowledge of Problem Framing**

We will start by looking at what has been written about problem framing in the design field and then investigate some key problem framing studies to build an understanding of problem framing. The first studies of problem framing in design research are often attributed to Schön's work on reflective practice (Cross 2004; Cross 2006; Kvan & Gao 2006; Lawson 2004; Stumpf & McDonnell 2002). Schön's seminal work on "Reflective Practice" (Schön 1983) has laid a strong foundation for problem framing. Schön's name-frame-move-evaluate framework has provided a good starting point for many research studies (Dorst 1997; Gao 2006; Hey 2008; Stempfle & Badke-Schaub 2002; Stumpf & McDonnell 2002; Valkenburg & Dorst 1998).

From the literature study, we found that framing consists of three activities: *seeing*, *thinking* and *acting*. Problem framing is the creation of a novel standpoint from which a problematic situation can be tackled (Dorst 2010). This includes perceiving the situation in a certain way, adopting certain concepts to describe the situation, patterns of reasoning and problem solving that are associated with that way of seeing leading to the possibility to act within the situation. A problem frame that is developed from the framing process may lead us to experience the world in a different way (Dorst 2010) by reorganising the knowledge to give new meanings or realities to guide actions (Schön 1993). In order to fulfil the intended purposes, problem frames serve as catalysts for change (Benford & Snow 2000) by providing a way of "seeing as"; that is, seeing an existing situations *as if* it were something else. Frames also provide a basis for elaborating new concepts (Schön 1993) in influencing and creating a new reality (Aarts, van Lieshout & van Woerkum 2011).

### **Seeing**

Designers usually start the design process by trying to gain an understanding of the problem issues. Through "seeing" and "listening" to the problem situation (Schön 1985; Seevinck & Lenigas 2013), the designers then "structure and formulate the problem" (Visser 2009) by determining the features of the problem which they want to pay attention to (Rein & Schon 1977). These activities entail a "moment-by-moment perception" of information related to the design problem (Dong, Kleinsmann & Deken 2013). By selectively viewing the design situation in a particular way (Schön 1985) and binding together the salient features of the situation, the designers can then adopt certain concepts to describe the situation (Dorst 2010).

It is important to “see” the problem issues in another way before we are able to address it differently. For example, it is only when the designers are able to see “Kings Cross as a musical festival” that they could tackle the problem differently.

## Thinking

After making sense of the problem situation, designers take proactive steps to impose order to steer and change the directions of the original problem (Rein & Schon 1977). This allows the designers to manage the complexities in the design situation (Schön 1985) into one that is coherent and graspable (Rein & Schon 1977).

In order to change the original way of thinking, the designers may intentionally bring together two disparate concepts. For example, “Kings Cross as a musical festival” problem frame links a place to an event. As we draw relationships between Kings Cross and the musical festival, we start to link the two concepts together. For instance, we start to relate attendees of musical events to visitors going to Kings Cross, and the musical event program to the experience visitors get to enjoy at Kings Cross etc. A new way of thinking may start to emerge based on these new connections.

With this new order established, the designer then applies the associated pattern of reasoning and problem solving steps (Dorst 2010). Very often, the framing process changes the meaning of the original problem situation that leads to a new interpretation of the problem situation with a different hierarchy of relationships. This provides avenues for non-standard and innovative responses to the problem (Dorst 2010; Seevinck & Lenigas 2013) as illustrated by the Kings Cross example.

## Acting

This new problem frame provides coherence and a way to grasp the problem situation. It also enables the designers to act by generating moves towards a solution (Dorst 2010). In the Kings Cross example, designers apply the “musical festival” problem frame to generate design ideas for organising the fun that the young people are enjoying. As the designer generates moves towards the solution, he reflects on the outcomes before making further moves (Stumpf & McDonnell 2002). Some designers might attempt to shift, blend and combine frames (Fairhurst 2010; Werner & Cornelissen 2014) to improve the outcome.

The *see-think-act* phases are usually iterative and continue until the desired problem frame is developed. Although we have divided problem framing into three distinctive activities, they are by no means discrete, that is, these are not stand-alone activities that designers conduct one after another. In practice, they flow fluidly and often times they happen simultaneously and in quick succession.

## Metaphor Theories

In the previous section, we have discussed the activities that take place during *see*, *think* and *act* phases. We will next discuss the notion of metaphor and then look at some related metaphor theories that can throw light on problem framing.

### Overview of metaphor

The type of metaphor that we will use in this paper is the “conceptual metaphor”, in the definition of Lakoff and Johnson. Lakoff and Johnson (1980) considered the essence of metaphor as “understanding and experiencing one kind of thing in terms of another”. By providing us with a new understanding of our experiences, metaphors can give new meaning to “our pasts, to our daily activity and to what we know and believe”. This is a very important purpose for problem framing as the possibility of reframing a problem situation is greatly dependent on looking at the problem situation in a new way.

Metaphors help us understand an abstract or unstructured situation, known as “target” in terms of something that is more concrete and structured, known as “source” (Lakoff 1993). Applying this notion of metaphor to the Kings Cross case, the target is the Kings Cross design situation, while the source is the “musical festival” which is more concrete and structured, as illustrated in Figure 1.

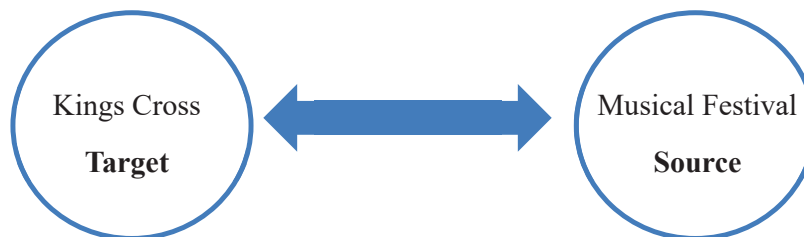


Figure 1: “Kings Cross as musical festival” metaphorical frame

We shall now tap into related metaphor theories to gain a deeper understanding of the *see* phase. Here, we address the question of how we sense that Kings Cross is potentially musical festival-like. From the literature study into metaphor theory, we unearth possible explanations that could throw a new light on how metaphors are associated, i.e. how two concepts become associated.

### Metaphor Association

There appear to be two broad ways in which concepts could be metaphorically associated. They are association by *correlation* and by *resemblance* (Grady 1999; Grady 1998). From his studies, Grady found that correlation based metaphors involve associations between two dimensions of experience. For example, AFFECTION IS WARMTH is created from co-

occurrence and recurring experiences such as affection and body warmth. As a consequence, these metaphors are quite constrained since they require direct experiential motivation. Correlation metaphors are also pre-conceptual in origin and are very much dependent on the nature of our bodies and the environment.

Resemblance based metaphors, on the other hand, may be triggered by *perceptual similarity* (Indurkha et al. 2008; Johnson & Malgady 1979), *similarity of attitude* towards two objects (Richards 1936), *conceptual similarity* and *abstract relations* shared by two complex events (Verbrugge 1977).

The question remains unanswered –what draws the musical festival to Kings Cross? A quick answer we can offer is that the designers saw a resemblance in the patterns that our bodies recognised between a musical festival and Kings Cross. The following section elaborates how it happens.

### Image Schema

Johnson (1987) proposed the theory of image schema to account for this pattern. He puts forward the concept of an *image schema* as a “recurring, dynamic pattern of our perceptual interactions and motor programs that gives coherence and structure to our experience”. We will illustrate the concept of image schema by using the BALANCE image schema.

The BALANCE image schema emerges from our everyday bodily experiences of equilibrium or loss of equilibrium. We grasp the structure of balance through many daily perceptions and activities from the time we learn to walk, struggling to stay upright on the bicycle and the capsizing moment when we are on the canoe. This BALANCE image schema is also experienced when we have too much caffeine and food intake. From this dynamic recurring pattern, our bodies learn to recognize and give a structure to this BALANCE experience. The BALANCE image schema may also manifest in abstract situations such as work-life balance, financial balance and having a balanced view.

We now return to the question of metaphor association between the musical festival and Kings Cross. A possible answer is that the designers saw a similarity between the image schema of Kings Cross and a musical festival. A similarity is recognised i.e. the designers associate Kings Cross with musical festival as they recognise a similar structure of bodily experiences encountered in Kings Cross with their previous musical festival experiences.

### Nature of Metaphor Association

We have seen in the preceding sections that immersive bodily experiences and image schema influence the creation of metaphors. It is useful to find out about the nature of this metaphor association to deepen our understanding of how a metaphor is created. Lakoff and Turner (2009) identify three broad structures: concept-to-concept, image schema-to-concept and image-to-image.



Concept-to-concept metaphor involves the mapping of a concept onto another eg. LIFE IS A JOURNEY. The second type of metaphor, image schema-to-concept, maps image schematic structures to abstract concepts such as BEING IN LOVE where IN-OUT image schema is mapped onto the abstract concept of love. The third type is image-to-image metaphor which involves mental images rather than abstract concepts such as the example “my wife ... whose waist is an hourglass” shared by Lakoff and Turner (2009). This type of metaphor maps image structure rather than conceptual knowledge. Image-to-image metaphors are often found in literary or advertising discourse, where highly unconventional and novel metaphors are created to trigger different interpretations.

It is useful to note that image metaphor is not the same as image schema. Image metaphors such as “...waist is an hourglass” are plausibly derived perceptually where the images “waist” and “hourglass” are analogue representations of specific things or activities (Oakley 2007). On the other hand, image schemas are “schematic gestalts that capture the structural contours of sensory-motor experience” (Hampe 2005).

We have so far discussed the *see* phase. The knowledge of metaphor by resemblance and correlation (Grady 1999; Indurkha 1994) throws light on the roots of problem frames. They have provided a window to the “working mechanism” of how metaphorical problem frames are created, and importantly they have enabled us to differentiate between various ways that metaphorical frames may be created. Equally important is the image schema construct that provides an access for us to tap into this pre-conceptual stage of problem framing. Image schema plays an important role in the act of “seeing as”. They enable the understanding of abstract concepts by transferring these schematic structures from physical interaction with the world to abstract and non-physical entities (Hurtienne, Weber & Blessing 2008).

We will next discuss the metaphor theories available to support the understanding of the *think* phase of problem framing.

## Mapping

In the *think* phase, designers apply the musical festival concept for exploring Kings Cross. According to Dorst (2010) and Schön (1967), thinking about a target in a source-like way leads to a new pattern of reasoning and problem solving. From the literature, we found two metaphor theories that provide insights into how this thinking, or mapping, may be facilitated. They are Gentner’s structure mapping theory (Gentner 1988; Gentner & Bowdle 2008) and Lakoff’s metaphorical mapping (Lakoff 1993). As Gentner’s structure mapping theory is very similar to Lakoff’s, we will only discuss Lakoff’s theory in the following.

According to Lakoff and Turner (2009), four components get mapped when source and target are put together. They are the elements, relations, properties and patterns of inference. We will explain these components by using the mapping of the Kings Cross example as shown in Table 1.



Table 1: Mapping of Musical Festival and Kings Cross

Musical Festival		Kings Cross
Attendees	→	Visitors
Organiser/Event Manager	→	Nobody
Scheduled Program	→	Personal arrangement with friends
Organised Facilities	→	Public infrastructure support
<ul style="list-style-type: none"> <li>- Toilets</li> <li>- Signs/directions</li> <li>- Guides</li> <li>- Transportation</li> </ul>		<ul style="list-style-type: none"> <li>- Public toilets</li> <li>- Road signs</li> <li>- Policeman and guards</li> <li>- Public transport</li> </ul>
Main program	→	Visit to pubs and stores
Fringe events	→	Hanging out in the vicinity of Kings Cross

### Elements

The common elements found in a musical festival include attendees, event manager, program etc. When we map musical festival to Kings Cross, we can draw several parallels between the elements. For example, the element of ‘musical festival attendees’ may be linked to ‘visitors to Kings Cross’. The mapping also reveals some missing elements in Kings Cross. For example, the event manager/organiser element present in the musical festival concept is not found in Kings Cross. New design solutions may be generated after filling in this missing role of event manager at Kings Cross.

### Relations

Several of the elements found in the musical festival are related. For instance, there is a well-defined relation between the scheduled program, main musical event, fringe events and transport arrangements in a musical festival. When this relation in the musical event is mapped to Kings Cross, it helps us design ideas to facilitate the circulation of people in the environment.

### Properties

A musical festival possesses several unique properties. One of which is the way that entertainment and fun for the attendees are organised. New design ideas may be developed when we map some properties of the musical festival to Kings Cross.

## Patterns of inference

Our knowledge of the musical festival enables us to reason and draw inferences about the event. For instance, to ensure that the musical festival attendees have an enjoyable experience, different services and guides are made available when help is needed. When we import this pattern of inference from musical festival to Kings Cross, we come to realise that there are only the policemen available to help the visitors when they are in trouble. Thus, by borrowing the reasoning patterns from musical festival, we can generate new design ideas of offering other types of services to visitors at Kings Cross before the situations turn grave.

By making use of a better understood set of elements, properties and relations in a musical festival, we can systematically probe and create inferences for addressing less understood issues at Kings Cross. As a result, new design directions may be generated using this way of thinking. This discussion shows how the pattern of thinking and problem solving may be conducted in a systematic and effective way using the mapping process.

It is useful to note that the above analysis of “Kings Cross as a musical festival” metaphor is meant for illustrating some possible ways of how metaphor concepts may be applied to the conduct the activities in *think* phase. The purpose of this discussion is not meant to generate design ideas for implementation, as our intention is to uncover the mechanics offered by metaphor. Thus, the design directions generated from this analysis may not be apt for the present context at Kings Cross.

The similarity between metaphors and problem frames appears to end in the *think* phase. In problem framing, designers start to generate initial design ideas based on the new problem frame. However, in the case of metaphor, it seems to have served its purpose in providing a new way of seeing, and a pattern of reasoning and problem solving associated with this way of seeing (Dorst 2010; Schön 1967). This might not come as a surprise as *act* is a generative phase where design ideas co-evolve with the problem (Dorst & Cross 2001).

These selected metaphor theories discussed in this section are certainly not the only ones that are available in literature. However, they are representative of a certain perspective of metaphor in a larger body of work. More importantly, they have been selected as we have found them beneficial for shedding light on the study.

## Initial Findings

From the study of selected metaphor theories, we have gleaned important aspects of how problem frames are created. Base on the analysis of the “Kings Cross as a musical festival” case study, we have found out that this metaphorical problem frame is based on resemblance of image schema through embodied experience. The findings are summarised at Table 2. Table 2 also shows an initial typology that we have developed comprising three dimensions; ‘metaphor association’, ‘nature of metaphor association’ and ‘trigger for jump’. The first

two dimensions and their related values are discussed in the earlier section while the third dimension ‘trigger for jump’ is derived implicitly from our discussion on the nature of metaphor association. The corresponding value of ‘conceptual knowledge’ is derived from the concept-to-concept types of metaphors. Kings Cross metaphor belongs to the ‘embodiment’ types of metaphors while the ‘waist is an hourglass’ metaphor is plausibly generated based on perception.

We now have a better grasp of how metaphorical frames are created through association of two concepts and the nature of this association; leading to a new pattern of reasoning by mapping. We will strengthen this understanding by discussing how metaphor is applied in problem framing.

Table 2: Dimensions and attributes of the typology of metaphors

Dimensions	Values		
Metaphor Association	Resemblance	Correlation	
Nature of metaphor association	Concept-to-concept	Image Schema – to-concept	Image-to-image
Trigger for Jump	Conceptual Knowledge	Embodiment	Perceptual

↓  
Kings Cross as musical festival metaphor

### Metaphor in Problem Framing

In the first part of this paper, we identified three activities; *see*, *think* and *act* taking place in problem framing. The previous section highlighted some selected metaphor theories that are used for illuminating the *see* and *think* phases in problem framing. We will now draw out the similarities between metaphor creation process with the problem framing process.

When we compare the making of metaphors with the problem framing process as defined by Dorst (2011), we find several similarities between them as shown in Table 3. Both processes start with seeing a problem situation in a certain way that is related to something familiar. While in metaphor creation process, we link two entities through a metaphor association. Both processes make use of precedents, episodic memories and cognitive knowledge to improve the understanding of a present problem situation.

As we gain a deeper understanding of the problem and seeing it in a different way, some features of the past experience are transposed to the problem situation (Schön 1967). In problem framing, we adopt certain concepts to describe the situation and then apply the patterns of reasoning and problem solving associated with this new way of seeing. For metaphor creation, new thinking is achieved as we map our knowledge of source to target by

means of the four components: elements, relations, properties and patterns of inference. This new interpretation enables us to generate new ideas and solutions leading to alternative possibilities of acting and generating of novel outcomes.

Table 3: Problem Framing and Making of Metaphor

	Problem Framing	Making of Metaphor
	Problem framing is the creation of a novel standpoint from which a problematic situation can be tackled (Dorst 2010). This includes:	The making of metaphors derived from selected metaphor theories (Grady 1999; Johnson 2008; Lakoff & Johnson 1980). This includes:
Seeing	perceiving the situation in a certain way	metaphor association
Thinking	adopting certain concepts to describe the situation, patterns of reasoning and problem solving that are associated with that way of seeing	mapping
Acting	leading to the possibility to act within the situation.	This usually leads to a new way of thinking and behaviour.

## Conclusion

This paper highlights the need to better understand problem framing in design. Unfortunately, it is very hard for researchers to unravel the problem framing process as expert designers practise it in an intuitive and tacit manner. In this study, we have turned to metaphor literature to learn about problem frames because many parallels exist between the creation of a metaphor and a problem frame. Understanding the metaphor creation process will bring about an improved understanding of problem framing.

From this study, we have caught a glimpse of the working mechanics underlying problem framing. We have observed various types of metaphors from the literature review. This observation leads us to infer that the problem framing process is not a unitary phenomenon.

Recognition of this heterogeneity has led to a typology. Findings from this research may be useful in several aspects. Firstly, it will achieve the original goal of finding out about how a problem frame is created. Secondly, the typology of metaphors can also be used by designers to reflect upon their own practice. This heightened awareness of the typology of metaphorical frames enables designers to be more intentional in building up their repertoire

of practice. Besides design practitioners, design educators may also use the findings to develop their curriculum in educating student designers in the use of metaphors in problem framing.

## Acknowledgement

The work by the first author is supported by International Postgraduate Research Scholarships (IPRS) and Australian Postgraduate Award (APA).

## References

- Aarts, N., van Lieshout, M. & van Woerkum, C. 2011, 'Competing claims in public space: The construction of frames in different relational contexts'.
- Benford, R.D. & Snow, D.A. 2000, 'Framing Processes and Social Movements: An Overview and Assessment', *Annual Review of Sociology*, vol. 26, pp. 611-639.
- Borah, P. 2011, 'Conceptual issues in framing theory: a systematic examination of a decade's literature', *Journal of Communication*, vol. 61, no. 2, pp. 246-263.
- Casakin, H.P. 2006, 'Metaphors as an unconventional reflective approach in architectural design', *The Design Journal*, vol. 9, no. 1, pp. 37-50.
- Cross, N. 2004, 'Expertise in design: an overview', *Design studies*, vol. 25, no. 5, pp. 427-441.
- Cross, N. 2006, *Designerly ways of knowing*, Springer.
- Cross, N. 2011, *Design thinking: Understanding how designers think and work*, Berg.
- Dong, A., Kleinsmann, M.S. & Deken, F. 2013, 'Investigating design cognition in the construction and enactment of team mental models', *Design Studies*, vol. 34, no. 1, pp. 1-33.
- Dorst, K. 1997, 'Describing design : a comparison of paradigms', Kees Dorst, Rotterdam.
- Dorst, K. 2010, 'The nature of Design thinking', *Proceedings of the 8th Design Thinking Research Symposium*, pp. 19-20.
- Dorst, K. 2011, 'The core of 'design thinking' and its application', *Design studies*, vol. 32, no. 6, pp. 521-532.
- Dorst, K. & Cross, N. 2001, 'Creativity in the design process: co-evolution of problem-solution ', *Design Studies*, vol. 22, no. 5, pp. 425-437.
- Dorst, K. & Dijkhuis, J. 1995, 'Comparing paradigms for describing design activity', *Design Studies*, vol. 16, no. 2, pp. 261-274.
- Dorst, K. & Tomkin, D. 2011, 'Themes as bridges between problem and solution', *Diversity and Unity*, eds N. Roozenburg, Chen & P.J. Steappers, Delft, the Netherlands.
- Fairhurst, G.T. 2010, *The power of framing: Creating the language of leadership*, vol. 290, John Wiley & Sons.
- Gao, S. 2006, 'A comparative study of problem framing in multiple settings', The University of Hong kong, Hong Kong.
- Gentner, D. 1988, 'Metaphor as structure mapping: The relational shift.', *Child development*, vol. 59.
- Gentner, D. & Bowdle, B. 2008, 'Metaphor as structure-mapping', in R. Gibbs (ed.), *The Cambridge Handbook of Metaphor and Thought*, Cambridge University Press., New York, NY, pp. 109 - 128.

- Grady, J. 1999, 'A typology of motivation for conceptual metaphor: Correlation vs. resemblance', AMSTERDAM STUDIES IN THE THEORY AND HISTORY OF LINGUISTIC SCIENCE SERIES 4, pp. 79-100.
- Grady, J.E. 1998, *Foundations of meaning: Primary metaphors and primary scenes*, UMI.
- Hampe, B. 2005, 'Image schemas in cognitive linguistics: Introduction', *From perception to meaning: Image schemas in cognitive linguistics*, vol. 29, p. 1.
- Hey, J.H.G. 2008, 'Effective framing in design', ProQuest.
- Hey, J.H.G., Joyce, C.K. & Beckman, S.L. 2007, 'Framing innovation: negotiating shared frames during early design phases', *Journal of Design Research*, vol. 6, no. 1, pp. 79-99.
- Hurtienne, J., Weber, K. & Blessing, L. 2008, 'Prior experience and intuitive use: image schemas in user centred design', in *Designing inclusive futures*, Springer, pp. 107-116.
- Indurkha, B. 1994, *Metaphor as change of representation: An interaction theory of cognition and metaphor*, Springer.
- Indurkha, B., Kattalay, K., Ojha, A. & Tandon, P. 2008, 'Experiments with a Creativity-Support System based on Perceptual Similarity', *SoMeT*, pp. 316-327.
- Johnson, M. 2008, *The meaning of the body: Aesthetics of human understanding*, University of Chicago Press.
- Johnson, M.G. & Malgady, R.G. 1979, 'Some cognitive aspects of figurative language: Association and metaphor', *Journal of Psycholinguistic Research*, vol. 8, no. 3, pp. 249-265.
- Kolko, J. 2010, *Exposing the Magic of Design: A Practitioner's Guide to the Methods and Theory of Synthesis: A Practitioner's Guide to the Methods and Theory of Synthesis*, Oxford University Press.
- Kvan, T. & Gao, S. 2006, 'A comparative study of problem framing in multiple settings', in *Design Computing and Cognition '06*, Springer, pp. 245-263.
- Lakoff, G. 1993, 'The contemporary theory of metaphor', *Metaphor and thought*, vol. 2, pp. 202-251.
- Lakoff, G. & Johnson, M. 1980, *Metaphors we live by*, University of Chicago press.
- Lakoff, G. & Turner, M. 2009, *More than cool reason: A field guide to poetic metaphor*, University of Chicago Press.
- Lawson, B. 2004, *What designers know*, Taylor & Francis.
- Lawson, B. 2009, *How designers think : the design process demystified*, Elsevier, Amsterdam [u.a.].
- Oakley, T. 2007, 'Image schemas', *The Oxford handbook of cognitive linguistics*, pp. 214-235.
- Paton, B. & Dorst, K. 2010, 'Briefing and reframing', *DTRS* 8, pp. 317-335.
- Rein, M. & Schon, D. 1977, ' in policy research', *Using social research in public policy making*, vol. 11, p. 235.
- Richards, I.A. 1936, *The philosophy of rhetoric*, vol. 3, Oxford University Press.
- Roozenburg, N.F. & Dorst, K. 1998, 'Describing design as a reflective practice: Observations on Schön's theory of practice', in *Designers*, Springer, pp. 29-41.
- Schön, D.A. 1967, *Invention and the Evolution of Ideas*, vol. 13, Tavistock.
- Schön, D.A. 1983, *The reflective practitioner : how professionals think in action*, Basic Books, New York.
- Schön, D.A. 1985, *The design studio: An exploration of its traditions and potentials*, RIBA Publications for RIBA Building Industry Trust London.

- Schön, D.A. 1993, 'Generative metaphor: A perspective on problem-setting in social policy'.
- Schon, D.A. & Martin, R. 1995, 'Frame reflection: toward the resolution of intractable policy controversies'.
- Seevinck, J. & Lenigas, T. 2013, 'Rock, paper, scissors: reflective practice for design process in the novice landscape architect'.
- Stempfle, J. & Badke-Schaub, P. 2002, 'Thinking in design teams-an analysis of team communication', *Design studies*, vol. 23, no. 5, pp. 473-496.
- Stumpf, S.C. & McDonnell, J.T. 2002, 'Talking about team framing: using argumentation to analyse and support experiential learning in early design episodes', *Design Studies*, vol. 23, no. 1, pp. 5-23.
- Valkenburg, R. & Dorst, K. 1998, 'The reflective practice of design teams', *JDST* Design Studies, vol. 19, no. 3, pp. 249-271.
- Verbrugge, R.R. 1977, 'Resemblances in language and perception', *Perceiving, Acting, and Knowing: Toward an ecological psychology*. Hillsdale, NJ: Lawrence Erlbaum, pp. 365-389.
- Visser, W. 2009, 'Design: one, but in different forms', *Design Studies*, vol. 30, no. 3, pp. 187-223.
- Werner, M.D. & Cornelissen, J.P. 2014, 'Framing the Change: Switching and Blending Frames and their Role in Instigating Institutional Change', *Organization Studies*, vol. 35, no. 10, pp. 1449-1472.
- Ylirisku, S. 2014, *Frame it Simple! Towards a Theory of Conceptual Designing*, School of Art and Design.

## Author Biographies

### Suat Hoon Pee

Suat Hoon is a Ph.D. student within the Design Innovation Research Centre at the University of Technology Sydney. She is particularly interested in problem framing and design thinking. She holds a Master's degree in Design Methods from Institute of Design, Illinois Institute of Technology and a Master of Science in Control and IT from UMIST. Suat Hoon's research focus is on understanding the metaphor creation process to bring about an improved understanding of problem framing. Through this research, she hopes to uncover the magic of innovation.

### Kees Dorst

Kees Dorst (PhD) was trained as an Industrial Design Engineer at Delft University of Technology, and he studied Philosophy at Erasmus University Rotterdam. He has worked as a product designer for various design firms and as a researcher, he has studied the ways in which designers work. Currently, he is Professor of Design Innovation at the University of Technology Sydney. He also holds a professorship in 'Entrepreneurial Design of Intelligent Systems' at Eindhoven University of Technology in The Netherlands. He is founder and director of the UTS Design Innovation Research Centre and the NSW Designing Out Crime center. He lectures at universities and design schools throughout the world. He has published 100+ articles and several books – most recently 'Frame Innovation - create new thinking by design' for MIT Press (2015).



## Mieke van der Bijl-Brouwer

Mieke van der Bijl-Brouwer (PhD) is Senior Research Fellow within the Design Innovation Research Centre at the University of Technology Sydney. She has a background in industrial design and has wide experience in studying and developing user-centred design methods. Her current research spans the fields of human-centered design methodology and social innovation, by investigating how human-centred design methods contribute to tackling complex societal problems. For that purpose she works with practitioners in the public sector across domains such as education, mental health, housing, crime and community.