

The Role of Values in Design Decision-making

Dr Rhoda Trimmingham, Loughborough University, England

Abstract

The paper presents the findings of a PhD study into design decision-making and specifically the use of values during design decision-making. Firstly it presents a model of design decision-making as a combination of the use of knowledge, skills and values and discusses a selection of the associated literature. It then describes the development of a taxonomy of values used in design decision-making developed from a series of pilot interviews, protocol analysis and focus groups. This was necessary because although the values agenda is not new, previous studies were found to have gaps, or did not reflect the current state of play. From this more in-depth case studies were carried out to explore the influence of values in design decision-making. Eight designers, ranging from A-level students to professionals were asked to design a lectern out of sustainable materials. They were given one day to complete the project. For one hour during the day they were asked to 'talk aloud' while being videoed, also known as concurrent verbalisation and protocol analysis. They also took part in a 40 minute retrospective interview about their design work, at the end of the day. One professional was also asked to complete a ten day design project in order to verify the results against a longitudinal project. They also took part in a 40 minute retrospective interview at the end of the ten day period. The results were analysed using the new taxonomy as a coding system. The study illustrates the ability to research the role of values in design decision-making using a variety of techniques. The data generated shows values driving

many of the decisions designers make including the way in which they cognitively organise their design activity and through which they can reduce avenues of enquiry. The paper discusses the key influences of both internal and external values, and similarities and differences between participants. Finally the paper discusses how these findings may contribute to the development of design and technology education and outlines possibilities for future work.

Key words

Design decision-making, knowledge, skills, values, empirical evidence, research methods

Introduction

Research regarding decision-making is not new. The concern of this paper is *design* decision-making in the context of industrial design. Educational debates of the 1970s and 1980s resulted in a working party being set up by the Assessment of Performance Unit (APU) under the Chairmanship of Hicks. In 1982 Hicks et al published *Understanding Design and Technology*. This categorised the factors involved in design decision-making under three headings: knowledge, skills and values (see Table 1.1 for the values category). Knowledge has been the subject of significant subsequent debate, but skills and values and their distinction is only now attracting significant work (see Norman, Pedgley and Coles, 2004b). This paper reports on some of the findings from a PhD that investigated the roles values play in design decision-making.

Category	involve the appreciation and application of:
Technical values	efficiency, and the ways in which input is compared with the resultant output
	robustness; flexibility, and the ways in which the performance of a man-made object or system might be sensitive to change
	precision, and the qualities of fit and of fitness to purpose, valued either for their own sakes or as a means to an end
	confidence, and the ways in which possible reliability or unreliability of information is taken into account
Economic values	the broad distinction between the ideas of use-value, intrinsic value and value-in- exchange
	the distinction between value, price and cost
	the marginal value of one product or product variation over another
Aesthetic values	the effects of variation in supply and demand on availability and price
	the structures, proportion and colours to be found in the natural and the man-made world
	of the importance of aesthetic factors in all forms of human communication and self-expression
Moral values	the inter-relationship between workmanship, tools and the aesthetic quality of the resulting environment or artefact
	mankind's impact on the natural environment and his responsibility for its and his own future survival
	the inter-relationship between the man-made world and religious, social, economic and philosophies
	the needs of individuals in society and ways of meeting them
	the importance of ethical values in carrying out design activity and evaluating the effects of technology

Table 1.1 Values acting on the decision-making process (Hicks et al, 1982:6-7)

The Role of Values in Design Decision-making

External values	Summary description	Internal values	Summary description
Societal values (SV)	Values from the designer's own or another society that have been readily sought by the designer. There must be evidence that these values have been sought through research, for example the designer has questioned members of the society where the interest lies.	Perceived societal values (PSV)	Values from the designer's own or another society that have not been sought but are instead perceived by the designer.
Identified stakeholder values (ISV)	Values that are sought from those identified as having greater influence or importance to the designer	Perceived identified stakeholder values (PISV)	Values perceived by the designer regarding those identified as having greater influence or importance to the designer
Economic system values (ESV)	Values sought by the designer regarding the economics affecting the product or system	Perceived economic system values (PESV)	Values perceived by the designer regarding the economics affecting the product or system
Values embedded in design (VED)	Values found in existing products and, or values the designer wishes to embed within their own product or system	Designer's personal values (DPV)	The designers own values
		Meta-values (MV)	Values used as principles for evaluation, organising activity and determining potential consequences

Table 2.1 *The new values taxonomy*

Categorising values in design decision-making

An initial literature review found that the role of values within design decision-making had been largely unexplored (see Coles and Norman, 2005). The aim of the research therefore, was to develop a complete classification system for values influencing design decision-making. The research also presented an opportunity to add to the development of best practice for the analysis of design activity.

The first stage of the research was a series of pilot studies designed to uncover the values used in design decision-making. Three methods were initially selected; retrospective interviews; concurrent verbalisation and protocol analysis; and a diary of designing. The diary of designing was later rejected.

The prior art showed the influence of *personal values* and *societal values* and *values embedded in design*. New understandings were provided by the pilot studies. There was evidence that the influence of stakeholder values differed from those of society; that designers used internal perceptions of external values; and that designers were

Expertise/ method	Protocol analysis	Retrospective	Diary method
A-level		Datasets 1+2	
Undergraduate		Dataset 3	
Postgraduate			Datasets 5 + 6
Professional	Dataset 4		

Table 3.1 *Data collection methods and participants used during the pilots.*

influenced by meta-values (These are explained further in section 4.10). From the literature and the findings from the initial phase of data collection, the new taxonomy presented in Table 2.1 was developed. For a more in-depth description of the pilot studies please refer to Norman and Coles, 2005.

Understanding values in design decision-making

The new taxonomy shown in Table 2.1 was then used to code data from the main study in order to better understand the influence of values during the design decision-making process.

A number of different data collection methods were trialled during the pilot studies, an overview is shown in Table 3.1 (below left).

These pilots showed that it was most appropriate to use a combination of data collection methods, these are retrospective interviews; and concurrent verbalisation and protocol analysis. The data for the main study was collected from two events: a one day event and a longitudinal study. Eight participants worked separately but on the same brief for the one day events to enable cross-case comparisons to be made. An overview of the participants and research methods is shown in table 3.2. During the PhD study, on which this paper reports, comparisons were made between expertise and the use of values in design decision-making, however there is insufficient space within this paper to discuss these findings (further publications which concentrate on this issue are planned).

The Role of Values in Design Decision-making

Expertise/method	Protocol analysis	Retrospective
A-level	AL and KC	AL and KC
Undergraduate	MLC and SP	MLC and SP
Postgraduate	CA and JM	CA and JM
Professional	AD and DL	AD and DL

Table 3.2 Research methods and participants used for the main study.

One-to-one retrospective interviews are a qualitative method of gaining in-depth responses to questions asked. The outcome is a wealth of information on case studies. The interviewer is also empowered with the ability to probe and explore responses that other research techniques would not allow. One of the main disadvantages of retrospective analysis is that it is not a reflection of true design activity and may therefore be unreliable. Participants are required to discuss processes and activities, both internal and external, after they have occurred. Lee and Radcliffe (1990) state, "The major weakness of this method is the difficulty of tracing how the time was spent during the actual design period". It must also be factored in that the participant's account of their processes and activities may not be wholly accurate due to the impregnable arena of tacit knowledge (Ryle, 1948). Another disadvantage of discussing design work retrospectively was discovered during the pilot studies. The drawing folios presented by both the A-level and undergraduate participants were presentation folios, in which many pages had been 're-done' to look more designerly, and some had been disposed of if the student felt they would not contribute to their marks. This has the effect that the interview reflected the design work that was presented to the interviewer, and did not completely reflect the design activity that occurred. This disadvantage was overcome during the main study, as participants were asked to complete the design activity within an allotted time, and all work produced in that time was collected. Had a third stage of studies occurred participants would have been asked to number drawings as they are produced.

Concurrent verbalisation and protocol analysis allows the researcher to document parallel activities in order to analyse different influences and interactions that are required at each stage of decision-making. There has been much discussion regarding the inadequacy of protocol analysis, experiments showing limitations such as; *The set-up*: Its obtrusive nature may change the subject's behaviour and their cognitive performances; *Concurrent verbalisation*: Akin and Lin have reservations that although verbalisation aids the researcher to "access the mental

processes of the designer" (1996:36) the effect of verbalisation on the designer and the design activities has not yet been determined. Dörner believes that any attempt to verbalise cognitive processes is detrimental, stating "Germinal processes exist in human thought, in which casting ideas into verbal form is premature because it would destroy the dynamics of thought" (1999:38); *The limitation of the data being captured*: "People do not necessarily know what is going on inside their own heads, let alone have the ability to verbalise it" (Cross et al, 1996:2). Indeed one participant made two comments to the researcher at the end of the pilot study. That he often found himself 'thinking one thing and saying another', this suggest he was reporting parallel but independent thoughts to those being employed in the task. And, that in periods of deep thought he would find he had not said anything at all.

However, all current research techniques are limited to collecting information on audio, visual or tangible data and that through all these methods it is impossible to do anything but make inferences about internal tacit processes. The use of both retrospective interviews and concurrent verbalisation and protocol analysis during the main study was advantageous in that it allowed a deeper understanding of the complex nature of values and the difficulties in their analysis. It also allowed us to suspend judgement on certain results (such as the frequency of the use of certain values) due to conflicting data.

The brief was developed in conjunction with Smile Plastics Ltd (www.smile-plastics.co.uk) and Recoup (www.recoup.org). The participants were required to propose a new lectern design made from recycled plastics for Recoup to use at conferences and trade shows. Each participant was given one day to complete the project. The one-day event can be considered as an artificially controlled event and therefore may come under scrutiny for being unrealistic. Because of this a longitudinal project was undertaken by one participant (AD) to see if there was any effect on the data. This project ran over ten days and the participant was left to design as he would do normally. A different brief for the longitudinal project was also chosen to see if the results were similar to the lectern brief (and therefore more generic comments could be made) and to ensure it was 'worth' doing both economically (as AD was a professional and was paid his standard rate) and personally for both the Department of Design and Technology (the brief was for one of their commercial ventures) and for the professional. The client who developed this brief was Cool Acoustics Ltd (www.coolacoustics.com), a Loughborough University venture resulting from the polymer guitar developed by Dr

The Role of Values in Design Decision-making

Owain Pedgley as part of his PhD thesis (Pedgley 1999). The brief was to develop a new and exciting concept for a solid body or semi-acoustic electric guitar. The data from the longitudinal project backed up findings from the one-day events, and therefore findings are combined within the discussion chapter.

Discussion

External values – Societal values

Although no evidence was collected regarding *societal values* during the one-day events, the longitudinal project showed values being sought from members of society. The prior art and pilot studies also provide data from which this external sub-set has been populated. The literature provides many examples of societal values including extensive contributions from Hicks (1982) and Layton (1992a) who both discuss the interplay between the man-made world and society (For a summary of all the related literature please see Table 4.1). The pilot studies illustrated design decisions that were influenced by the values of the

society for which the participant intended the final product. Participants discussed using information sought from members of society to understand how the outcome would effect that society and gained information about their needs and wants (also discussed by Pedgley, 1999).

External values – identified stakeholder values

Identified stakeholder values were highlighted during the pilot studies. Participants discussed actively seeking the value judgments of clients, teachers, peers and family members. Having observed that stakeholder values appear to have a unique influence on design decision-making the prior art was re-visited. There was little mention of stakeholder values however many of the findings from societal values were applicable to stakeholders (for example gaining information from a stakeholder about for instance their preferences, priorities, convictions and emotions). There was empirical evidence from the main study where identified stakeholder values were highlighted as having influenced design-decisions. All apart from one occasion was from the brief, for example one participant states:

JM (page one): "I suppose one point is I decided to ditch the adjustability because there was already a set height in the brief".

The one other example came when one participant reports that she asked the author questions regarding the recycled materials.

CA (page four): "And I think I was asking how the materials were when they were in their very basic form"

External values – economic system values

The traditional view of value relating to economics is well reflected in the prior art (For a summary of all the related literature please see Table 4.2). The relationship between a designed object and the economic gain that can be achieved is documented by authors such as Baynes (2005) and Boztepe (2003).

The pilot studies provided initial evidence of design decisions being based on *economic system values* and also highlighted the relationship between these and other values. The main study provided fewer examples where judgements were made on the basis of economic system values and were related to the importance of the cost of materials and processes.

Author	Summary
Concise Oxford Dictionary, 1992	How the outcome effects the user.
Hicks et al,	Responsibilities to mankind's future survival Inter-relationship between the man-made world and religious social and philosophies. The needs of individuals in society and ways of meeting them. The importance of ethical values in carrying out design activity and evaluating the effects of technology.
Elhamdi et al, 2003	Level of effect that people personally expect from products and services
Baynes, 2005	Designers addressing socially important problems. Social worth of products.
Layton, 1992a	Technology bears social imprints. Technology shapes society. Design preserving social hierarchies. Design reflects cultures Societal values allow technological adoption or technological obsolescence.
Goonatilake, 1984	Technology as a social gene. Social values drive design decisions. Technology carries the scars of the socio-economic system that gave birth to them
O'Brien and Guerrier, 1995	Values are embedded in a social context.
Green, 2003a	Design must be socially and culturally acceptable.
Boztepe 2003	Needs are experienced within cultures Social values determining how we view products. Classification of consumer values

Table 4.1. Summary of societal values referred to in the prior art.

The Role of Values in Design Decision-making

Author	Summary
Concise Oxford Dictionary, 1992	The amount of money or goods for which a thing can be exchanged in the open market
Baynes, 2005	Turning products into wealth Contributing to profits Seeking a fit between profit and needs and wants Economic constraints of the market place Relationship between economics and the political and environmental power of consumption Solving problems within the imperatives of the market economy Consideration of the project budget, cost of materials and processes. Acceptable levels of performance in relation to cost Understanding of economic competition
Ashby and Johnson, 2003	Relationship between cost and the market place
Boztepe, 2003	Use value Exchange value
Hicks et al,	Use value Intrinsic value Value in exchange Marginal value of one product over another Supply and demand vs. availability and price

Table 4.2 Summary of prior art regarding economic values.

External values – values embedded in design and internal values – embedding values in design

Values embedded in design, alongside its internal counterpart *embedding values in design* yielded by far the most data during the research project. Initially the evidence provided by the literature review and the pilot studies was used to build one external category (For a summary of all the related literature please see Table 4.3).

The main study, however, showed a clear distinction within this category. Evidence was collected regarding the influence of values embedded in existing design, existing products and materials, but evidence was also collected regarding participants making decisions to embed value in their designs, a more internal value judgement based activity. Having made this observation the initial literature review regarding values embedded in design was re-visited. It was clear that the literature related to both categories with the distinction being most eloquently put by Cross who describes the difference being a designer's desire and ability to 'read or write in material culture' (1982).

Author	Summary
Goonatilake, 1984	Products carry embedded value
Layton, 1992a	Value in products highlighted by how they're used Technology cannot be value free Portraying a sense within a design Conveying messages through design Embedding other values within design Values embedded in design affect their success
Cross, 1982	Existing products as a great source of inspiration Designers can both read and write in material culture
Middleton, 2003	Designers work from existing products to create new ones Designers use products as inspiration
Jordan and Macdonald, 2002	Designers have an understanding of the additional values a product holds including physio-pleasure, socio-pleasure, psycho-pleasure and ideo-pleasure Designers have an understanding of product semantics
Feils and Overbeeke, 2003	How an artefact can be interpreted Creating meaningful products
Boztepe 2003	People value products for what they signify
Martin, 1999	Products reflecting other values (societal etc)
Eckert and Martin, 2000	Previous designs furnish a vocabulary for new designs, processes and interpretations Products are used in the following ways; precedent; reuse; pattern and primary generator
Sassatelli, 2000	Value is inherent to the product Value is enhanced by subjective judgement
Boztepe, 2003	Value comes from a persuasiveness from design
Ashby and Johnson, 2003	Materials have embedded personalities and characters Selection by similarity Some objects have a meaningful relationship to the to-be-invented object
Ryle, 1948	Dispositional concepts
Rompay et al, 2004	Values embedded in design are connected to image schemas

Table 4.3 Summary of the prior art regarding values embedded in design.

Values embedded in existing design

There were a great number of instances where participants discussed the use of existing products and materials as a source of inspiration. This provides evidence that designers see value embedded in existing products and materials. Existing products and materials were also used to inform subsequent design activity. For example one participant used an existing laptop to inform them about the size of the working platform of the lectern, and a balsawood jigsaw to suggest how the product could be manufactured

The Role of Values in Design Decision-making

ADI	Material samples (in room) Pictures of lecterns (in room) Old lectern picture (in room)
SPI	Old lectern picture (in room)
ALI	Tripod (in room) Material samples (in room) Old lectern picture (in room)
CAI	Pictures of lecterns (in room) Material samples (in room) Fish tank tubes Ellula Sounds speakers
DLI	Folding chairs 3D balsawood dinosaur jigsaw Drawing board Tripod (in room) Material Samples (in the room) Laptop
JMI	Pictures of lecterns (in room) Original lectern (in room) Material samples (in room) Periscope Architecture Parasol bases Bicycles
KCI	Material samples (in room) Flat pack boxes Bottle tops Corkscrew Display board Drawing board Spiral staircase Drawers
MLCI	Seat in a magazine Lectern pictures (in room)

Table 4.4. Products and materials used by participants in the one day event

and assembled (DL). A drawing board in the foyer of the building where the one-day event took place inspired one participant to produce a concept in which the lectern top was multifunctional; rising when papers were being read, and flattening out for the use of a laptop (KC). Existing products and materials were also used to reject ideas or to reduce avenues of enquiry. For example CA decides to reject all ideas that look similar to the existing lecterns seen on an inspirational poster that was displayed in the room. The existing products and materials used by each participant is shown in Table 4.4 Figure 4.1 shows some of the resources that were made available. There was also evidence that designers associate values with materials before they are made into products. For example one participant comments:

AD (Page three) [about using more than one recycled plastic]: "But really the values are so different for all of them that I'm not sure that you'd find it worked very well like that. Maybe if you had a progression".

New materials (in this case the recycled plastics) are also associated with materials of similar value, and this association is used to help drive decisions about, for example manufacturing processes.

AD (page two) "I made assumptions and based them on how that [recycled] material is like other plastic sheet material except that it comes apart rather more easily...".

Materials also hold embedded value through what can be done with them. Many of the participants discussed using plastic in ways other materials cannot be manipulated to highlighted this embedded value.



Figure 4.1. Some of the resources made available to participants

The Role of Values in Design Decision-making

SP "You could do that with any material really and that's a shame. If you've got a material with flex in it you might as well use it"

In the example above SP sees a material's natural flex as a positive embedded value, DL also saw this flex as a possible positive embedded value, but he also highlights that the values embedded in design, and in this case embedded in a material's natural properties, may not be congruent with other values that must be considered during design decision-making.

DL (page 2): "You would probably want to do some mock ups and stuff to understand how it sort of buckles and flexes and can we sort of use that in a positive way, because obviously a flexible stand is not going to give the right impression".

This connection between values embedded in design and other value categories was made explicit by many participants. Decisions were also based on whether the embedded values held by the materials were congruent with the perceived values of identified stakeholders (PISV).

JM (page 2): " So that's why I moved away from some of these materials that which were um...sort of quite garish and bright and colourful because I thought actually from a distance it would just look, it would look horrible and it wouldn't do the company any favours".

DLI discusses the connection between values embedded in design and societal values. He reports that he looked at many of the material samples and made judgements about which ones have the appropriate embedded values for the context. For example he decided the recycled sheet made from multicoloured plastic bottle flakes (based on the 1970's plastic used by Jane Atfield, see Figure 4.2) gave the wrong impression. Eventually he decided the



Figure 4.2 Jane Atfield's recycled chair (Atfield, 1996)

judgment should be left to Recoup. His final idea was made from separate panels, that could be made from different examples of the recycled plastic sheet and interchanged dependant on the audience.

Achieving values embedded in design

The retrospective interviews produced a lot of evidence of designers being involved in decision-making to try and embed certain values within their design or making decisions that highlight, or increase a product's embedded value. Table 4.5 (right) shows some of the words used to convey the 'sense' the participants were trying to achieve (or trying to avoid) within their product:

Participants also chose to incorporate the qualities of other plastic, or those functions that cannot be achieved with other materials, to show the material either holds the same, or superior value.

DL (page 2): " So I was thinking about those big over-centring folds like you get with plastic stuff, So you're incorporating a function you get with plastic mouldings and devices you see around you, but you're doing it to show this material does exactly the same as that, if it does! I'm assuming it probably does".

There was also evidence of participants associating shapes and styles with values they wished to embed in their new lectern designs. Evidence of designs being rejected because the designer had embedded values that were not desired was also evident in the retrospective interviews. *AL (page 2): "When I think about modern...I think of curves and circles and that so..."*

JM (page 3): "But I just thought it lacks elegance. It's too camping...it's too...it just lacks...it's just too home salesman sort of ish. You know it's sort of dell boy on a stall!"

The decisions designers make that are influenced by the wish to embed value in their design are also connected to other value categories. For example JM's decision to use plastic welding and make the lectern recyclable at the end of its life is influenced by perceived identified stakeholder values. He wants the lectern to be congruent with Recoups environmental ethos.

DL (page3): "...so it was well ok then appropriate styling in this sort of arena is something that doesn't detract from the person who's speaker, so it needs to be fairly refined".

The Role of Values in Design Decision-making

Participant	Sense	Participant	Sense
ADI	Forward thinking Light Cool Floating Bland (negative) Striking	DLI	Recoup's ethos Broadening awareness Novel Stereotypical (negative) Wobbly (negative) Creaky (negative) Flex (positive or negative depending on the intention) Challenging preconceptions Innovative Inspiring Refined Obvious (negative) Blocky (negative) Unimaginative (negative) Curvy Distracting (negative) Subdued High quality Corporate
JMI	Garish (negative) Subtle Elegance Camping (as a sense – negative) Home salesman (negative) Dell boy on a stall (negative) Shield Flimsy (negative) Unity	CAI	Modern Professional Smooth
ALI	Slick Simple Modern Blocky (negative) Streamlined Fast Dramatic Floating	KCI	Simple but attractive Different Intrigue Normal (negative) Undoing a bottle
MLCI	Cool	SPI	Alive Elegant Active Dynamic Blocky (negative) Chunky (negative) Oscars

Table 4.5. Words used by participants to describe the sense they were trying to portray, or avoid in their designs

JM (page 3): "I then I went onto thinking of a lectern and I know when I've stood at a lectern at a conference it's...it's almost your little point of safety, it's almost your little shield from the audience".

The examples above show that the influence of other value categories also guides the designer to embed appropriate value. DL explains it was important that the lectern did not detract from the person speaking behind it. The perception of appropriate value is, however subject to many internal

value judgements. For example DL, as stated above, believes the lectern should not detract attention away from the speaker. JM feels that the lectern should also have the added value of acting as a shield for the user, as he associates his own nervousness of presenting with the value he wishes to embed in the product.

There are occasions where these two sub-sections of values embedded in design combine. Existing artefacts or materials are selected to be combined with the product

The Role of Values in Design Decision-making

Bar chairs	Steel (3 people)	Surfboard (negative)	Kite	Flower petals
Swan	Glass (4 people)	Bird tables (negative)	Snake	Snake
Dyson vacuum cleaner	Marble (3 people)	Tree (negative)	Martini glass (negative)	Polyprop integral hinges
Coke bottle (in room) (4 pple, 1 negative)	Slate	Sharks fin (2 people)	Other bottles (3 people)	Holly leaf chair (previous project)
Modern art	Leatherette	Clear tubing (previous project)	Exhibition stands	Carpet

Table 4.6. Existing materials and design used to combine with new designs to transfer embedded value or to reject ideas through not wanting the association

that is being designed in order to associate their value with the new artefact (for example three participants made the decision to use steel in their designs in order to associate the lectern with the high embedded value of steel, they all perceived steel to be indicative of quality). New designs are also developed to resemble an existing item in order to take on similar values. These selected products can also be from previous projects, the outcomes of which must hold some value for the participant. The above concepts are also used to reject concepts. Table 4.6 shows materials that were used either to accompany the recycled plastic or from which the recycled plastic was chosen for its resemblance. It also presents products and concepts used in the new design in order for it to take on the same value and presents connections to items that led to concepts being rejected.

Internal values – Perceived values

A significant finding from the pilot studies was that designers have an internal perception of external values that they use to make value judgements 'on behalf' of external influences. This includes *perceived societal values*, *perceived identified stakeholder values*, and *perceived economic system values*. Literature related to the external categories from which perceptions are made are relevant here as designers are 'representing' societal, identified stakeholder and economic values.

Internal values – Perceived societal values

The designer's perception of societal values was observed to be a driver of many decisions during the one-day event. Some of these decisions considered what they believed the audience response would be to the aesthetics of the product. For example JM based some aesthetic considerations on how the lectern would look from a distance, as this is how a member of the audience might view it. These aesthetics considerations were also used to conceptually organise aesthetic priorities (meta-values). For example one participant paid more attention to the upper half of the lectern, observing that the lower half will not be seen by many members of the audience. Another however, acknowledged that the whole lectern will be seen if it is used as a display stand.

Their perception of societal values were made with three distinct drivers a) Assuming a society's values were congruent with their own (PSV through DPV); b) Acknowledging that different groups of people will hold different values. (PSV through PSV); and c) Perceiving the values of society through their perceived value understanding of identified stakeholders. (PSV through PISV, for example not blocking the audiences view of the lecturer).

Internal values – Perceived Identified stakeholder values

The use of perceived identified stakeholder values was similar from the participants and was focussed on the person using the lectern, and the company (Recoup or Smile Plastics). Decisions based on the perceived values of the user included how the user would use it, One participant listed what she believed would be the lectern's primary and secondary uses. Another considered how an employee who was new to Recoup would intuitively assemble the lectern. Considerations were also made regarding how the user was observed by others. One participant ensured her lectern obscured any possible fiddling with papers, that the user may do in the course of a presentation.

Decisions were either driven by the perception of what the company wants or how to achieve what they want, or through how it is believed they want to be viewed (ethos). One participant made the decision not to create a product that was ironic to the company's values but instead to develop a concept that was not only made from recycled plastic, but also used minimal materials and was itself recyclable.

Internal values – Perceived economic system values

There was only one example of PESV during the retrospective interviews:

DL (page eight): "Yeah, and although cost isn't the sort of be all and end all it was. It should be something that is simple to produce. Otherwise people will think well yeah it

The Role of Values in Design Decision-making

looks like it does but, its really complicated to make, so trying to think along those lines a bit more. Um...then how do you make the bits and pieces, how do they all fit together?"

Here the participant is discussing how the cost of the product as far as it is related to the number of processes will have a result on how it is then perceived (connection with PSV).

Internal values – designer’s personal values

The idea of a designer’s decision-making being influenced by their personal values is not new. Literature regarding designers *personal values* can be found from the 1970s (Rokeach 1973, Gregory and Commander 1979) to more recent publications (for example Dorst, 2003).

Author	Summary
Dorst, 2003	The designer can design according to his own taste, style and abilities.
Kumar and Bjorn-Anderson, 1990	Choices are determined, to a large extent, by the designer’s personal values
Pedgley, 1999	Designer’s make decisions based on, for example, their preferences, priorities, opinions, passions, convictions and emotions
Rokeach, 1973	Terminal values and instrumental values
Daley, 1984	Perception and personal experiences
Dorner, 1999	Use of personal analogies Ballistic thinking Heuristics
Gregory and Commander, 1979	Models of design behaviour Heuristics
Kaldate et al, 2003	Decision traps Heuristics

Table 4.7 Summary of the prior art regarding designer’s personal values.

The pilot studies provided examples of many instances where a designer’s decisions were swayed by personal values such as personal preference, interest and previous experiences. The focus group activities also yielded additional personal values during the development of the initial taxonomy. The main study, although not presenting any new findings, gave rise to many additional examples of decisions being influenced by a designer’s personal values. The designer’s personal preferences and tastes as well as their personal wishes was observed to have a strong influence over decisions regarding the aesthetics of the lectern, and the selection of materials.

ALI (page 3): “I had already chosen those two cos they look nice”.

CA (page 9): “ I wanted it all smooth”.

Past experiences and personal rules of thumb, or heuristics that the designer has built up, either through previous design projects or from other personal experiences also appear to have a high level of influence over decisions. For example one of the professional designers has a personal rule of thumb to avoid symmetry in his product design outcomes. Another participant chose to use clear tubing for the supporting mechanism of the lectern, this is based on a previous successful project in which she also used clear tubing. Only the two experts seem to have built up rules to inform their actions suggesting that this is one element of expertise.

Meta-values

These could be considered as a designer’s personal values, however they are slightly different and worth separating. Meta-values describe value judgements at a more abstract level of judgement about the art of decision-making as a whole. It is not only decisions regarding the physical form, manufacture and intended use (to name a few) that must be considered by the designer, but also to what extent each step towards the conclusion satisfies the overall need. As well as personal values designers also appear to have an internal, value based organisational system. Essentially the thinking behind designers’ actions does not just look backwards, as suggested by Schön’s reflective practice but also looks forward to plan ahead. This is hinted at by Layton who suggests the use of organisation values when he mentions ‘judgements about how intentions are realised shape the activity’ (1992:36). Daley (1982) commented on a designer’s use of values as an ordering mechanism. It is also clear that designers must make value judgements as to what extent an idea satisfies the overall need or whether alternatives should be sought. This is apparent in the following pilot study extracts

Dataset 5. RC: “Realised the need to discover the properties of materials” A value judgment of what needs to happen next based on an earlier decision that there would be great benefit from the design requiring only simple changes to the original material.

Dataset 5. RC: “Today I also decided to make some small models of some of the ideas and thought I could print out the examples of the plastics from smile plastics.co.uk to use for the models – more realistic idea of designs, assembly etc (models not made yet though)”, A decision about later activity based on not knowing exactly how the design will be assembled.

Designers also appear to have an internal hierarchy of values. One participant places more importance on certain value judgments than others. She basis her decisions on

The Role of Values in Design Decision-making

personal values of aesthetics before she decides on the most appropriate material for the design:

Dataset 1. RH: "We kind of design the ideas of how we want it to look, then take a range of materials, try to analyse them – which one is best"

Author	Summary
Layton, 1992	Judgements about how intentions are realised shape the activity
Daley 1982	Designers use of values as an ordering mechanism Designer's employment of values for ordering conceptual priorities
Keeney	Values as principles used for evaluation and to determine potential consequences

Table 4.8 A summary of the prior art regarding meta-values.

This group of values was initially referred to as 'organisational values'. However these early observations suggest a concept that is an abstraction from values, used to analyse and determine their use. In epistemology the prefix 'meta' is used to mean 'about', so here it is used as 'about values' as a more appropriate descriptor of this subset. There is little prior art regarding meta-values, a summary is shown in Table 4.8.

Conclusions

It is clear that values have an enormous influence on design decision-making. During the course of the study many sources of evidence (such as the literature review, pilot studies and focus groups) highlighted numerous examples of the values categories. These sources of evidence have been combined with the results from the main study to develop the summary presented in Table 5.1.

Decisions based on:	Includes:
Societal Values	<ul style="list-style-type: none"> • gaining information from members of society about for instance their preferences, priorities, convictions and emotions; • gaining information from members of society about the acceptability of a design for instance regarding market desire, current fashion, aesthetic appeal and less tangible political, religious, cultural social and ethical positions; • using information from society to gain an appreciation of their needs and expectations; • using information from members of society to understand how the outcome will affect that society; • gaining information from members of society in order to address socially important problems; • an understanding that design can be used to reflect the values of society using information from its members; • an understanding that design can be used to shape the values of society using information from its members; • an understanding of the social context within which a product is placed in order to embed additional value; • an understanding of how other values interact with societal values.
Identified Stakeholder Values	<ul style="list-style-type: none"> • Paying attention to a brief that has been written by an identified stakeholder; • gaining information from identified stakeholders about for instance their preferences, priorities, convictions and emotions; • gaining information from identified stakeholders about the acceptability of a design; • using information from identified stakeholders to gain an appreciation of their needs and expectations; • using information from identified stakeholders to understand how the outcome will affect that identified stakeholder; • an understanding that design can be used to reflect the values of an identified stakeholder using information from that identified stakeholder; • an understanding of the importance of gaining information and/or advice from particular stakeholders such as clients, peers, lecturers and bosses; • an understanding of how other values interact with identified stakeholder values.
Economic values	<ul style="list-style-type: none"> • an understanding of the importance of minimising cost and of knowing the cost of materials, processes, and designer's time; • an understanding of economic competition; • an understanding of the economic constraints of the market place and the need to solve problems within the imperatives of the market economy; • seeking a fit between profit, needs and wants; • an understanding of the relationship between supply and demand and availability and price; • an understanding of the relationship between cost and other attributes such as strength and performance; • an understanding of the relationship between cost and context; • an understanding of how the cost of a product relates to its price and an appreciation of the difference between use value, intrinsic value and value in exchange; • an understanding of the relationship between economics and the political and environmental power of consumption; • an understanding of the marginal value of one product over another; • an understanding of how other values interact with economic values.

The Role of Values in Design Decision-making

Decisions based on:	Includes:
Values embedded in design	<ul style="list-style-type: none"> • the use of existing design as a source of inspiration and/or to inform decisions; • the use of existing design as a start point for new designs; • the use of materials and/or existing products directly in the new design due to an appreciation of the value they hold; • an understanding and appreciation of the embedded value existing products carry; • using existing materials and products to gain an understanding and appreciation of how values embedded in design affect their success; • using existing materials and products to gain an understanding and appreciation of the additional value a product holds, such as physio-pleasure, socio-pleasure, psycho-pleasure and ideo-pleasure and of product semantics; • using existing materials and products to gain an understanding and appreciation that people value products for what they signify; • Using existing materials to understand the embedded value of similar new materials; • Using existing products to gain an understanding that materials hold value through what can be done with them and how they are used; • The use of existing products to gain an understanding of the need to embed values that are appropriate for the context in which the new design will be used; • The use of existing products to gain an understanding of the use of shapes and styles to embed particular values (selection by synthesis); • an understanding of how other values interact with values embedded in design.
Decisions based on:	Includes:
Perceived societal values	<ul style="list-style-type: none"> • the perception of for instance the preferences, priorities, convictions and emotions of society; • the perception of the acceptability of a design for instance regarding market desire, current fashion, aesthetic appeal and less tangible political, religious, cultural social and ethical positions of a society; • the perception of the needs and expectations of society; • the perception of how the outcome will affect that society; • the perception of socially important problems within society; • an understanding that design can be used to reflect the perceived values of society; • an understanding that design can be used to shape the perceived values of society; • a perceived understanding of the social context within which a product is placed in order to embed additional value; • an understanding of how other values interact with perceived societal values.
Decisions based on:	Includes:
Perceived identified stakeholder values	<ul style="list-style-type: none"> • the perception of for instance the preferences, priorities, convictions and emotions of identified stakeholders; • the perceived acceptability of a design for identified stakeholders; • a perception of the needs and expectations of identified stakeholders; • a perception of how the outcome will affect that identified stakeholder; • an understanding that design can be used to reflect the perceived values of an identified stakeholder; • an understanding of how other values interact with perceived identified stakeholder values.
Decisions based on:	Includes:
Perceived economic system values	<ul style="list-style-type: none"> • a perception of the cost of materials, processes, and designer's time; • a perception of economic competition; • a perception of the economic constraints of the market place and the need to solve problems within the imperatives of the market economy; • a perception of the fit between profit, needs and wants; • a perception of the relationship between supply and demand an availability and price; • a perception of the relationship between cost and other attributes such as strength and performance; • a perception of the relationship between cost and context; • a perception of how the cost of a product relates to its price and a perception of the difference between use value, intrinsic value and value in exchange; • a perception of the relationship between economics and the political and environmental power of consumption; • a perception of the marginal value of one product over another; • an appreciation of how the cost of a product will affect how it is perceived; • a perception of how much people will be willing to pay; • an understanding of how other values interact with perceived economic values.

The Role of Values in Design Decision-making

Decisions based on:	Includes:
Embedding values in design	<ul style="list-style-type: none"> • the use of existing design as a start point for new designs in order to embed their value in the new design; • the use of materials and/or existing products directly in the new design in order to embed their value in the new design; • an understanding of how the value of a product can be highlighted by how it is used; • the desire to portray a sense within a design; • the desire to convey a message through design; • the use of an understanding and appreciation of how values embedded in design affect their success to embed appropriate value in new designs; • the use of an understanding and appreciation of the additional value a product holds, such as physio-pleasure, socio-pleasure, psycho-pleasure and ideo-pleasure and of product semantics; • the use of an understanding and appreciation that people value products for what they signify; • the selection of new materials because of their similarity to old materials with appropriate embedded values; • the use of an understanding that materials hold value through what can be done with them and how they are used; • the use of an understanding of the need to embed values that are appropriate for the context in which the new design will be used; • the use of shapes and styles to embed value (selection by synthesis); • the desire to change a material or products embedded value; • an understanding of how other values interact with embedding values in design.
Decisions based on:	Includes:
Designer's personal values	<ul style="list-style-type: none"> • the designers personal preferences, conviction, priorities and emotions; • the past experiences/projects of the designer; • the use of a designers personal rules and heuristics; • the terminal and instrumental values of the designer; • the use of personal analogies by the designer; • the application of ballistic thinking; • the need to show for instance dedication, passion, concern for issues, personality and the values of the designer's own society; • the use of gut instinct; • the designer's personal aspirations and personal drive; • an understanding of how other values interact with the designer's personal values.
Decisions based on:	Includes:
Meta-value	<ul style="list-style-type: none"> • making judgements in order to guide the activity and decide what steps to take next; • assessing conceptual priorities that can be addressed within the time allocated; • the evaluation of ideas, making decisions as to what extent each step towards the conclusion satisfies the overall need, values of satisfaction; • the organisation of future work; • making assumptions in order to continue; • the decision to consider one value over another, influencing the process by which a hierarchy of values is prescribed; • making judgements as to how intentions can be realised; • the employment of values for ordering conceptual priorities; • principle used to determine potential consequences; • the perception of the truth of information; • the application of different degrees of importance; • a designer's set ways of working; • an understanding of how other values interact with meta-values.

Table 5.1 An overview of the influence of values on design decision-making

The PhD on which this paper reports provides evidence that the values influencing industrial designers decision-making can be identified and described. It also shows we can distinguish values from other influences involved in design decision-making (namely knowledge and skills - but they cannot be separated entirely and there are many grey areas). The evidence presented in this paper, which is only some of the evidence presented in the PhD shows we can distinguish between decisions based the different values.

Another contribution to knowledge that the PhD makes is new paradigms of researching design decision-making. It is clear that data can be collected and analysed regarding values in industrial design decision-making. Within the framework presented in Table 4.1 designers are free to be influenced by few, or all values at different stages of a design project. They are also free to be influenced by values to a lesser or greater degree. For some design projects, the values influencing the designer's decisions can

The Role of Values in Design Decision-making

be simple and straightforward. For other projects decisions may be based on complex interactions and trade-offs between a number of different values. The purposeful avoidance of certain values may well simplify the decisions a designer must make in order to complete a task, but, ultimately, this approach may not lead to an appropriate outcome.

The thesis on which this paper is based expands on the value-based explorations done by Hicks et al in the 1980s and includes the contributions made by key authors in the field as well as evidence collected during the course of the study. A taxonomy of the values influencing design decision-making has been added to a model of design decision-making as a summation of knowledge skills and values (see Figure 5.1).

The findings present many opportunities for the development of resources to improve design decision-making. By furthering our understanding of design decision-making it is possible to develop more effective teaching practices and resources. This enables students to improve their design capability and essentially become better designers.

It is the author's opinion that the use of values in design decision-making needs to be included in course curricula, and presented in a framework of knowledge, skills and values. It is clear that values influence design decision-making in many ways, for instance they are used to reduce avenues of enquiry, to direct activity, to analyse ideas, to inform about sizes, properties, functions and manufacture, among many other. Values are used to drive all sorts of decisions from manufacturing to aesthetics and yet their

comprehension by designers is currently made at a personal cognitive level. By developing a design curriculum which includes teaching regarding the awareness and understanding of values within design course providers can contribute to the development of more considered decision-makers.

An understanding of values is also helpful to professional designers in increasing their awareness of what constitutes design decision-making, therefore allowing them to apply effective and more informed strategies to their activities. Many of the findings could be transferred into a resource for professional designers.

References

Akin Ö and Lin C (1996) 'Design Protocol Data and Novel Design Decisions' in Cross N Christiaans H and Dorst K (Eds) *Analysing Design Activity*, John Wiley and Sons

Atman C J, Chimka J R, Bursie K M and Nachtmann H L (1999) 'A comparison of freshman and senior engineering design processes', in *Design Studies* Volume 20, Issue 2, March 1999, 131-152

Ashby M and Johnson K (2003) *Materials and design: the art and science of material selection in product design*, Butterworth Heinemann, Oxford

Atfield J (1996), *Recycling: forms for the next century - austerity for posterity*, Craftspace Touring, Birmingham

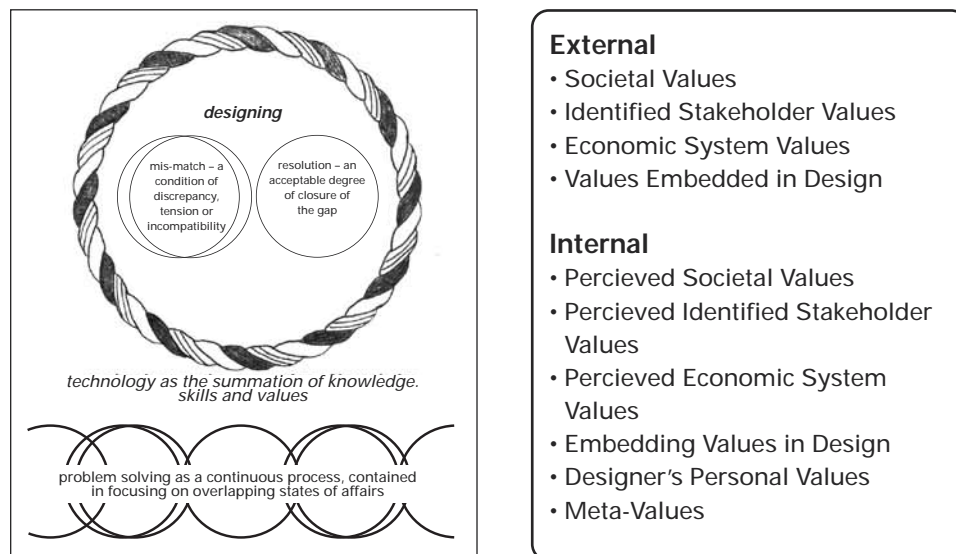


Figure 5.1 Values as integrated into Norman's model of designing.

The Role of Values in Design Decision-making

- Baynes K (2004) *Design and Democracy: Speculations in the Radical Potential of Design and Design Education*, Department of Design and Technology, Loughborough University, Photocopy
- Baynes K (1992) 'The Ethics of Representation' in Roberts P Archer B and Baynes K (1992) in *Modelling: The Language of Designing: Design: Occasional Paper No 1*, 13 – 18
- Baynes K (2005) *Design and Democracy: Speculations on the radical potential of design, design practice and design education*, draft copy, private correspondence, Department of Design and Technology, Loughborough University.
- Boztepe S (2005) *The Notion of Value and Design*, www.idemployee.id.tue.nl/gw.m.rauterberg/conferences/CD_doNotOpen/ADC/final_paper/609.pdf [accessed 28 July 2005].
- Cross N (1982) 'Designerly Ways of Knowing', *Design Studies*, Vol 3 No 4 October, Butterworth and Co Ltd, 221-27
- Cross N, Christiaans H and Dorst K (1996) *Analysing Design Activity*, John Wiley and Sons, Chichester
- Coles R (2003a) 'An Exploration of Role Values play in Designer Decision-making and how this Effects Ecodesign Outcomes' in Hon B (Ed) *Design and Manufacture for Sustainable Development 2003*, 3rd-4th September 2003, Homerton College, Cambridge, UK, Professional Engineering
- Coles R and Norman E (2005) 'An exploration of the Role Values Plays in Design Decision-making' in *The International Journal of Technology and Design Education* (2005) 15:155-171, Springer
- Daley J (1982) 'Design Creativity and the Understanding of Objects' in N. Cross (Ed) (1984) *Developments in Design Methodology*, John Wiley and Sons, Chichester, pp 291-302
- Dasgupta S (1994) *Creativity in invention and design: computational and cognitive explorations of technological originality*, Cambridge University Press, New York
- Dasgupta S (1996), *Technology and Creativity*, Oxford University Press, New York
- Dörner D (1999) 'Approaching design thinking research' in *Design Studies* Vol 20 407-15
- Dorst K (1996) 'The Design Problem and its Structure' in Cross N Christiaans H and Dorst K (Eds) *Analysing Design Activity*, John Wiley and Sons
- Dorst K (2003) 'Exploring the structure of design problems' in *Research for Practice: Innovation in Products, Processes and Organisations*, Proceedings of the 14th International Conference on Engineering Design, ICED, Stockholm, August 19-21st, 2003
- Elhamdi M, Yannou B and Marx D (2003) 'Design of value chains in companies – an integrated optimisation of the value of products and processes' in *Research for Practice: Innovation in Products, Processes and Organisations, Proceedings of the 14th International Conference on Engineering Design*, ICED, Stockholm, August 19-21st, 2003
- Feijs L and Overbeeke K (2003) Design: Meaning, Action and Value, in *The Journal of the Asia International Design Conference* http://www.idemployee.id.tue.nl/g.w.m.rauterberg/conferences/CD_doNotOpen/ADC/final_paper/185.pdf
- Goonatilake S (1984) *Aborted Discovery: Science and Creativity in the Third World*, Zed Books, London
- Green J (2003) 'The value of valuing people', *New Value News*, No 15, Phillips Design, January 2003, 21-23
- Gregory S A and Commander M W (1979) 'New Materials Adoption Study: Some Contributions to Design Knowledge', *Design Studies*, Vol1 No2 October, IPC Business Press, pp107-112
- Hicks G et al (1982) *Understanding Design and Technology*, Assessment of Performance Unit
- Jordan P. W and Macdonald A (1998) 'Pleasure and product semantics' in Hansen (Ed) *Contemporary Ergonomics*, London, Taylor and Francis
- Kaldate A D, Thurston H, Emamipour and Rood M (2003) 'Overcoming Decision Traps in Sustainable Design' in *Sustainable Design*, Proceedings of the 14th International Conference on Engineering Design, Stockholm, August 2003
- Kumar K and Bjorn-Anderson N (1990) A Cross-Cultural Comparison of IS Design Values, in *Communications of the ACM*, Vol 33, No 5 528 - 538
- Layton D (1992a) *Values and Design and Technology – Design Curriculum Matters: 2*, Department of Design and Technology, Loughborough University of Technology

The Role of Values in Design Decision-making

- Layton D (1992b) 'Values in Design and Technology' in C. Budgett-Meakin (Ed) *Make the Future Work – Appropriate Technology: A Teachers Guide*, Longman Group Limited, Essex
- Layton D (1992c) 'Values in Design and Technology' in Catherine Budgett-Meakin (Ed) *Make the Future Work-Appropriate Technology: A Teachers Guide*, Longman Group UK Limited, Harlow
- Layton D (1993a) *Technology's challenge to science education: cathedral, quarry or company store?* Open University Press, Buckingham
- Layton D (?) 'Science Education and Praxis: the Relationship of School Science to Practical Action', pp11-23
- Middleton H (2003) Some new ideas on new ideas: Creative, inventive thinking, values and Design and Technology Education, in Dakers J and de Vries M J (Eds) *Patt-13: International Conference on Design and Technology Education Research 2003*, University of Glasgow, pp 165-69.
- Norman E (1998) 'The Nature of Technology for design', *International Journal of Technology and Design Education* 8, 67-87, Kluwer Academic Publishers, Netherlands
- Norman E (2000) 'The Teaching and Learning of Technology for Design', in R. Kimbell (Ed) *Design and Technology International Millennium Conference 2000*, The Design and Technology Association, Warwickshire
- Norman E, Pedgley O and Coles R (2004a) 'Design decision-making and materials – investigation in the context of recycled polymers' in Hon B and Bhamra T (Ed's) *Design and Manufacture for Sustainable Development 2004*, 1st – 2nd September 2004, Burleigh Court, Loughborough University, UK, Professional Engineering Publishing Ltd.
- Norman E, Pedgley O and Coles R (2004b) 'Design decision-making and materials: Research agendas and Gathering Evidence', in *The Journal of Design and Technology Education*, The Journal of Design and Technology Association, Summer 2004, Vol 9, No 2, Trentham Print Design Ltd, Chester.
- O'Brien M and Guerrier Y (1995) 'Values and the environments: an introduction' in Geurrier Y, Alexander N, Chase J and O'Brien M (Ed's) *Values and the Environment*, xiii – xvii, John Wiley and sons, Chichester
- Pedgley O F (1999) *Industrial Designers' Attention to Materials and Manufacturing Processes: Analysis at Macroscopic and Microscopic Levels*, PhD Thesis, Loughborough University
- Rompay et al (2004) 'The bodily basis of product experience' in *Design Studies*, Vol 26, 359-377
- Rokeach M (1973) *The nature of human values*, free press, New York
- Ryle G (1948) *The Concept of Mind*, Hutchinson
- Sassatelli R (2000) 'From Value to Consumption. A Social-theoretical Perspective on Simmel's Philosophie des Geldes', *Acta Sociologica*, Vol 43, No 3
- Schon D and Wiggins W (1992) 'Kinds of Seeing and their Functions in Designing', *Design Studies* Vol 13 April, Butterworth-Heinemann Ltd, pp135 – 157
- Schon D (1996) *The Reflective Practitioner: How Professionals think in action*, Basic Books inc.

R.L.Trimingham@lboro.ac.uk