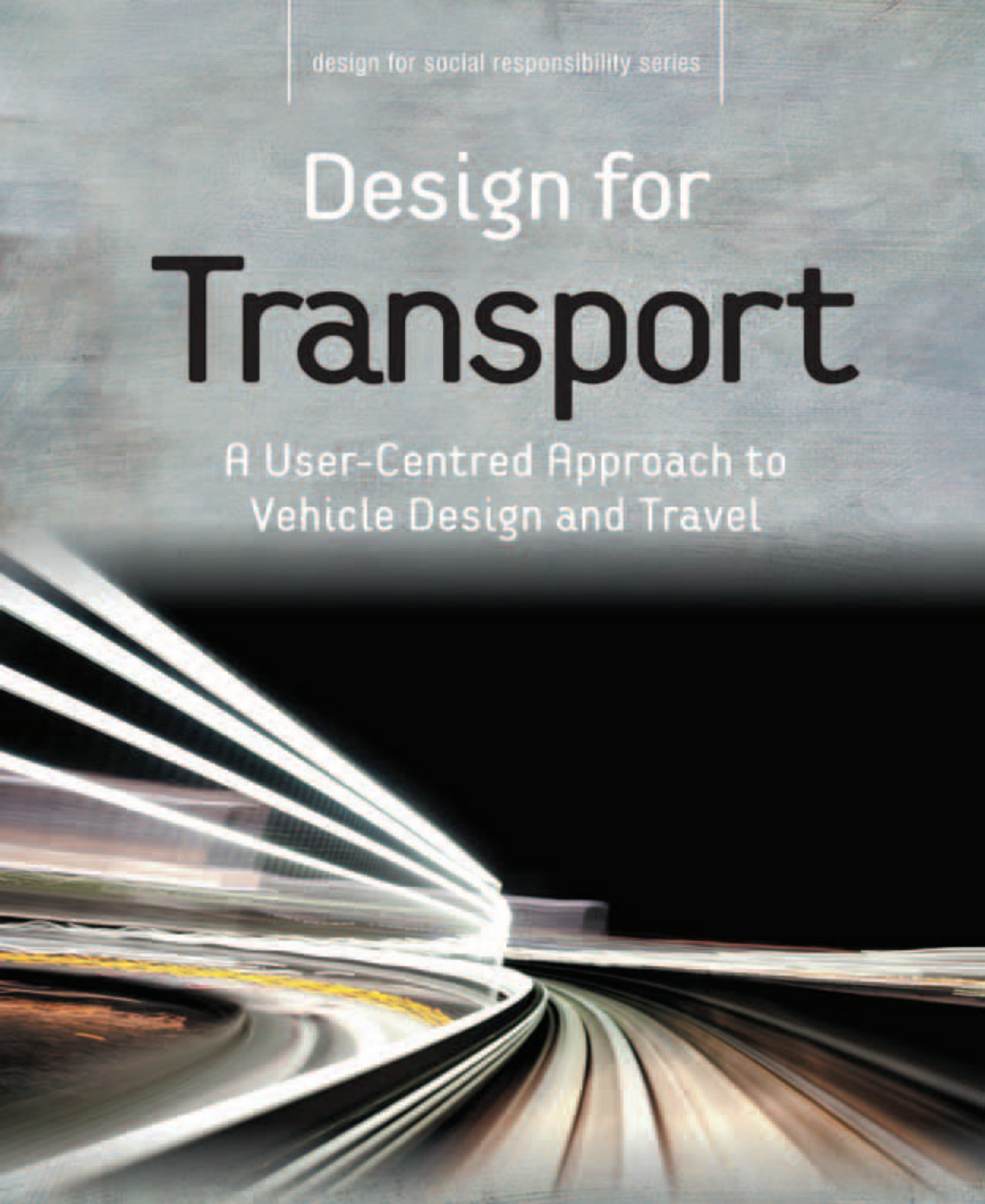
design for social responsibility series

Design for Transport

A User-Centred Approach to Vehicle Design and Travel



Edited by

Mike Tovey

Series Editor: Rachel Cooper

A **Gower** Book

ROUTLEDGE

Design for Transport

Design for Social Responsibility Series

Series Editor: Rachel Cooper

Social responsibility, in various disguises, has been a recurring theme in design for many years. Since the 1960s several more or less commercial approaches have evolved. In the 1970s designers were encouraged to abandon 'design for profit' in favour of a more compassionate approach inspired by Papanek.

In the 1980s and 1990s profit and ethical issues were no longer considered mutually exclusive and more market-oriented concepts emerged, such as the 'green consumer' and ethical investment. The purchase of socially responsible, 'ethical' products and services has been stimulated by the dissemination of research into sustainability issues in consumer publications. Accessibility and inclusivity have also attracted a great deal of design interest and recently designers have turned to solving social and crime-related problems.

Organisations supporting and funding such projects have recently included the NHS (research into design for patient safety); the Home Office has (design against crime); Engineering and Physical Sciences Research Council (design decision-making for urban sustainability). Businesses are encouraged (and increasingly forced by legislation) to set their own socially responsible agendas that depend on design to be realised.

Design decisions all have environmental, social and ethical impacts, so there is a pressing need to provide guidelines for designers and design students within an overarching framework that takes a holistic approach to socially responsible design.

This edited series of guides is aimed at students of design, product development, architecture and marketing, and design and management professionals working in the sectors covered by each title. Each volume includes:

- The background and history of the topic, its significance in social and commercial contexts and trends in the field.
- Exemplar design case studies.
- Guidelines for the designer and advice on tools, techniques and resources available.

Design for Transport

A User-Centred Approach to Vehicle Design and Travel

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Routledge
Taylor & Francis Group
LONDON AND NEW YORK

First published 2012 by Gower Publishing

Published 2016 by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN
711 Third Avenue, New York, NY 10017, USA

Routledge is an imprint of the Taylor & Francis Group, an informa business

British Library Cataloguing in Publication Data
Design for transport : a user-centred approach to vehicle
design and travel. -- (Design for social responsibility
series)
1. Transportation--Environmental aspects. 2. Sustainable
design.
I. Series II. Tovey, Mike.
388'.049-dc23

Library of Congress Cataloging-in-Publication Data
Design for transport : a user-centred approach to vehicle design and travel
/ [edited] by Mike Tovey.
p. cm. -- (Design for social responsibility)
Includes bibliographical references and index.
ISBN 978-1-4094-3325-5 (hbk) 1. Automotive engineering-
-Design and construction. 2. Transportation engineering--Design. 3. Urban transportation--
Planning. 4. Human engineering. 5. Industrial design. I. Tovey, Mike.
TL240.D483 2012
629.04'6--dc23

2012007147

ISBN: 978-1-4094-3325-5 (hbk)
ISBN: 978-1-3155-7667-1 (ebk)

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Mike Tovey is Professor of Industrial Design at Coventry University. He joined the institution following a period of practice in industry. He was responsible for the establishment and development of transport design. This has now achieved international prominence and centre of excellence status.

He was Dean of the Coventry School of Art and Design for 18 years. During this time it doubled in size, incorporated Performing Arts, achieved strong research rankings and a very positive identity and profile.

He pioneered design research, contributing publications and holding a number of research council grants. He has served on research council committees, supervised and refereed grants and publications.

Much of his research work has been concerned with the design process and how designers work. There has been a particular focus on the use of computer support for the creative aspects of design. The context for this work has been concept design in the automotive industry and the development of novel techniques to support the design activity. He also pioneered the portfolio PhD and this work is a useful summary of much of his research activity.

From 2007 to 2010 he was Director for Design and responsible for leading and co-ordinating design education and design research across the university. In addition to his cross-university role he was Director of CEPAD (the Centre of Excellence in Product and Automotive Design). It has strong links with the Industrial Design Department, as well as connecting with other parts of both the Coventry School or Art and Design, and the rest of the university.

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Robin Roy is Professor of Design and Environment at the Open University. As one of the first of Open University's design academics, he has contributed to many OU distance-teaching courses on Design, Technology and the Environment, including *Design and Designing*; *Innovation: Designing for a Sustainable Future*; and *Environment: Journeys through a Changing World*. In 1979 he founded the Design Innovation Group to conduct research on the management of product development and innovation and on energy and sustainable design and has many publications on design, innovation and environment.

Tom Wellings studied Chemical Engineering at the University of Birmingham, followed by a Masters in Industrial Design Engineering at the Royal College of Art, London. After working as an engineer, and industrial designer, in 2004 Tom joined the department of WMG at the University of Warwick, investigating user interaction with automotive Human–Machine Interfaces. As Senior Research Fellow, Tom has worked on numerous projects with premium automotive manufacturers, most recently leading research into the use of HMI in low-carbon vehicles. Currently Tom is working as an HMI and Usability Programme Leader in Jaguar Land Rover.

Andrée Woodcock is an applied researcher at Coventry University, where she has been employed since 1999. She is leader of the university's research initiative in Integrated Transport and Logistics and has led both the Centre of Excellence in Product and Automotive Design and the Design and Ergonomics Applied Research Group. Her Chair is in Educational Ergonomics and Design and she has specialized in research into the way in which ergonomics can be taught in schools, or used to inform the design of better educational facilities.

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Reviews for *Design for Transport: A User-Centred Approach to Vehicle Design and Travel*

Design for Transport *shows how designers can take a user-centred and socially responsible approach to tackling a range of types of transport, from systems to products and from bicycles to automobiles. The approaches they employ and the methods they use in producing a rich array of solutions are demonstrated through case studies. This is timely and relevant as we face unprecedented economic and climate change issues, which call for radically new approaches from transport designers. This book is essential reading for anyone interested in the future of transport design.*

Seymour Roworth-Stokes, Pro Vice-Chancellor Research and Development, University for the Creative Arts, and Chair, Design Research Society

Of all the imperatives concerning humanity's ability to devise systems for sustainable living 'transport' is perhaps one of our most important priorities. The story of transport not only provides an illustration of our evolution into urban and sub-urban inhabitants but our predictions for future transport epitomise our human capacity for creativity and innovation. Of course, not all visions have recognised the social and environmental implications of their creation but new approaches to the user-centred design of transport products and systems offer both liberation and sustainability. This book expertly charts recent and relevant milestones on the journey towards truly sustainable transport.

Steve Garner, The Open University, UK

A key reference for designers and students because of its comprehensive approach – from bicycles to buses, from supercars to sustainability, from maps to modal interchanges – and its focus on how design can create not just new vehicles and transport systems but new futures for travellers.

Nigel Cross, Emeritus Professor of Design Studies, The Open University, UK

Introduction

Mike Tovey

The central premise of this book is that the designer's role is to approach design for transport from the point of view of the user. People have a collection of wants and needs and a significant proportion of them are to do with their requirements for mobility. For a wide range of different reasons everyone needs to get about. For some this is because they must get to and from their places of work, or because their work involves travelling. For others there are very similar equivalent requirements such as getting to and from places of education or training. For many there are essential reasons which are personal or social, visiting the doctor, doing the shopping or calling in on dependent relatives or friends. Then there are many needs which may be less essential but which are very necessary such as social and cultural reasons for journeys. These include travelling to see friends or family, and to visit places for sport, entertainment or art. Indeed, for some the use of the transport product is itself the source of pleasure or sport. It is a long list of reasons for travelling. The designer's responsibility is for devising products, systems or arrangements which meet as far as possible these needs and expectations.

It is a natural consequence of approaching design for transport in this way that the emphasis should be on passenger transport, rather than freight transport. User needs translate into passenger mobility requirements. Both passenger and freight transport are very important in any successful economy (Eddington, 2006). But the proportions are different for each. For example, worldwide the most widely used modes for freight transport are the sea (40,000 bn ton km), followed by road (7,000), railways (6,500), oil pipelines and inland navigation (1,500) (Wikipedia, 2011). By contrast for passenger transport the most widely used modes are the automobile (16,000 bn passenger km), followed by buses (7,000), air (2,800), railways (1,900) and urban rail (250). We have chosen to concentrate on these passenger modes, although because of its specialist character we have not included much on either air travel or water-based transport, but instead concentrate on land transport.

This still leaves a large range, even if we exclude animal-powered transport (such as carts and chariots). It includes human-powered transport (for example, pedestrians, bicycles, rickshaws, skateboards, skates, sledge, ski, wheelchair), rail transport (for example, train, tram, metro, subway, monorail, funicular, cable car) and road transport (for example, car, motorcycle, bus, trolley bus, coach, truck, heavy goods vehicle, auto rickshaw). In this volume we include examples of each, with the main emphasis on road vehicles.

The history of transport has seen different modes emerging at different times (Votolato, 2007). The nineteenth century saw the dramatic impact of the inventions of steam-hauled passenger railways and safety bicycles. By the twentieth century, in developed nations, land passenger transport came to be dominated by the motor car powered by the internal combustion (IC) engine. However, in the early parts of the century the prevalence of the IC powered automobile was preceded by much experimentation with alternatives, in particular both steam power and electric battery power, before it became the preferred power source.

It would seem that in the early decades of the twenty-first century we are faced with a similar period of experimentation (Maxton and Wormald, 2004). The reasons for this are very visible. They are the huge impact of the global economic recession, and the enormous challenge presented by global warming. We could add to this the very significant appetite and expectations which people have developed for being able to accomplish individual journeys, both in developed and in developing countries. Many have experienced the convenience of motor cars and are loath to relinquish it. Many more see having access to a motor car as part their aspiration in achieving a Western type economy.

Key challenges for designers and engineers include the development of individual transport devices which are carbon-friendly, be they differently powered motor cars, or more radical alternatives to them. Other significant challenges include the development of social and public transport so that a higher proportion of the population can fulfil its mobility ambitions. Clearly designers have an important role in addressing these issues.

Design for Sustainability

The evolution of approaches to designing products and systems which meet user requirements, and are more sensitive to environmental and social needs, has come in three main phases (Bhamra and Lofthouse, 2007). The first wave

happened in the 1960s and 1970s with the birth of the Green Movement and the rise of Non-Governmental Organizations, such as Friends of the Earth and Greenpeace. Their drive towards creating change through government policy and regulation has had some success. The second wave was in the 1980s, when a succession of economic crises following historic political change (for example the collapse of the Berlin Wall), and environmental catastrophes (such as Bhopal and Chernobyl) further prompted legislative changes, and the creation of environmental, health and safety standards.

The third phase can be located in the new millennium. This has been a period of tremendous political activity and economic change, with momentous events in the Middle East and elsewhere, and the growth of anti-globalization and anti-Americanism. Major financial institutions have failed and the world economic order appears to be undergoing a shift of power with the emergence of China, India and others as major centres. At the same time the development of environmental science has led to the widespread acceptance that our current levels of energy consumption, and of carbon emissions, are unsustainable. This concern is exacerbated for many countries by anxiety over security of the supply of raw materials for energy production and the manufacture of core products. There is much debate over how we should deal with this (Woudhuysen and Kaplinsky, 2009) but clearly designers have a role in any solution.

During the first phase during the 1970s, Victor Papanek (Papanek, 1971) was able to blame the design profession for creating wasteful products and customer dissatisfaction. Since then there has been a growing concern in environmental circles that design has lagged behind in tackling environmental issues, and meeting real user requirements (Bhamra and Lofthouse, 2007). Maybe this is a consequence of designers being employed by companies who feel themselves to be constrained by market conditions and the need to meet short-term financial constraints. The successes of the environmental movement and of consumer groups have been in creating a legislative framework within which such responsibilities cannot be ignored.

Design for sustainability offers a new and broader context for designing (Birkland, 2008). Designers need to be responsible, synergistic, contextual, holistic, empowering, restorative, eco-efficient, creative and visionary. This is a heavy responsibility for an individual designer, and it is probably only achievable when these values are shared by the organizations they are involved with. However, the contention in this book is that through the use of a starting point of 'design for the user' a number of these ambitions can be realized.

User Needs, Ergonomics and Inclusivity

In addition to complaining that designers were complicit in the creation of wasteful products Papanek also railed against their producing designs which led to customer dissatisfaction. In so doing he was effectively arguing against an approach to designing which sought to exploit consumers by producing products which functioned poorly and needed replacing within a short period. Such products failed not only to meet users' real needs, but also their expectations and wants.

Of course he was complaining about one extreme type of designing. There have always been other approaches, as witness the concern for design integrity and social context in the craft tradition of such as Ruskin and Morris. And contemporary with Papanek, in his work on design methods, Jones highlighted connecting with users, interviewing them and understanding their needs as core methods for exploring design situations (Jones, 1970). There have been more ethical and user needs based approaches to designing for many years.

The second half of the twentieth century also saw the development of the science of ergonomics. This is the study of areas in which a human interacts with a machine, product, system or aspect of the designed environment. By understanding human characteristics, ergonomists can inform the design of products and environments so that they better fit the individual's way of working and behaving. Clearly this has the potential for being of immense use to designers.

Inclusive design is an approach to designing which also developed in this period. It was a reaction to the perceived shortcomings of design for mass production, in which consumers were seen as 'universal types' rather than individuals (Coleman et al., 2007). By its very nature such an approach excludes significant numbers of people, such as the young, older people and those who have disabilities. In the West there has been an increasing articulation of the rights and needs of such groups, and a realization that with improvements in health care and people living longer, such groups were increasing in size. Inclusive design provides approaches for the consideration of the needs of these groups both within design strategy and in product audit.

Thus if design is to be approached with the starting point of 'design for the user' then it needs to incorporate both the methods of ergonomics, and the approaches to inclusion which ensure that the full range of users is

accommodated. Designers, companies, governments and others all have a role in addressing this.

The Car Industry in the Twenty-First Century

Clearly the car industry has a major part to play in any consideration of design for transport. So how is it faring in the twenty-first century, and how does it measure up?

Despite unprecedented events until recently the global automotive industry was continuing to grow worldwide at about 2.5 per cent annually, driven by increased car ownership in the developing countries. In the mature Western economies growth has been much lower or absent. The great majority of the growth in capacity has been in the BRIC countries (Brazil, Russia, India and China), or within the European Union in Eastern Europe (New Automotive Innovation Growth Team/Parry Jones, 2009; PricewaterhouseCooper, 2007). Much of this has been because of their location closer to the relevant markets, or because of local content restrictions imposed by governments. There has been a move of manufacturing to these countries not least because of their lower labour costs. This has mainly affected the automotive supply base, and has had less impact on the location of vehicle assembly sites.

Currently the industry faces the challenges presented by the global economic downturn and recession (King, 2008; Stern, 2006). Prior to this it was already facing the enormous challenges of global overcapacity, unsustainably marginal and inconsistent profitability from many companies, and increasing pressure on reducing vehicle emissions, especially CO2. However, the advent of the worst downturn to hit the car industry for decades has brought the position into much sharper focus. There has been a marked acceleration in the trends to capacity reduction, fixed-cost streamlining, consolidation and restructuring.

In Japan and Europe, industry's response to this has been to invest heavily in productivity, using such devices as modular design, the development of flexible manufacturing technology and training a highly skilled shop-floor workforce. The research and development of new technologies has been directed to reducing dramatically HC, NOx, particulate and more recently and most importantly CO2 tailpipe emissions.

The current state of vehicle usage is that cars provide 90 per cent of all passenger transport needs and commercial vehicles over 90 per cent of all

freight transportation needs (New Automotive Innovation Growth Team/Parry Jones, 2009). Because of the particular advantages of cost and convenience it is unlikely that this overall emphasis will change except in very congested urban areas. Although within such areas there is considerable scope for switching modes to much greater use of public transport, and hence congestion alleviation, it seems unlikely that this will offer a wider and more general solution outside such areas. It seems more likely that the vehicles used will undergo a technological transformation, to provide solutions which are in line with consumer preference, and in line with the climate change agenda, to provide a low-carbon personal transportation system.

Such a transition will not be easy. In Europe the EU regulatory framework is directed to achieving major reductions in CO2 emissions. This provides the basis for forward technology planning for most manufacturers. This is essentially an intervention aimed at making it obligatory for such manufacturers and importers to conform to CO2 emission levels of a mixed fleet of new vehicles. What has not been developed is the complementary array of incentives to consumers to overcome the cost and price barriers to the large-scale adoption of such new technologies.

Two of the main directions being followed to achieving new low-carbon products are those which facilitate the development of more efficient power trains to make better use of fossil fuels, and those which involve more advanced technologies to facilitate the shift to clean electricity.

In Europe in the recent past the greatest legislative pressures from the EU have been on vehicle tailpipe emissions, crash, noise and safety performance. More recently there has been an increasing emphasis on CO2 reduction as the greatest driver for change. The timeframe for this is 2012 to 2020. This is likely to have a major impact on the vehicle market. The public perception is both of the overwhelming importance of the challenge of global climate change, and for individual nations the need for energy security. The need is to provide low-carbon solutions which meet actual transport requirements.

It can be argued that it is important that the reduction in CO2 emissions be evaluated holistically. Currently the performance of vehicles is measured on the so-called tank-to-wheel (TTW) assessment of CO2 emitted over the New European Drive Cycle (NEDC). Within this framework there is great advantage in moving to electric vehicles. However, there is merit in considering a more thorough measurement method. This is the well-to-wheel method (WTW) which takes account of the CO2 emitted in the production of energy such as

the fuel or electricity (Woudhuysen and Kaplinsky, 2009). Energy maps reveal that the greatest source of CO2 emissions is electricity production. So the only way in which a move to favouring electric vehicles makes sense is if it is accompanied by a very serious commitment to clean electricity generation. Overall it is worth paying attention to the energy consumption throughout the lifecycle of the product.

The designer's role in the automotive industry varies from that of the industrial designer to the design engineer. The former typically visualizes the design, and leads on user needs, in ergonomics and aesthetics (Tovey, 1992). The latter has a wide range of responsibilities for the technology of the product. Conventionally they complement each other. However, much of the response to the low-technology agenda requires innovative engineering design, in the technology of hybrid, electric and fuel cell vehicles. Similarly these new devices provide a different user needs agenda for the industrial designer. For this to amount to an overall approach which is sustainable and inclusive requires both a company philosophy which is open to such considerations and a legislative context within which they cannot be avoided.

Transport More Widely

In looking at design for transport we consider a number of different approaches. These include the specialist approach required in tackling different types of product, from standard motor cars to microcars and bicycles, and for transporting groups on public transport. These devices fit into systems which, we contend, should themselves be designed for customer convenience, as transport interchanges and as examples of information design. Further all users of transport could make use of the radical communication technology which has the potential to transform their ability to engage with the range of transport devices, and to optimize their mobility.

The professions of transport design have grown with the development of transport technology, high-density living and complex patterns of movement. From being the province of individual specialists such as entrepreneurial engineers, creating new products has become a team responsibility with a key role for designers who can conceptualize the product and represent the users to ensure that their practical and emotional needs and wants are addressed. For transport products these are now established professions with their own vocabularies and communities of practice (Tovey and Bull, 2010).

These are activities which typically put designers alongside variously teams of specialist engineers, ergonomists, planners and others to tackle issues which are both difficult and exciting. Most designers appear to be motivated by an obsession with transport problems and transport technology which they attempt to convert into creating devices and solutions which are themselves attractive and exciting. What many users appear to want is transport which both works for them and which adds to their enjoyment of life. The evidence shows that users want several things from their transport system, placing different weights on their relative importance, but highly valuing journey time, journey time reliability, cost, network coverage, comfort, safety and security (Eddington, 2006). Other evidence indicates that consumers want their transport products to excite and delight them (Horbury, 1998).

The Design Process

The process which designers go through is at its simplest level generic. There is a movement from an initial brief through a combination of processes at the end of which there is a credible new design proposition.

A lot of what designers such as automotive designers need to know is specific to their specialist area. They are expected to understand and be familiar with current and past practice in car design, with the relevant technology, legislation, vehicle human factors and a whole host of domain specific information and skills. There are equivalent areas of specific understanding which characterize all other areas of design. In the context of transport areas such as bicycle design, design for public transport, information design, IT systems design, transport systems and interchange design all have their own areas of specialist knowledge, domain related skills and characteristic capabilities. These are what make each design discipline distinctive, giving it its specific identity.

However, there are core similarities across specialist design areas. After all they would not be called ‘design’ if they did not share with each other a common pre-occupation with solving design problems. A good generic definition of design which signals what this core activity is appeared in the Cox Review (Cox, 2005).

The ‘Cox Review of Creativity in Business’ appeared in 2005. In it Sir George Cox defined design as follows:

> *Design is what links creativity and innovation. It shapes ideas to become practical and attractive propositions for users or customers. Design may be described as creativity deployed to a specific end.*

This core process makes the design activity different from the processes of social or scientific analysis which are central to other disciplines. It implies a whole way of understanding the world and responding to it. This has been characterized as the 'Designerly Way of Knowing'.

Designerly Thinking

In the *Designerly Way of Knowing* (Cross, 2006), Cross characterizes design as an activity involving tackling 'ill-defined' problems through a 'solution-led' problem-solving approach. Designers employ constructive thinking by using codes to move from the abstract to the concrete and deploying these codes as an object language. Cross makes a number of useful and relevant observations about the design cognition process, noting that designers are solution-focused not problem focused. The designer's attention oscillates between the problem and its solution, in an appositional search for a matching problem-solution pair, rather than a propositional argument from problem to solution. It is probable that design thinking operates with two simultaneous interacting cognitive styles being employed. Thus it would be expected that an analytic, linear strategy would be at work in the process of data generation and organization to yield a design specification, and also in the evaluation of design proposals. In parallel with this a synthetic-holistic strategy, used in the generation of solution conjectures, would be the integration of visual relationships and the physical representation of the design as drawings or 3-D models.

These two interacting lateralized mental operations can be used to map out design thinking in what Tovey has called the dual-processing model of the design process (Tovey, 1984). In it there is the assumption that the two halves of the brain will both be involved in solving the design problem, each half working in its own preferred information processing mode, each tending towards its favoured modelling language, the left in words and symbols, the right in drawings and 3-D models. It is likely that design thinking has at its core these two parallel and interacting modes of thought. One of these is analytic and linear. The other is synthetic and creative. Handling 'wicked' problems depends on an appropriate match of the two modes. Thus there will be a balance between analytical processes such as information and data gathering, optimization and evaluation, and creative, solution-focused and integrative activities.

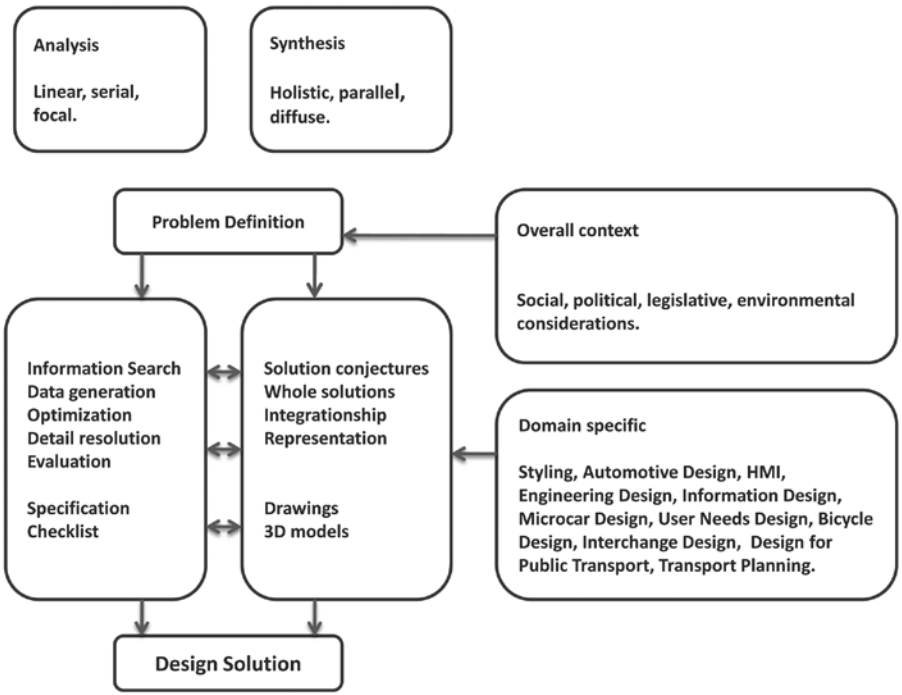

Figure I.1 The design thinking process
Source: Permissission of author.

Designers tackle problems which tend to be ill-defined, ill-structured, or 'wicked' and they may not have all the information necessary to solve them. To cope with this lack of information, experience indicates that the quick production of a draft solution will allow a definition of the limits of the problem and the provision of a basis for developing an idea or ideas further. The production of a solution conjecture at an early stage in the process could be said to facilitate the re-examination of the problem by providing the spectacles through which to look at it. The designer is able to tell where she or he needs more data because without it the design cannot move forward. In some areas of design this solution-focused strategy is fully formalized in the way in which the design activity is managed; for example at an early stage in the process there will be a requirement for a 'Concept Design' which is the designers' attempt to provide a sketchy representation of what the finished design might be, or might look like. If the designer or design manager sees the concept as providing a basis for proceeding then the structure of the rest of the process falls into place. This is the solution-led approach, which has, at its core, the process of moving from

an abstract statement to a visual object. The designer learns to think in a sketch-like form, in which the abstract patterns of user requirements are turned into the concrete patterns of an actual object. Thus the designer uses a code to effect this translation from individual, organizational and social needs to physical artefacts. This is the use of the language of designing, employing its translation codes, and is the match of the analytical statement to the holistic solution. The manifestation of this outcome will be a visual representation, a drawing, a 3-D or virtual model.

The Design Family

This refinement of the core process of designing has been developed in a context of a family of design activities each with its own history and traditions. Walker (Walker et al., 1989) has developed a representation of the range of design specialisms which gives some sense of their historical development, and shows diagrammatically the interrelationships between design disciplines. It has its roots in traditional craft skills and methods such as drawing, modelling and simulation, to show how it has spread into more specialized activities. It ranges from graphics and fashion, which rely on artistic sensibilities to science-dependent activities such as engineering and electronics. Some designers may spread across more than one area, and others may be more narrowly active. This helps us to understand the diversity of design and understand its interrelationships and development (Cooper and Press, 1995).

To illustrate the range of transport design disciplines and their relationships I have mapped them onto a version of Walker's tree diagram (see Figure I.2 on the following page).

Design Initiation from the User Perspective

Approaching the design problem from the point of view of the user is not an unfamiliar process for the types of designer included in this volume. The role of the automotive designer is to lead on the ergonomics and aesthetics of the product, and typically this includes attempting to perceive the product from the user's perspective through focus groups or mood boards. Bicycle designers have to consider the cyclist and machine as an integrated system. Similarly in public transport the designer champions the passenger, and in transport planning and in interchange design the needs of the traveller should be fore-fronted.

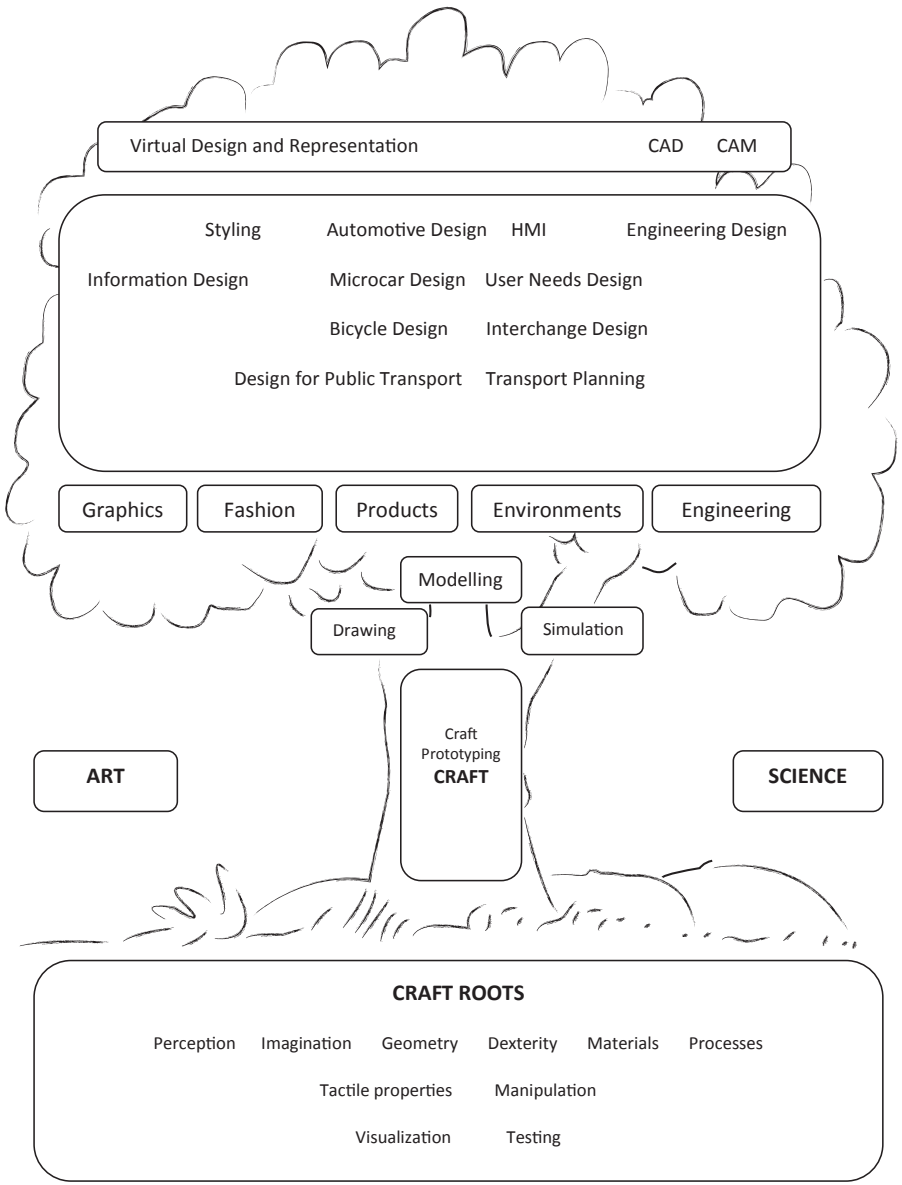

Figure I.2 The design family tree
Source: Permissission of author.

Information design exists to assist the traveller, and of all the types of design considered here it comes closest to facilitating user-choice. All of the others assume an initial decision, to travel by public transport, or by bicycle or by car, and then provide a designed product or system. But of course the user

makes such a decision, either following deliberation or through habit, to opt for a particular transport mode. Typically such issues as journey time, reliability, cost, range, comfort and security will figure (Eddington, 2006). For users there are a number of self-evident initial decisions, such as where do I want to go, do I want to return, do I want flexibility, am I carrying anything, or bringing anything back? Similarly the user may be in a group, and could be delivering or collecting someone, such as children, parents, relatives or friends. She or he may be travelling for business, social or other personal reasons. It may be critical that her means of travel be secure and reliable. Or she or he may be using a car, bike, or rail simply for pleasure. Then there are economic considerations, such as is the preferred choice affordable? And of course a responsible citizen will ask whether or not the planet can afford this choice? Can these ambitions be achieved without increasing our carbon footprint?

One or more of these considerations can provide the stimulus for design which links creativity and innovation by building on a perception that what is currently available is unsatisfactory or could be improved on. The purpose in designing is to replace what we have currently with something better and as such this is the generic starting point. More particularly the articulation of 'creative dissatisfaction' can provide both the primary generator for a new design (Darke, 1979) and the direction for solution-led thinking.

Of course one creative solution to transport problems is the development of communication technology to make travel less necessary. If we can access information on-line, or have conversations without meeting face-to-face, then travel may not be needed. Clearly designers have a role in devising such systems. However, they are beyond the scope of this book.

What we attempt to do here is to show how creative designers can take a user-focused approach for a wide range of types of transport products and systems. In so doing their starting point should be one of creative dissatisfaction with what is currently available, and their specialist capability is in imagining and developing new solutions which respond to that opportunity. How this is tackled varies depending on the context, and the variety of solutions produced reflects the different aspirations and needs of the people they are designing for.

The Structure of the Book

The book is organized as a collection of specialist chapters, each by an expert in one or more area of design for transport. Because of this diverse authorship

there is variation in style and tone, reflecting the different positions the authors occupy. Although most of the chapters work as self-standing documents, the intention is that the cumulative effect should enable the reader to develop a greater overall appreciation of the character of design for transport, of the limitations it faces and of the creative opportunities it presents.

The chapters are grouped into sections as follows:

- User Needs and Transport
- Design and the Transport System
- Transport Design Case Studies
- Transport Design: The Case for the Automobile
- Conclusions: Transport Design in the Future

USER NEEDS AND TRANSPORT

Because the stance the book takes is one of emphasizing user needs as the initiating force for developing transport design solutions, the chapter which focuses on person-centred transport design is placed first. In it the key role which ergonomics plays in the process of identifying and designing for user needs is described. It is argued that a user or human-centred approach is critical to all levels of transport design, from the setting of transport policy, to its implementation, through to infrastructure, vehicle and interface design. All need to proceed from an understanding of user needs.

One of the principle concerns of the human-centred approach is the design of the user interface. A key ingredient is the provision of information through the interface to enable the user to make the journey. This needs to be accomplished so that it is not only accurate and comfortable, but also an enjoyable process. This issue is addressed in the second chapter on person-centred information design for the traveller.

DESIGN AND THE TRANSPORT SYSTEM

These chapters are concerned with the context in which the journeys occur, in transport planning and in interchange design. Transport planners have

a key role to play in employing design thinking to shift from an approach of responding to 'what is' to seeking 'what could be' in order to meet user needs. Transport planning is in a state of creative dissatisfaction as it attempts to change from an approach which largely took for granted the factors that generated traffic growth, into one that seeks to meet and manage transport demand. Within any transport system the interchanges when travellers change modes are crucial to the success or failure of the system. They represent the pinch points, and their design, along with good information design, are key ingredients in facilitating satisfactory journeys. Transport interchanges such as rail stations are where different public transport systems meet, and where private transport interfaces with public transport.

TRANSPORT DESIGN CASE STUDIES

The greatest use of designers in the transport domain is in the design of vehicles. For land transport these include both public transport and personal transport. How the design is approached for a range of devices is illustrated through case studies beginning with the general case of design for public transport.

The importance of low-carbon transport is emphasized in the next three chapters. The example of bicycle design is given as a 'complete' design problem, one in which the user and the machine operate as one system. It is used to illustrate a range of design strategies, which designers have employed to move from creative dissatisfaction to developing creative and innovative solutions. This is complemented by the chapter on microcars in which there is a description of the astonishing range of alternative proposals which have emerged from the attempts to create designs for the minimal lightweight motor vehicles which would have both a smaller carbon footprint, and a smaller operational footprint than the conventional motor car. The particular case of Microcab is used to provide a detailed example of the design of such an alternative vehicle.

TRANSPORT DESIGN: THE CASE FOR THE AUTOMOBILE

As has been illustrated above, a significant proportion of our transport needs and desires are likely to be met by automobiles for the next few years. It is anticipated that the environmental, social and political context for their production and use will require vehicles with a much smaller carbon footprint. They will need to be influenced by alternatives such as microcars. However, because of the industry's dominance we devote our next four chapters to

describing the role which designers have in the car industry, identifying both their importance and the limitations of their influence. Although it is clear that without good industrial design and good engineering design any particular model of automobile will not succeed, nonetheless the designers' influence should not be overestimated. Each new model requires huge levels of investment and many are involved in the process. There is a very high level of demarcation of roles and the specialist character of automotive design is illustrated by the chapter on their community of practice. The chapters on their functional roles within the design process are intended to give a clearer indication of what they contribute and how, with examples from Ford, Land Rover, and a 'supercar'. The description of their role in designing the interface is intended to re-affirm the central premise of this book and to demonstrate that even in an industry as cumbersome as this, it can address the user needs which the alternatives to the IC engine are presenting.

CONCLUSIONS: TRANSPORT DESIGN IN THE FUTURE

The final chapter considers the direction transport design might take in the future. Of course all design is about the future, about creating devices and systems which will be used in years to come. In the case of transport design this can mean for many years to come, given the scale of investment often required. However, that does not mean that how designers undertake their designing can stay the same. If design does not change then designers will continue offering solutions to today's problems, rather than what they should be doing, which is anticipating tomorrow's.

One conclusion is that if transport design is to be better future-proofed then designers need to acknowledge the wider context within which they operate. Designing is already a team activity for any but the simplest products and systems. Increasingly it will need to be multidisciplinary, with designers working with other specialists. This will be necessary not only to ensure the sustainability of the technology produced, but also to match the product better with its context, and the environment in which it will be used. So transport designers will need to be working differently from the way they do now, and design education will have a key role in producing designers able to do this.

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