AFFECTIVE DESIGN
(Kansei Engineering)
IN JAPAN

A Report from a DTI International Technology Service Mission

dti
Department of Trade and Industry

sponsored by The Faraday Packaging Partnership
歡迎
EXECUTIVE SUMMARY

New products introduced by consumer goods companies operating in many market sectors are often not as successful as expected even though they are functionally reliable and produced to a consistent standard. They do not seem to connect with the feelings of customers who are rejecting anything that does not truly satisfy them in the way that they want to live.

The Japanese realised earlier than most that their product development methods just did not reveal the deep insights into customers’ feelings that enabled emotional needs to be satisfied. They have developed methods and tools to overcome this, supporting the creation of products targeted to meet those needs, that they call Kansei Engineering. This report is about a mission to Japan to study that. Experience of the use of Kansei Engineering was sought from the food and drink (Asahi Breweries Ltd.), packaging (Toppan Printing Co. Ltd.), building products (Matsushita Electric Works Ltd.), cosmetics (Shiseido Company Ltd., Milbon Co., Ltd.), electronic products (Seiko Epson Corporation) and automotive (Mazda Motor Corporation) sectors, and from three Universities (Hiroshima International, Shinshu and Tsukuba).

The Companies confirmed to us their belief in satisfying both rational / physical and subjective / psychological human needs in products, and all think that Kansei will become more important. Kansei Engineering was defined as the translation of consumer feelings and images into design elements. The main established tool is analysis of users’ self-report reactions to products and prototypes, in many cases at a depth far beyond anything common in the UK. The situation is not static. We also saw trials of subjective psycho-physiological test methods and these are set to grow. There is also emergence of an applied art / psychology / neuro-science research activity into understanding the human-artefact interface, currently more directed to Information Society Technology (IST) products but in the longer term likely to feed back its knowledge more generally to all manufactured products.

In a number of cases, the Companies operated a Quality Function Deployment (QFD) approach and had successfully integrated Kansei Engineering into that. Their underlying philosophy was to minimise intuition in design decisions and to maximise understanding of all aspects of their products, in a systematic way.

Our observations of the successes and workings of Kansei Engineering lead us to recommend both short and longer term activities in the UK. In the short term, a programme of case study research trials should be launched, based on the current Japanese methods, to assess the benefits to the UK, in the different organisational and financial context here. In the longer term, more research into the human-product interface will surely become applicable generally to products and packaging.

We wish to acknowledge the support and financial assistance of the International Technology Service of the Department of Trade and Industry, with that of the Science & Technology Section of the British Embassy Tokyo, that made this mission possible.
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BACKGROUND

The Faraday Packaging Partnership exists to strengthen the competitive position of its member companies through research and innovation. In the area of design, members report that the rational technologies and tools that support achievement of functionality and usability in new products are certain and swift in their results but products that are functional and usable may not sell. The frontier of consumer goods design is at the emotional and cognitive or affective human-product interface. There are both threats and opportunities there. The issues are generic, spreading beyond packaging to all consumer products.

The Threat

As customers come to take for granted that a new product or packaging will function well and be usable, failure to compete in the area of delight, affect or aesthetic beauty increases the risk that a new design will make no impact and fail in the marketplace.

The Opportunity

Better understanding of the mechanics of delight and how to integrate aesthetic beauty into design, on top of ergonomic and engineering beauty, becomes a driver of improvement, creating competitive advantage.

If a product is not a success, to blame someone else is an easy option; ‘the brief was not clear enough’ or ‘it looked good but didn’t work’ the industrial or engineering designers might say. But to develop tools and working methods with a reduced risk of failures must be a better response. Claims are made in Japan that Kansei Engineering, developed there, provides the basis for such tools and methods. This report describes a visit to leading practitioner companies and university researchers in Japan, to explore and report back on what is Kansei Engineering and could it be adapted to the benefit of UK companies. The members of the mission are six managers with packaging innovation responsibilities from the fast moving consumer goods, pharmaceutical and retail sectors, and from Pira International, and two academics of the Faraday Packaging Partnership.
THE VISITS

The views expressed in this report are developed from visits to the following companies and universities, recommended by local knowledge in Japan.

**Asahi Breweries Ltd.** with an Institute of Lifestyle and Culture. Dramatic turnaround in 1987 on release of ‘Super Dry’ – attributed to breaking the mould and marketing on taste.

**Shiseido Company Ltd.** 4th ranked global cosmetics manufacturer, creative integration philosophy for functional and aesthetic design to create true ‘integrated human-science products’.

**Toppan Printing Co. Ltd.** Printing, packaging & electronics company, net sales $10bn/year, providing universal and kansei design services and lifestyle trends analyses for its customers.

**Seiko Epson Corporation.** Global company with mature range of products; Design Centre moving to focus on product differentiation by brand and customer likes and taste.

**Matsushita Electric Works Ltd.** Leading maker of building products and lighting equipment, using kansei to build human satisfaction more soundly into products than by intuition.

**Milbon Co. Ltd.** Comprehensive manufacturer of hair cosmetic products for hair salons, applied Kansei Engineering as a trial to a new product range in 1999 and made a success in the market.

**Mazda Motor Corporation** – achieving a coherent brand image (brand DNA) through world-class integration of engineering, ergonomic and kansei/aesthetic design.

**The Universities.** Hiroshima International – the ‘father’ of Kansei Engineering’s current base; Tsukuba – centre of new-wave kansei; Shinshu – developing kansei tools in textiles arena.
Many design movements are addressing human-product interface issues. Some brief definitions and descriptions set the scene for later detail.

**KANSEI ENGINEERING**

Kansei Engineering, developed in Japan from the 1970s, is defined by its originator Nagamachi as a technology for translating a consumer’s feelings and image of a product into design elements. Kansei in the Japanese language contrasts with Chisei. It is the subjective feeling and aesthetic part of our mind-set, as opposed to Chisei’s rational knowledge set. Both together determine how we interact with the world around us. Today, the original design focus of Kansei Engineering is expanding, to what might better be described as kansei science – integrating with psychological and neurological researches to increase understanding of our subjective and aesthetic reactions.

**UNIVERSAL DESIGN, INCLUSIVE DESIGN, DESIGN FOR ALL**

Universal or inclusive design (sometimes called design for all) has its roots in industrial design in the USA in the late 1980s concerned to provide a satisfying life style for people of all ranges of abilities. It has a 7-point set of guidelines for achieving that, including that products should be usable and appealing to all, not segregating or stigmatising users in any way, including provisions for privacy, security or safety. The industrial design community has developed contextual and immersive working methods to support universal design. Its original focus was rational usability but it can be thought of as overlapping kansei aims through its inclusion of appealing within its guidelines.

**AFFECTIVE HUMAN FACTORS DESIGN, AFFECTIVE DESIGN, AFFECTIVE ENGINEERING**

Ergonomics has traditionally concerned itself with cause and effect relations between products and human performance (as measured by responses to tasks or by physical pain). It is expanding its remit to include emotional relations with the phrase cause and affect, in contrast to effect. A new international conference series, Affective Human Factors Design, has been initiated, with the 2nd conference in 2001 attracting ergonomist, psychologist, philosopher, information technologist and sociologist delegates – but few engineers. The term affective design is a shortening of this; and affective engineering may not be so different from kansei engineering.

**HUMAN-CENTRED DESIGN**

‘Human-centred design processes for interactive systems’ is the title of ISO 13407:1999. It supports managers of hardware and software design projects, and reflects realisation of the importance of users in human-computer interface design. It advocates (see below) specifying the context of use of an identified need, translating that to requirements, producing and evaluating design solutions and iterating until a satisfactory solution is attained. It offers a process but does not consider the methods for use within it. Its context is strongly usability ergonomics, but it could equally be applied to affective issues. Engineers would recognise ISO 13407 as generic if its title were simply ‘design processes’.

**A COMMON THEME**

Engineers, industrial designers, ergonomists and information technologists accept that the product-human interface has both rational and subjective elements. Kansei Engineering, Universal Design, Affective Design, Human-Centred Design are the different communities’ responses to this. The mission to Japan that is the subject of this report has found that practitioners there do not distinguish strongly between the viewpoints. They draw on all as they see fit.

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**SOME EXTENDED DEFINITIONS WITH A COMMON THEME**

Identify need for human-centred design

Understand & specify the context of use

Specify user & organisational requirements

System satisfies specified user & organisational requirements

Evaluate designs against requirements

Produce design solutions

after ISO 13407
The previous pages have been written in part with hindsight. Beforehand, the objectives of the mission approved by the Department of Trade and Industry, with a list of questions supporting them, were as follows. With hindsight, the questions are not all appropriate, but our overall purpose has been achieved - as is set out in the remainder of this report.

Objectives
1. To learn and understand the current state of the art of affective design and its application within the Japanese industrial and academic communities.
2. To explore the impact of this approach, commonly referred to in Japan as Kansei Engineering, across a diverse range of industries and to assess its potential impact, particularly on the UK packaging and consumer goods industry.
3. To provide senior managers with first-hand opportunities to meet experts within Japanese industry and assess the potential impact and benefits to UK industry that affective design could achieve.
4. To disseminate this information throughout UK industry, not only within the packaging and consumer products area but as widely as possible to all sectors of relevant industries.

List of Questions
1. **Historical development of subject area**
   - What is Kansei Engineering
   - How do you view it in relation to the term ‘affective design’
   - How did it develop - market demand or curiosity led
   - What were the key contributions or milestones in improved understanding
   - Where are the centres of excellence - academic or industrial
   - What are the advantages/disadvantages relative to traditional methods

2. **Current status**
   - What is the prevailing Japanese view and how does this compare with your understanding of the global position
   - What specific technologies or processes are at the heart of Kansei Engineering
   - Is it suited to some particular industries more than others
   - Is it specifically unsuitable for some industry sectors

3. **Commercial impact**
   - Where does it sit within business process engineering
   - How has it impacted on your business position
   - Have you been able to measure or quantify its effect
   - How has it impacted on Japanese markets compared with overseas markets
   - Is it suited to some particular markets or product areas more than others

4. **Implementation in business process**
   - What is your Kansei Engineering process specifically
   - Where does it sit in the overall product development process
   - How does it impact on people skills
   - Does it require a cultural change to designers
   - What is the impact on materials and manufacturability
   - Are there any links to environmental issues or disposability

5. **Research topics**
   - What are the topical current issues
   - What are the key research challenges
   - What are the leading journals/conferences

6. **Way forward**
   - How do you predict the subject developing
   - Is anything hindering its development as an academic engineering topic
   - Is anything hindering its uptake by companies
歡迎
KANSEI ENGINEERING IN JAPAN - FACTS FROM THE VISIT
foundation decade, c. 1975 – 1985. Kansei Engineering’s roots may be traced to Hiroshima University’s Faculty of Engineering. Professor Nagamachi, with a psychology and medical school education, was appointed to the Engineering Management group there in the early 1970s, with a brief to develop an emotional ergonomics for product design. He described it as emotional technology. At first, he focussed on interior design, with studies of lighting and colour effects on room atmosphere. By 1985 he was publishing jointly with Matsushita Electric Works in this area. 1986 saw the emergence of the expert system HULIS (Human Living System) supporting that.

growth decade, c. 1985 – 1995. The word kansei, different from emotional in the original Japanese, was first used in 1986 by K. Yamamoto of Mazda Motor Corporation. The term Kansei Engineering was soon adopted by Nagamachi. In the decade to c.1995 he created many statistical and knowledge engineering systems, based on self-report, to elicit users’ kansei and feature – affect product relations and embed them in computer-based design support tools. Applications spread to automotive (Mazda, Nissan), apparel (Wacoal, Goldwin), electronic home product (Sanyo, Sharp), office machine (Fuji, Canon), cosmetics (Shiseido) and other sectors. In 1996, Nagamachi retired from Hiroshima University to become President of Kure National Institute of Technology. He is now Dean of the College of Human and Social Environment at Hiroshima International University.

new wave, c. 1995 – now. Nagamachi’s Kansei Engineering has continued its growth in design. But the last 10 years has seen new departures, led by others, linking with robotic intelligence, psychology and neural sciences. 1997 saw the start of a 5-year Ministry of Education ‘special research project of modelling the evaluation structure of kansei’, led by Professor Harada at Tsukuba University, which has generated Western links e.g. with Carnegie Mellon, IIT, MIT MediaLab and Delft IDStudioLab. The Japan Society of Kansei Engineers, formed in 1998, now has 40 group members and publishes an international journal in English. Kansei in Japan has broadened to take on a mainstream sciences, arts and humanities transdisciplinary role.

a brief speculation on the future. Kansei Engineering in Japan has developed in parallel and is now an integrated part of the new product development process, within for example what engineers would recognise as stage-gate and Quality Function Deployment (QFD) activities. Its current status of responding to observed emotional responses might be classified as passive emotional design. It is sometimes criticised outside Japan as lacking the imagination of the best industrial design. Some of the case studies next - with kansei and industrial designers working together - will show this criticism to be a misconception. And it is not too hard to imagine a future kansei science returning to support enhanced active emotional design.
CURRENT STATUS - NAGAMACHI’S PROCESSES, COMPANY ADAPTATIONS & EXTENSIONS

This section is organised round information from the visit to Professor Nagamachi at Hiroshima International University, 555-36, Gakuen-dai, Kurose-cho, Kamo-gun, Hiroshima 724-0695 on 6 December 2002. Additional general information is added from the company visits. It prepares for the more detailed company case studies described later. It reviews the kansei background to the techniques observed across the seven companies visited. A number of the techniques employed are familiar to UK industry e.g. qualitative consumer research focus groups and semantic mapping. However we believe that Japanese companies follow through more rigorously examination of their consumer preference data, applying statistical and scientific analytical ‘Kansei Engineering’ tools, to understand fully and act on end user requirements. During the visit, the team was impressed by the wide range, number and connectivity of tools that were being used in the product design process.

Professor Nagamachi developed a three-stage Kansei Engineering process: the gathering of customers’ kansei data about a product class; analysis of the data; and synthesis into design tools and / or working methods. Each of these stages in turn has sub-elements and variants. Gathering involves decisions on what data to collect as well as how to collect them. Analysis includes analysis of the data’s internal organisation as well as of the data’s relationship to the product design elements that prompt it. Synthesis is the most varied, with Nagamachi claiming numerous separate implementations. Advancing technology, particularly computer and information technology, but also physiological measurement methods, continues to drive the evolution of kansei methods. Nagamachi himself favours the sensitivity of verbal self-report data gathering methods over psycho-physiological methods but companies are starting to experiment with the latter. The methods of self-report themselves are becoming more sophisticated on the back of computer science advances. Analysis spans from linear regression to neural network and fuzzy logic methods. Synthesis has advanced from 1980s expert systems to web-based virtual reality systems. On top of all this, companies seamlessly combine Kansei Engineering with other human-centred movements, such as universal design, and with relevant tools from other sources of design, such as Quality Function Deployment (QFD). It is the many strands of this story that are briefly reviewed here.

But, before describing the elements, the main benefit claimed for Kansei Engineering as a whole should be brought to the front. Nagamachi describes Kansei Engineering as customer rather than company led. On several of our visits (e.g. M ibon, Shiseido, M atsushita) companies said that Kansei Engineering enabled them to include users’ feelings in new products more certainly than did designers’ intuitions alone. Some Western observers have taken comments of this sort to be ‘anti-designer’. But the best practice that we saw drew users and designers together in iterative improvement. Companies think that investing their own effort early in product development to learn more about the human-factors that their products should support pays back by reducing market failure risk. If anything, Kansei Engineering in Japan is anti ‘contracting out’ product development. One company said that it sub-contracted to a design agency only if it was sure it already knew everything about its product.

DATA GATHERING TECHNIQUES: SELF-REPORT

The oldest form of gathering data about feelings for products is to ask people to report their feelings in adjectival words. This requires some way of choosing the words and then asking people to express their feelings using those words. The development of self-report data gathering has followed a path of giving people more and more freedom of how to respond, from requesting responses to isolated words, through asking for completion of prescribed sentences, to recording people’s free speech about a product. It is the environment of self-report that will be most familiar to UK industry, with wide use of consumer focus groups (e.g. Asahi), using feedback from loyal customers / expert users of the brand (e.g. dialogue with hair designers by M ibon) and companies having their own consumer evaluation room and other test facilities (e.g. Seiko Epson, M azda).
ADJECTIVES AND SEMANTIC SCALES. Nagamachi describes the selection of kansei adjectives as the starting point of Kansei Engineering. The initial search for the words should draw on all sources with any interest in the product – obviously consumers and designers and the product or brand owners, but also words should be taken from lifestyle or other appropriate magazines, mail-order catalogues and from conversations with retail store personnel. A search typically throws up in excess of 100 words. This is too many to cope with as far as asking people to assess product examples in terms of the words. There is a preliminary stage of reducing the words to a more manageable number, maybe around 20, as outlined in the DATA ANALYSIS section. But then a test group of people is asked to score a number of product examples in terms of the selected words, using usually either a 5-point or 7-point semantic scale. The scores become the raw data for kansei analysis. To reduce ambiguity in the meanings of words, antonyms are not used to define the end points of scales. For example, scoring on a scale of hardness, endpoints ‘hard’ and ‘soft’ are replaced by ‘hard’ and ‘not hard’.

Nagamachi in his published academic papers has typically described examples using group sizes from 10 to 30 people, and product numbers from 30 to 40 (car instrument panels, watches) to 80 (beer can graphics, women’s suits) – and sometimes over 100 (door handles). Almost all the companies that we visited were using semantic scales (certainly Asahi, Toppan, Seiko Epson, Matsushita, Mazda) but our impression is that they used fewer words and many more people. Companies generally would not disclose their lists of words, saying these were their intellectual property, closely supporting product development strategies. Figure 1 gives an academic example of a kansei word collection (for wristwatches). The word loadings and watch scores are considered under DATA ANALYSIS.

TEXT COMPLETION AND FREE-RANGE SPEECH RECORDING. Mazda, Milbon and Shiseido gave us examples of self-report methods that were more sophisticated than completing semantic scale questionnaires. Data from text completion methods are being used to establish what is important to a customer and what aspects of a product are perceived to deliver what affect; and also to clarify meanings of words (one of the shortcomings of self-report is word ambiguity). For example, Shiseido widely uses sentence completion e.g. ‘In general, foundations are (comment) and my ideal foundation is (comment), but this foundation is (comment)’, and more complex text completing methods ‘because my foundation has (some characteristic) it has (some result) and gives me (some feeling)’, as well as employing standard open questions such as ‘what are safe cosmetics for you?’ Milbon in particular makes a great effort to ensure

Principal Component Loadings of Kansei Words
(Watch)

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Figure 1. Original kansei words for watches (above), their principal component loadings (left) and watch examples (right), after Nagamachi.
it understands what its hair designers mean when they use everyday words such as ‘soft’ in a professional application context. Free-flowing speech about their products is recorded by both Shiseido and Mazda as a means of determining what most interests customers in their products, what are impressions of products, and to differentiate between groups of customers.

**DATA GATHERING TECHNIQUES: OTHER METHODS AND SOURCES**

We also found company examples of data gathering other than by self-report, both by sub-conscious and physiological methods. Video-recording to observe facial expressions and body language is used by Seiko Epson and Mazda. These companies also use eye-tracking cameras to record eye movement and dwell time, to gauge which objects and elements of objects are of most interest to users. Muscular loads measured by electromyography (EMG) and hand-grasping stresses by sensor-instrumented gloves were described by Seiko Epson, Shiseido and Mazda, for evaluating ease of use of products and evaluating touch and texture phenomena. This last group of methods is almost traditional ergonomics except that links are being sought between output signals and users’ subjective feelings of comfort. In keeping with this continuous spectrum from effective to affective ergonomics, various companies (e.g. Matsushita, Shiseido) are using government databases for mean demographic and physiological information such as height, hand size, finger width, etc. to support their detailed kansei design choices.

**DATA ANALYSIS: WORDS**

Kansei Engineering based on self-report needs to analyse the meaning and use of words for several reasons. In the context of semantic scale questionnaires, regression analysis of preliminary replies can lead to a systematic reduction of the number of required words without loss of affective breadth. Answers to the questions can also give insight into the important affective dimensions of the class of product being investigated. This sort of basic study probably does not need to be repeated very often for any one product type, and is carried out before considering what aspects of a product cause what affect (see next section for this) - that second stage being repeated more frequently, to follow product style and fashion changes, for use in detail design. In the context of question completion and free-speech recording, analysis can be aimed at extracting customer preferences and expectations of a product, more at the market need identification and concept design stage.

**REGRESSION-RELATED ANALYSIS.** Nagamachi draws on earlier semantic differential linguistic research by Osgood (Osgood, C. E. et al.: The Measurement of Meaning, University of Illinois Press 1957) to analyse the structure of the collection of adjectives relating to a product class. By multiple regression, principal component, factor or cluster analysis, adjectives are grouped by similarity of correlations with particular product examples. In principal component analysis for example the meanings / feelings expressed by each of the words are assumed to be approximated by linear combinations of an underlying smaller (principal) set of feelings. The level of approximation reduces the larger is the smaller set. Principal components are sought by minimising the residuals between the feeling scores from the examples obtained directly from the semantic differential questionnaire data and the feeling scores reconstructed from the new (principal component) combinations of variables. Frequently, three (sometimes two, sometimes four) principal components satisfy meanings with sufficient accuracy. For the watch example (Figure 1) Nagamachi found that three principal components were sufficient, representing, as interpreted by him, feelings of [firstly] softness (in a gender-related sense), [secondly] appeal and [thirdly] activity. The figure shows the distribution of original kansei adjectives in the three-dimensional space. A word reduction could be carried out by uniform sub-set selection.

**DATA MINING.** The extraction of key words from free-ranging speech, to isolate a customer’s subjective feelings and expectations about a product class has been greatly advanced by data mining techniques developed to search for and extract information from massive amounts of wordage, for example on the web. Shiseido and Mazda are using such methods.

**DATA ANALYSIS: PRODUCT FEATURE - AFFECT RELATIONSHIPS**

Once a principal component space, for example, has been established, particular examples of products may be placed in the space according to their approximated component scores. Figure 1 on watches is completed by such an example. It begs the question of what features of the product are responsible for its affect. To answer that question requires some hypothesis to be tested. For beer can
graphics design, for example, Nagamachi suggested that the background colour, the can illustration and label or printed panel shape are the main design elements. He carried out a linear multiple regression analysis which established that a bitter taste expectation is most strongly aroused in non-beer drinking Japanese women students by can colour (black), followed by the type of illustration (a person or an animal), with label shape having least influence. But he comments that interpretation of regression analyses becomes difficult when more than three or four design variables are included at a time. For products with many features, a controlled variation is required. Nagamachi has also experimented with non-linear analysis systems and other ways to represent results (neural networks, fuzzy set representations) in a search for robust analysis methods and concludes that in most cases, similar results are obtained by linear and non-linear methods.

Whether the axes of a semantic space are determined systematically or by marketeers', psychologists' or industrial designers' intuition (which is always a possibility), there is wide company use of two and three dimensional semantic differential mapping to identify what examples of products cause what customer affects. We were shown taste maps at Asahi, and taste, fragrance and appearance maps at Toppan. Both these companies use mapping over time to keep track of consumer preference trends. Companies are also developing their own software analysis tools for linking customer's desires to product properties (e.g. value creation assist system (VACAS) to grasp value recognition logic at Shiseido), for linking product features and affects (e.g. Hit Hunter system at Toppan) and how close a product approaches a target benchmark (e.g. craftsmanship score at Mazda): more of these later.

**KANSEI DESIGN SYSTEMS**

The company-specific analysis softwares just mentioned are clearly being used to support product development decisions and guide detailed design. In this section three generic types of system introduced by Nagamachi, some of which we saw used by industry, will be described. These are the Category Classification, Kansei Engineering and Hybrid Kansei Engineering Systems. Computer technology is providing new environments (e.g. virtual reality, web based) in which these systems can be implemented, leading to further variant processes.

**KANSEI CATEGORY CLASSIFICATION SYSTEM.** Nagamachi's first system (Figure 2) starts with a marketing decision as to what need the product should fulfil. We saw examples of the use of this system at Mazda and at Milbon, where the zero level kansei could for example have been creating a spirited car for young-at-heart people or trendy hair conditioning for regular salon-goers.
Deconstruction of those concepts into a small set (three or four) of contributory feelings, further verbal decomposition more and more to refine the interpretation of the concept, consideration of which senses (sight, sound, feel, smell, taste) are relevant to the words, which design elements are important for the feelings and senses and finally detail element design, are the stages of the process. Kansei tools cascade through, blurring with ergonomic tools as the physical level is reached.

**KANSEI ENGINEERING SYSTEM (KES).** This rule-based expert system form of Kansei Engineering offers design proposals to a potential user in response to the user’s kansei responses to questions. It has (Figure 3) image and adjective databases that contain the sector specific design features and kansei words used to establish feature-affect relations in a prior kansei self-report data gathering and analysis activity. It has a knowledge base that relates features to affects through the rules established from the analysis and a graphics module able to represent chosen designs on a computer screen. Responses to life style and feelings questions are converted to a design proposal through an inference engine drawing on the knowledge base. Nagamachi has published applications in home interior and fashion design (HULIS and FAIMS, Figure 3). Companies are known to have developed their own rapid-response design proposal tools in this mode (e.g. for other interior design circumstances).
HYBRID KANSEI ENGINEERING SYSTEM. KES translates kansei words to design elements and is sometimes called Forward Kansei. The same rule and databases can support Backward Kansei. This takes a designer’s sketch and outputs its associated kansei words. Both together are the Hybrid Kansei Engineering System. It is a designer’s tool. In the first step of use a designer enters kansei words and obtains a proposed design. In the second step, the designer takes cues from the first step to create new ideas that can be sketched and tested for their affect in backward mode. Cycling can continue creatively until a satisfactory solution is reached. In effect, designers interact with a historical user group rather than with a current one. Nagamachi reports that a Nissan steering wheel (Figure 4) has been designed in this way. However software for interpreting designer sketches in terms of the existing databases can be complex and there do not currently appear to be many examples of this system in use.

RELATED METHODOLOGIES

Some of the companies that we visited were explicitly combining Kansei Engineering with Universal Design and within a Quality Function Deployment (QFD) framework. The last two are summarised here, to support later descriptions.

UNIVERSAL DESIGN. Beyond the brief definition given earlier in this report, staff from the Center for Universal Design, at the University of North  

![Table 1. Universal design’s seven principles, based on information in http://www.design.ncsu.edu](http://www.design.ncsu.edu)

<table>
<thead>
<tr>
<th>Key concept</th>
<th>Concept definition</th>
<th>Guidelines for achievement (abridged)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equitable use</td>
<td>The design is useful and marketable to people with diverse abilities.</td>
<td>Provide the same or equivalent means of use for all users; avoid stigmatising users; provide privacy, security, safety, equally for all users; make design appealing to all users.</td>
</tr>
<tr>
<td>Flexibility of use</td>
<td>The design accommodates a wide range of individual preferences and abilities.</td>
<td>Provide choice of methods of use; accommodate right and left-handed access and use; facilitate user’s accuracy and precision; provide adaptability to the user’s pace.</td>
</tr>
<tr>
<td>Simple and intuitive use</td>
<td>Use of the design is easy to understand, regardless of the user’s experience, language skills or level of concentration.</td>
<td>Eliminate unnecessary complexity; be consistent with user’s expectations and intuition; accommodate a wide range of literacy and language skills; arrange information consistent with its importance; provide effective prompting and feedback during and after task completion.</td>
</tr>
<tr>
<td>Perceptible information</td>
<td>The design communicates necessary information effectively, regardless of ambient conditions or the user’s sensory abilities.</td>
<td>Use different modes (pictorial, verbal, tactile) for redundant presentation of essential information; maximise legibility of essential information; make it easy to give instructions; consider the needs of users with sensory limitations.</td>
</tr>
<tr>
<td>Tolerance for error</td>
<td>The design minimises hazards and the adverse effects of accidental actions.</td>
<td>Arrange elements to minimise hazards, with most used elements most accessible and hazardous ones eliminated or shielded; provide warnings and fail safe procedures; discourage unconscious action in tasks needing vigilance.</td>
</tr>
<tr>
<td>Low physical effort</td>
<td>The design can be used efficiently / comfortably and with least fatigue.</td>
<td>Allow user to maintain a neutral body position; use reasonable operating forces; minimise repetitive actions and sustained physical effort.</td>
</tr>
<tr>
<td>Size and space for approach and use</td>
<td>Appropriate size and space is provided regardless of user’s size, posture or mobility.</td>
<td>Provide clear line of sight to important elements and make reach to all parts comfortable, for seated or standing users; accommodate variations in hand grip size; provide adequate space for assistive devices.</td>
</tr>
</tbody>
</table>
Carolina State University (where the Universal Design movement was founded by the late Dr. Ronald L. Mace) have given the following definition: Universal design is the design of products and environments to be usable by all people, to the greatest possible extent, without the need for adaptation or specialised design. Principles for achieving this have been broken down into key concepts, concept definitions, and guidelines for addressing the concepts. Table 1 summarises these. The original documentation emphasises that the principles concern only usability, with other aspects e.g. economic, engineering, culture and gender also needing to be considered.

**QUALITY FUNCTION DEPLOYMENT.** QFD originated in Japan, growing out of Deming’s work from the 1950s there on statistical quality control. It has spread around the world, in various forms. It provides a method of prioritising where design effort should be deployed to add customer value or quality to a product (quality deployment); and where organisational effort should be deployed to support the processes that in turn ensure the product quality (quality function deployment). Its procedures may be illustrated in principle through the famous House of Quality visualisation. In the case of quality deployment (Figure 5) a proposed satisfaction of customer needs by selected technical options is formalised in the relationship matrix. After combining with a ranking of the needs, a technical response is the outcome. The technical elements might interact: the elements of the roof of the house identify regions of interaction and provide a framework for decision taking on compromises in developing the design. A similar structure can be created to plan the deployment of processes.

![Figure 5. The QFD House of Quality representation.](image)
In the following reports of our visits to companies, employee and sales figures are given as background. These refer to a company and its subsidiaries, and are taken from the Japan Company Handbook and Company Annual Reports. Sales are quoted in £, converted from ¥ at £1 = ¥186.

ASAHI BREWERIES LTD.
(www.asahibeer.co.jp)
23-1, Azumabashi 1-chome,
Sumida-ku, Tokyo 130-8602.
Visit date – 2 December 2002.

Company Profile
Osaka Beer Brewing Company, forerunner of Asahi Breweries Ltd, was founded in 1889. Asahi Breweries Group was established in its current capacity in 1949 and now employs around 15,000 people with net sales in 2001 c. £6,000m. Asahi’s core business area is alcoholic beverages and soft drinks. Within its sector, ‘Asahi Super Dry’ beer is Japan’s no.1 brand. Asahi Breweries is ranked number three in the world based on an annual output of 20.7 million barrels. Asahi also has secondary business activities in food and food supplements (Asahi Food and Healthcare Co). Overseas operations include production and sales activities in other parts of Asia. It also has production sites in the USA and Europe. The group also owns a number of supporting businesses such as logistics, can and bottle manufacture, information systems, distribution, raw materials and restaurants. A strong emphasis is placed on research and development. Asahi runs and supports a separate, large, research and development facility in Japan.

The New Product Development Environment at Asahi
A presentation was given to us by Asahi management on the development and introduction of the Asahi ‘Super Dry’ product and brand. The brand has enjoyed enormous commercial success and still remains the market leader in Japan fifteen years after its introduction, with a market share of 45%. Clear product development strategy and careful understanding of customer feedback is fundamental to its success. Over the years, Asahi’s growing expertise in new product development has allowed them substantially to reduce new product lead times and ensure ‘right first time’ development.

In 1953, the three main breweries in Japan each enjoyed about equal market share. From 1953 to 1985 Asahi’s share declined to a low of 9.6%. A management decision was taken to try to reverse the downward trend. This led to the introduction of Asahi ‘Super Dry’. At that time, it was explained, the formulation of Japanese beer was based on two hypotheses. Firstly, that consumer preference was constant over time and therefore traditional recipes were still appropriate. Secondly, that consumers could not taste the difference between the products of Asahi and its two main competitors, hence consumer preference was purely based on the brand image / graphic design. Asahi decided to challenge these hypotheses. Research into trends in food offered in school lunch boxes and restaurants suggested that consumers were moving preference from heavier towards lighter, less salty tasting, foods. Working with consumer groups (expert users), Asahi also established that consumers were able to tell the difference between beers in a blind tasting situation (a test using same Asahi branded bottle, different content). Asahi argued that if it could engineer a new product that fitted with consumers’ changing preference, then it would gain a commercial benefit.

Through market research (focus groups and consumer preference questionnaire techniques), Asahi then analysed the characteristics of the various beers available on the market at the time. It identified a potential opportunity in the development of a ‘crisper’ tasting beer i.e. with a short, not lingering taste. This acknowledged the changing preference of consumers away from more full-bodied recipes. A pilot recipe was developed and the product was market tested in 1986. The results confirmed that the development strategy was good, but that the product was not yet well enough identified with ‘crisp’ taste. Asahi followed this up by further development of the product in the ‘crisp’ direction. The final ‘Super Dry’ formulation was launched in 1987.
The launch was successful. It was backed by substantial advertising and a communication strategy to re-educate consumers on beer taste, getting consumers to identify with the new language of full bodied vs. crisp. Blind consumer tasting events were held nation-wide to substantiate Asahi’s new product claims. By the early 1990’s ‘me-too’ activity by Asahi’s competitors started to erode Asahi’s market share. Asahi recognised then the need to develop other aspects of product appeal. It decided to concentrate on product freshness taste. Working on logistics, it managed to reduce the time from production to delivery from between two to three weeks down to five days. These logistics improvements (enabling a ‘fresh-taste’ beer to reach the consumer) have ensured further competitive advantage, maintaining market share at around 45%.

Asahi’s detailed and structured approach to product development is instrumental in its success. Annual customer surveys are carried out with sample sizes in region of twenty to thirty thousand people. The focus of these surveys is taste, covering the positioning of Asahi products, the adequacy of the concept, the product and recording any changes in taste preference. The survey results are used to confirm the targets of Asahi’s new and existing products, checking their positioning against changes in consumer preference. Asahi’s customers have come to expect new tastes, and Asahi product development is now moving to expand the feelings associated with the product from simply taste to a more broadly defined ‘well-beingness’.

Following consumer feedback, the product concept is translated into a basic product recipe. Asahi’s product development experts use analytical techniques to translate marketing terms into technical specifications. A huge database of brewing characteristics, process controls and ingredient charts (hops, yeast, malt) has been built up over time. Work then begins on the manufacturing methods and processing parameters. Through its experience and techniques in translating consumer product concepts into technical specifications Asahi has managed to reduce development times from six months to one day in the selection of the basic recipe. Further fine-tuning of the recipe and process takes approximately two to three months. Selecting the basic recipe is for Asahi a rationally understood process. It is the finalising stage that resorts to feelings and intuition, and how to integrate logic and intuition is an issue.

Key Points from the Visit
• Asahi recognised that they must lead the market by migrating their product from competition on packaging / graphic design (container wars) to competition on taste. Indeed this has led to a new concept of the Asahi Brand: Expecting New Things.
• Asahi recognise that continuous improvement through deep understanding of taste and changing trends of taste is key to their continued success. They are using the kansei semantic differential tools to support their activities to this end.
• Asahi anticipates continuing migration of their customers’ needs, beyond new tastes to new lifestyles enabled by taste. It has an Institute of Lifestyle and Culture, charged with researching what is happiness. Kansei science has a role here.
SHISEIDO COMPANY, LIMITED
(www.shiseido.co.jp)

Shiseido Research Centre
2-2-1 Hayabuchi,
Tsuzuki-ku, Yokohama-shi 224-8558.
Visit date – 3 December 2002.

Company and Research Centre Profile

Shiseido’s company history originates with a western-style drug store opened in Ginza (Tokyo) in 1872, with advance into cosmetics in 1879. The current company was established in 1927 and is now the largest cosmetics manufacturer in Japan, ranking 4th in the world, with 98 subsidiary companies world-wide, manufacturing in 23 factories across Asia, the Americas, Europe and Oceania, with 25,000 employees and net sales in 2001 of c. £3,200m. Shiseido’s core business for many years has been cosmetics and toiletries (skin whitening, protection against UV, hair growth and anti-ageing), with products from high-prestige to mass market appeal, marketed from speciality stores to supermarkets. Other businesses have grown from these: hair salons, health and beauty foods, over-the-counter pharmaceuticals and fine chemicals. Shiseido prides itself on the depth of its understanding of its products. It was its skin care research, for example, with Harvard Medical School and Massachusetts General Hospital, undertaken at first to underpin its cosmetics business, that led it to pharmaceuticals growth. Our visit was taken at first to underpin its cosmetics business, and when that occurs, no one knows why, either. Using fixed survey questionnaires yields only part of the information needed for a new product and has difficulty in exploring new directions; something more qualitative is needed. Satisfying the physical quality need of a product is no longer enough for success, and anyway, improvement in physical quality large enough for most people to notice the difference is difficult to achieve. Success now involves product impressiveness, and that is where kansei comes in, adding sensitivity, emotional and preference based design dimensions to a product. Shiseido describes impressiveness (customer quality or ‘I want to buy’) as the product of delivering need (physical quality) and ‘wow and indeed’ (kansei quality).

Shiseido has developed a range of methodologies and tools to explore consumers’ kansei or subjective feelings about its products. One is called Value Creation Assist System (VACAS, patent pending). It aims to find what features of Shiseido’s products a customer values most, by presenting open-ended questions for completion. It then asks customers to assess the extent to which existing products satisfy those values. The customer value and product evaluation scores enable Shiseido to prioritise options for new product development actions. High value and evaluation scores indicate a product feature that must be maintained through new activities. High value and low evaluation signals ‘must improve’ while low value, even with low evaluation, indicates ‘leave alone’. Shiseido also has a software-based text mining system that is called DIONISOS for evaluating impressions of products. A further suite of tools (path influence calculation method DEMATEL) helps to establish value recognition logic paths between subjective causes and affects by analysis of sentences completed by customers. An example is ‘Because my hairspray [smells of roses], it has [a natural feel] and I [often use it]’ – where the bracketed part is the customers’ contribution. Shiseido use DEMATEL to navigate through new product development options less intuitively than without its help. In a QFD context, VACAS and DIONISOS enable needs for new products to be ranked while DEMATEL supports finding design solutions.

The case studies were the design of screw-caps for bottles and of foundation cases. It was explicitly said, in an ISO 13407 Human Centred Design context, that Kansei helped to establish the customers’ needs of the cap, while the design solution was obtained by ergonomics. Kansei estab-
lished that 'ease of opening' had effectiveness, efficiency, satisfaction and comfort dimensions. The presentation concentrated on researching what is comfort, through experimentation on opening bottles, with the subject wearing pressure sensitive gloves. Comfort was particularly associated with pressure distributions over the hand, with some parts of the hand more important than others. Detail design then involved shaping the cap to ensure the relevant parts of a hand worked in the best way. This in turn required demographic data to be obtained on the population's range of hand sizes. The detail of study was well beyond the common level of what torque is required to open a cap. It also illustrates the convergence of Kansei and Universal Design that we also observed in other companies. The foundation case study, in its first part, was closer to a traditional cluster analysis, with users being asked to rank fifteen different samples against a range of key words that were associated with attractiveness. But its outcomes were clarified by VACAS. In a question session, Shiseido staff said they used Kansei only when they were uncertain of how to develop, that a typical Kansei survey took about one month, and that work was only contracted out to design agencies when a brief could be totally specified.

**Key Points from the Visit**

- In Shiseido’s market, products need to wow, indeed, as well as work, with wow, indeed, being strong but difficult to quantify.
- Shiseido use Kansei Engineering methods to take the intuition out of 'wow and indeed'.
- Shiseido, with working phrases such as ‘creative integration’ and ‘solutions based on science’ believes strongly in in-depth understanding of its products for the creation of new businesses.

**TOPPAN PRINTING CO., LTD.**

(www.toppan.co.jp)

1, Kanda, Izumi-cho, Chiyoda-ku, Tokyo 101-0024.

Visit date – 3 December 2002.

**Company Profile**

Toppan Printing started business in 1908 and has grown to be one of the leaders in the Japanese printing and packaging industry. Toppan employs nearly 32,000 people with net sales in 2001 of c. £6,970m. It operates from Japan, China, Taiwan, Singapore, Australia, USA and the UK. Its products include the manufacture and printing of packaging, manufacture of bank, pre-paid and credit cards, manufacture of packaging specialist films for a variety of applications and business forms, manufacture of photo masks for semiconductors, manufacture and sales of books, magazines and commercial printing. Toppan also manufactures inspection equipment for electronic precision components and sells electronic precision components. It also manufactures colour filters and interior décor and industrial materials and prints electronic circuit boards. Toppan is a keen environmentalist and has introduced environmental

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**Table 2.** Toppan’s checklist of packaging product assessment points and criteria.

<table>
<thead>
<tr>
<th>Consumer contact points</th>
<th>PRODUCT ASSESSMENT CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>At purchase</td>
<td>1) understandability, 2) ease of identifying the content, 3) portability.</td>
</tr>
<tr>
<td>During use</td>
<td>4) openability 5) contents’ pourability / removability, 6) ease of use, 7) child safety.</td>
</tr>
<tr>
<td>When storing</td>
<td>8) storage ease, 9) re-sealability.</td>
</tr>
<tr>
<td>General information issues</td>
<td>10) font and font size, 11) information placement e.g. expiry date, storage method, 12) easy to understand indicators / pictograms, 13) helpful information e.g. nutritional, calories, etc.</td>
</tr>
<tr>
<td>At disposal</td>
<td>14) ease of sorting / disassembly, 15) recyclability, 16) crushability.</td>
</tr>
<tr>
<td>Other general</td>
<td>17) accident prevention measures.</td>
</tr>
</tbody>
</table>
accountancy in 1998. This tool assists in decision-making concepts and projects. Toppan uses its development skills, which draw on advanced technologies, planning and marketing capabilities, to provide high value products and services that are infused with a customer led philosophy. It recognises the need for a good focus on product development and has embraced Kansei Engineering in order better to understand and facilitate customer requirements.

The New Product Development Environment at Toppan

Presentations were made to us relating to the packaging of food and drink and other fast moving consumer goods. Competition in Japan in this area is not on cost (which must be acceptable) but on brand differentiation by quality of packaging. Many consumer products in grocery stores in Japan have a very short life; it is usual that only 5-7% last more than one year. Many products will be removed from the shelves after two weeks if the sales have been poor. Most of the grocery outlets in Japan are small convenience stores such as Seven-Eleven, Sunkus and Lawsons and several others, most of which are franchised American companies. Supermarkets have almost no own brand labels in Japan, leaving them with little or no power over the product manufacturers. It is against this market that Toppan has used Kansei to enhance its packaging products such as stand up pouches, pouring devices, specialty films, microwavable and retort packaging, closures, plastic barrier bottles, ‘cartocans’, metallized films and labels.

Toppan combines the usability principles of Universal Design (see earlier) with kansei methods to explore subjective issues of a changing market, for example consumers’ feelings about colours. Toppan applies Universal Design to packaging from three perspectives: physical (openability, portability, complexity of use, product access, storability, possibility of injury, disposability), sensorial (sight, touch, smell, taste, hearing) and psychological (understandability, comfortability, and taking account of users’ poor memory, reduced alertness, change of mentality or personality, and degree of exposure to information). Design assessments are made at every scene that interfaces the consumer with the product (Table 2), using a structured questionnaire diagnostic sheet developed to a product benchmarking system.

Toppan promotes research into ageing, for example into colour perception and changes in colour discrimination (Figure 6) that can inform choice of colour contrasts in packaging design. It has also researched the influences of font size and line spacing on readability, concluding that bolder fonts are better than pale and size 8 is the smallest that should be used for easy readability. Further, for easy-to-read documents, the blank space between lines should be half font height.

Toppan’s kansei studies are aimed at creating package images that reinforce the product contents image (e.g. taste) mathematically rather than intuitively. Toppan maintains an in-house product trends database (updated at 6-monthly intervals) against which it can assess its client customers’ needs and respond to requests for business. It regards the breadth and depth of its package creation support for customers as a core capability and believes it gives a market edge over others that contract out more of their activities.

Toppan’s in-house database is created from classical kansei multiple regression, principal component, word and product association tests based on self-report questionnaires. Kansei words are established that relate (for example) to a product’s taste image.

Figure 6. Human eye changes with age and associated differences in colour perception, courtesy of Toppan.
its packaging image and desire to return for more. Beverage products were used as an example to show the positions of existing products by their taste image in a three-dimensional principal component space with axes of sweetness, smoothness and fragrance. The ‘return for more’ responses and their change with time are used to establish consumer trends. Packaging images were placed in a two-dimensional space, also to prompt the direction of design change in line with taste trends. One element of design that can be extracted and compared with taste is colour (Figure 7): from the study, pinks, magenta and reds are perceived to be sweet whilst blue, green and yellow are perceived to be not sweet.

Toppan’s industrial designers use Toppan’s Universal Design and kansei information in developing their responses to customer requests. Toppan intends to extend the use of its knowledge base to a consultancy for its clients and customers. Toppan calls its kansei product development system Hit Hunter Ajisuke and a business model patent is pending.

Key Points from the Visit
- Toppan holds that, in Japan, packaging cost must be acceptable but competition is on quality.
- Toppan employ kansei techniques to establish consumer trends and to establish the design features that create coherent product and packaging feelings. They combine these with Universal Design rules to ensure usability.
- Toppan believes in in-house, in-depth, design capability. Too much out-sourcing is regarded as a weakness with a threat of allowing competitors to gain market share. Toppan’s image is leadership in information synthesis.

Figure 7. Relational analysis between main colours of packaging and taste and package image, courtesy of Toppan
rate design activities, grouped into product design, interface design, graphic design, human-life design, contents design and design planning, and on 6 sites – mainly 4 in Japan with 2 satellite sites overseas (Europe, USA). Our visit was to the office in central Tokyo which works on new product design i.e. the appearance and method of use of new models of colour copiers, printers and scanners.

### The New Product Development Environment at Seiko Epson

Seiko Epson states that it has four main elements in its design vision: philosophy – taking the lead in satisfaction; concept – understanding the human angle with nature; expression – simple, balanced with impact; and value – increasing actual value and value of the appeal. Within these elements, Seiko Epson’s goal is to realise easy to use, customer pleasing designs from the human and user’s viewpoint. To achieve this, it is investing in research as well as evaluation functions in design development. In 2001 research was focussed on understanding customer’s overt and latent demands, and several methodologies have been established. Seiko Epson is also researching product styling, making comparisons with competitor products. Other activities include packaging surveys on the use of packaging for printers, scanners and consumables, and general studies and research into modern lifestyle trends.

For product concept assessment, the Tokyo office is well equipped with its own consumer evaluation room, which can be used for focus group studies. Consumer evaluation is used at many points in the product development cycle, for example, developing the graphic-user interface, evaluation of human behaviour and user sequence, and testing pilot software. Focus group interviews are used as well as one-way mirrors to observe the feedback from actual users.

Seiko Epson has used QFD (Quality Function Deployment) techniques for a long time in its business and market development strategies. It aims to build in quality into its design specifications and develop new products with features that relate directly to user needs, identified from consumer feedback / market research. The goal of developing the perfect machine-user interface has led Seiko Epson in recent years to integrate Kansei Engineering techniques into QFD. Concentrating on the usability of the machine, it is researching and developing user interfaces based on potential requirements that have been identified from users’ expressed emotions. This work is based on the hypothesis that the best user interface will be the one that causes the user the least ‘discomfort’ from both a physical and psychological perspective. Comfortable behaviour is both stable and reproducible.

Seiko Epson has enjoyed a successful collaboration with Shinshu University in the development and use of kansei techniques for office equipment design. This has allowed relationships to be identified and differences to be evaluated between new and experienced users. Two examples were given, opening of an office printer cover and use of an eye-tracking camera.

The opening of an office printer cover. By measuring the kinetic element, load and dynamic force on opening the printer it was possible to define optimum ‘openability’ in terms of the parameters of load, distance and time. This gives an accurate, physical, technical specification to follow. By also evaluating sensitivity or user ‘feeling’ on opening the cover, Seiko Epson has been able to develop a

![Figure 8. Eye tracking at Seiko Epson and Shinshu University.](image)
total operability specification. Measurement of the EMG signal from arm muscles was used in testing five different types of printer cover. Users were also asked to score their preference on a scale of one to five. When the variation in EMG signal was at its lowest, the cover opening motion was defined as the most ‘comfortable’. This combined with a high user score gives a cover specification and opening motion that is believed to have the highest reproducibility with both new and experienced users.

Use of eye tracking camera. Shinshu University has performed various studies on behalf of Seiko Epson using an eye tracking camera to pinpoint the area of concentration on a design. Two measuring methods are used, one with the chin fixed, the other with the camera attached to a hat with free head movement. For example in a study involving seventeen people of different ages and sexes, the camera was used to establish the look of an office printer. Measurement of the eye target area and time of concentration was compared to answers given on a user questionnaire. This helps to validate whether users look at particular design features and the way they look at the overall design (Figure 8). This feedback can be built into the overall design process to confirm that users do look at what designers want them to. The camera can also be used during machine operation to deduce the cause of problems, for example with machine software. From the combination of eyeline data and input feedback from the machine, the researcher can identify quickly weak spots in the software operation.

Seiko Epson staff commented on the additional cost of using kansei techniques in product design. They estimate that 50-70% more man-hours are taken when using for example eye camera techniques, compared to a more conventional design approach (e.g. self-report questioning). This cost has to be weighed up against the additional data these techniques provide which is very useful in specifying the technical and emotional aspects of the equipment that Seiko Epson design. They also said they had been using kansei techniques for two years only. In their view kansei methodologies are still under development but will be used more in the future.

Key Points from the Visit
• For mature products, Seiko Epson sees increasing integration of human life aspects as the way to add value.
• Seiko Epson has extended the meaning of usability to include subjective psychological aspects and integrates Kansei Engineering into a QFD framework.
• Seiko Epson is moving beyond self-report to psycho-physiological kansei testing.

Matsushita Electric Works, Ltd.
(www.mew.co.jp)
1048, Kadoma
Osaka 571-8686.
Visit date – 5 December 2002.

Company Profile
Matsushita Electric Works, Ltd (MEW) and its sister company Matsushita Electric Industrial Co. Ltd. trace their origin back to 1918. Public incorporation was in 1935. Today MEW is a leading maker of home building products (e.g. lighting, information equipment and wiring, home appliances, building products, electronic and plastic materials, automation controls, some 200,000 products in all). It has just over 46,000 employees, with net sales in 2001 of c. £6,450m. Its Japan, China and other Asian markets account for 89% of sales income and the majority of its manufacturing base but MEW is pursuing globalisation with expansion in North America and Europe. It is strongly seeking new business by responding to social trends such as the IT revolution, global environmental concerns, and Japan’s dual challenges of a low birth rate and ageing population, under the integrating slogan “Smart Solutions by NAIS (National Amenity Intelligent System)”.

The New Product Development Environment at MEW
MEW was one of the first companies in Japan to work with Professor Nagamachi. Ergonomic and kansei activities are now strongly embedded in the design process, with universal design and human life style considerations as well. The three key areas of awareness of eco-, human- and scene-consciousness have led MEW to identify five satisfaction elements – safety and security, happy lifestyles, good health, environmental awareness and efficiency – that should underpin its product ranges. Kansei Engineering is being used to translate these feelings to physical features of specific products and product ranges. General comments were made to us
about the benefits of Kansei. 1) Before, they designed with experience and intuition – now they look for more understanding. 2) If they hadn’t used Kansei, it would be the designers’, not the users’, feelings in the product. 3) Before their use of Kansei, they designed products one by one and thought about co-ordination later. It was not effective. Kansei understanding enabled them to migrate from designing individual products to developing total integration among many products (particularly significant in environmental – home – surroundings). 4) Kansei has given their products an image distinctive to them, an image that is not just a copy of competitors’ products.

Presentations were made on a number of case study designs: handrails (Figure 9), door handles, exterior walls, wall patterns, lighting levels. In all cases, users’ likes were found to be made up of a combination of physiological components (addressed by ergonomic / universal design methods) and lifestyle / subjective psychological components (addressed by kansei methods). MEW’s main kansei evaluation tool is self-report, with the use of 5-point scale semantic differential methods applied to product specific emotional words (these words being MEW’s IPR, giving them their brand image). Principal component analysis leads to word loadings and product scores in the principal component space. Products are decomposed into their components, for example handrails into main body, end fixings, fasteners, and these in turn exploded to variants, e.g. main body diameter, finish, colour, on which kansei evaluations are performed. These are both appearance and use evaluations. Interestingly enough, the diameters of handrail that would be chosen on ergonomic and kansei grounds differ slightly. Relief (safety and reassurance) and beauty kansei measures are different from physiological, grip, assessments of performance. The comment was made that there still remains a difficulty of methodology in translating kansei data into design elements, and of how to compromise between ergonomic-optimal and kansei-optimal solutions. But kansei can be creative when performed on a company’s own prototype designs.

MEW has also used Nagamachi’s Kansei Engineering System (KES) with virtual reality technology (VT) for kitchen design. Firstly, a customer inputs family data, height and kansei to the system. The KES component then displays the proposed kitchen prototype on screen. The VT provides a walkthrough of the virtual space, allowing taps to be touched and cupboards opened. The agreed design can then be transferred for production to the CIM (computer integrated manufacturing) factory.

Key Points from the Visit

- MEW is a company pioneer of Kansei Engineering. It is certain of its benefits but believes that improvements of methodologies are still needed.
- MEW uses Kansei Engineering to gain a better understanding of the subjective needs of the
users of its products, to underpin a coherent
development of new products with a distinc-
tive MEW brand, upgrading their image to one
of ‘total integration’.
• MEW integrates its Kansei Engineering with
Universal Design.

Company Profile
Milibon is a comprehensive manufacturer and
supplier of hair-care products for hair salons,
including permanent wave products, hair colour-
ing, shampoos and rinse. It was founded in 1960
and operates mainly in the Japanese market, where
it has a 15% share of its market. Its approximately
300 employees were responsible for net sales in
2001 of c. £68m. It is noted for sales people educa-
tion and training (Field-man system) and regards
expert interaction with its customers - the hair
designers - as key to its continuing success and
growth. This leads it naturally into exploring new
techniques and collaborations with academic
researchers. Milbon applied Kansei Engineering
methods (Kansei Category Classification System) to
developing a new product range, in order to learn
about Kansei Engineering, under the guidance of
Professor Nagamachi. The resulting brand and
products (Figure 10) are Milbon’s leading growth
brand increasing in value over the 3-year period
from launch to 2002.

The New Product Development
Environment at Milbon
Milibon’s direct customers are the salons and their
professional hair designers. This had led Milbon,
before its Kansei experiment, to a ‘joint project’
approach to its new product design, involving close
contact between its expert staff in the field and the
designers, in a product development process that
Milbon calls TAC (Target Authority Customer).
Target is the hair designer for and by whom the new
product is to be created. Authority is the key
benefits to be addressed by the product - as
expressed by the professional hair designer
consulted. Customer represents the hair designer
again, giving feedback on preferences. TAC had led
to a successful range of products, but Milbon
wanted to understand more certainly how to
identify and locate the knowledge it needed to
create further new, exciting, products. It also
wanted to know better how to communicate and
share the knowledge needed among the members of
its development team. And finally it wanted to
know how better to combine knowledge from
different sources to create the insights needed to
develop the new products. This is the background
to Milbon’s Kansei pilot study.

Within the Kansei Category Classification System
(Figure 2) Milbon’s concept or zero level kansei was
expanded into four first level kansei words, three of
which related to the nature of the hair treatment.

Figure 10. Milbon’s kansei-engineered shampoo and TF (tender feel) hair treatment, courtesy of Milbon.
The fourth word was ‘agreement’ and specifically required the packaging to reinforce the treatment’s image. It took two further levels of kansei decomposition to clarify the word meanings sufficiently for translation then to be made into the physical domain, of formulation of the product and form and other attributes of the packaging. Milbon commented that the approach was easy to use, based on their TAC experience.

**Key Points from the Visit**

- Milbon is very happy with the results of the Kansei approach, using the Kansei Category Classification System.
- Deesse’s, with its main product parameters and packaging shape, colour, and brand name too, created by Kansei, has become Milbon’s top brand.
- The Deesse’s literature for Milbon’s professional customers highlights the Kansei Engineering approach adopted by Milbon, adapting the Kansei sheets that were used during the development process.

**MAZDA MOTOR CORPORATION**  
(www.mazda.com)  
3-1, Shinchi, Fucho-cho,  
Aki-gun, Hiroshima 730-8670.  
Visit date – 6 December 2002.

**Company Profile**

Mazda Motor Corporation was established in 1920 in Hiroshima. It has a reputation of quality products for a mid range market of vehicles. With almost 37,000 consolidated employees in all, and manufacturing in 2 plants in Japan and a further 15 in other countries around the world, and exporting to over 150 countries, net sales for 2001 were c. £11,000m. Having been a profitable company for many years, in 2000 Mazda and its consolidated subsidiaries made a net loss of c. £800m. This led to an increase of a long-standing collaboration with Ford – the appointment of a President from Ford, with 1/3rd of shares owned by Ford. 2001 saw a consolidation in manufacturing systems and personnel, which brought forth a new “Millennium Plan” and a return to profitability. The first part of the Millennium Plan, “Execute, Deliver and Grow” was drawn up for the years March 2002 to March 2003 and has been seen as successful, with plans to continue the growth momentum into the future. Mazda positions its brand world-wide with a personality of stylish, insightful and spirited, reinforced with product attributes of distinctive design, exceptional functionality and responsive handling and performance. Mazda Brand DNA is summed up in the new brand message Zoom-Zoom (love of motion experienced as a child) and all corporate activity is united behind this.

**The New Product Development Environment at Mazda**

Ford considers Mazda a centre of excellence for design, style and build quality. Mazda has a ‘Craftsmanship Development Group’ that is responsible for ensuring that brand quality is embedded in new vehicles. A craftsmanship rating system has been developed with which both new designs and competitors’ products can be benchmarked against quality goals. It explodes elements of a vehicle into some 1,500 items in a structured, cascading, way and uses 7-point self-report questionnaires to determine user responses to them.

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**Figure 11. Clarification of priorities in interior quality feel, from a presentation by Mazda**
Over time, the scope of questioning has expanded from built-in quality (finish and fit, appearance and performance), to ergonomic beauty (usability) and now includes subjective feelings or kansei beauty.

A presentation was given of procedures to prioritise the importance of different design elements as far as first impressions subjective feelings quality was concerned, and of determining which senses were important to which elements, and why. Discussion panels and text mining are the methods used, with panelists made up of men and women, from Mazda’s different market regions (e.g. Japan, Europe, USA). Different priorities from different markets can lead to different design actions. It seemed to us that the framework of this activity was QFD. Figure 11 gives example data in pie chart form from an interior quality study in Japan. Among instrument panel, seat, steering, etc., the instrument panel was ranked of highest priority. Within the panel, the upper part was most important – and at this level, among appearance, colour, touch feel, etc., appearance followed by design, followed by touch feel was the rank order.

The prioritised elements (or the tree of such elements) become the target for Kansei Category Classification System translations from brand word concepts to physical implementations. Further presentations were made selecting examples of translation of words like firm feeling, clean and simple to feelings experienced through drivers’ hands and feet. These include not only touch (or tactile) feel as just identified as of some importance for the instrument panel, but impressions of firmness and smoothness from turning a control switch, operating a gear or a seat adjustment lever, opening a door, or – by foot – operating clutch or brake pedals. Mazda has carried out detailed researches into what force (or torque) – displacement relations on turning switches or opening doors, etc. give rise to what impressions of firmness and smoothness, and which of these reinforce their Brand DNA. They have further decomposed tactile feel into surface touch (stroking) feel, functional (grasping) feel and ergonomic shape (draping) feel and identified what surface materials properties such as friction, compliance, thermal and hygroscopic properties influence those feelings. They

Figure 12. EMG tests on the influence of pedal step-over height on comfort, courtesy of Mazda.
have kansei evidence that harmonisation of feelings across different elements of activity itself gives extra satisfaction.

In a further presentation on translation of the Brand DNA into a car operation vision, Mazda identified speed, fun, harmony and comfort as relevant kansei words. Mazda designs the human-machine interface to reinforce these attributes, in a process that it calls Impedance Matching. This involves Mazda in psycho-physiological testing, for example electromyogram (EMG) studies of muscle usage and pressure glove and mat studies for assessing comfort of different hand controls or seat designs. Figure 12 gives an example of comfort studies in which muscular EMG signal is measured for different pedal step-over heights. There is a change point step-over height above which EMG increases rapidly. Selection of a good step-over height is based on this.

Key Points from the Visit
• Mazda has shifted its basis of competition into the subjective, kansei, arena.
• Mazda has a well-developed methodology for this, blending QFD with Kansei Engineering tools.
• Mazda is a Ford centre-of-excellence in this area.

SHINSHU UNIVERSITY (www.shinshu-u.ac.jp)
Faculty of Textile Science & Technology,
3-15-1, Tokida,
Ueda, Nagano 386-8567.
Visit date - 4 December 2002.

Profile
This last case study reports the visit to Shinshu University’s Department of Kansei Engineering (headed by Professors Morikawa and Shimizu) within the Faculty of Textile Science and Technology. Shinshu University was founded almost 100 years ago, in a silk industry region. It is now funded as a Centre of Excellence for textiles, although silk is an interest of the past. It regards research into the subjective kansei measures of textiles’ affects as an important element of both its and its industry collaborators’ new directions and competitive advantage. This visit is placed in the industry case study part of this report because of the strong textile product focus, compared to the broader interests of the Hiroshima International and Tsukuba University visits. Clothing has a unique place among products as cloaking both other people’s and our own bodies. Thus basic kansei researches at Shinshu relate to visual perception and tactile feelings, with brain wave and other psycho-physiological studies as well. These are related back to fibre materials science and engineering at the micro level and on to tailoring for example at the macro level.

Research activities from the visit
We were able to connect a number of the researches with company activities that we had seen elsewhere, and further found a range of basic studies from classical self-report pioneered by Nagamachi to the next-wave psycho-physiological.

One presentation described a self-report investigation into the subjective assessment of woven textile fabrics used to cover car seats. Feelings about a fabric, from sitting on it made up as seat, were being related back to the fabric’s measured physical properties. Principal component analysis clustered verbal response words such as high-class, soft and voluminous in a ‘comfortable’ zone of a principal component space, while words such as smooth, hard and sporty clustered in another region. The placement of the fabrics (such as jersey, tricot, plain and moquette) in the principal component space, depending on their factor scores, enabled which fabrics gave rise to which feelings to be clarified. In turn, compression modulus, friction along and across the warp direction, thickness and thermal properties were being measured, to understand the physical source of the subjective feelings. A parallel study on feelings about a fabric, from handling a swatch of cloth, gave very similar results to the sitting study. This suggests that it may not be necessary to go to the expense of making up fabric into a seat cover in order to evaluate its suitability for supporting a particular feelings outcome. As a point of detail, a word like ‘high class’ was found to have a weaker correlation to materials’ features than ‘warm’ and needed around 20 to 30 subjects for significant information to emerge.

Methods of studying people’s feelings subconsciously were also described, such as eye tracking and facial electromyogram studies (which facial muscles respond to what emotional feelings?) and were being applied in a product development context. As an example of eye tracking, equipment
was demonstrated for recording which part of an image attracted the centre of the eye's attention (for example of a range of trouser shapes, Figure 8, with head-set left and recording equipment right). A parallel study was developing a criterion of visibility evaluation by which subjective visual sensations were being correlated with objective visibility levels, based on luminance contrasts within an object field. As well as applications to textile visual texture, studies were extending to safety enhancement of road layouts and markings.

The complexity of sensory interactions was being studied. Feelings about tightening a belt round a person’s waist were being solicited verbally, both with the person’s eyes shut but with a light on and with eyes open but in the dark, and with the belt either covered up or visible, at the same time as measuring brain $\alpha$-wave (electroencephalogram) changes with tightening and un-tightening the belt. And how does sight, sound and feel interact in judging the weight of a hand-sized ball (Figure 13)? In the same Department materials science studies are concerned for example with the development of new thin film and fibre materials based on poly(vinyl alcohol)/NaCl/H$_2$O gel systems. Mechanical testing methods continue to be developed for yarns and made-up fabrics. And this traditional materials and engineering activity is being combined with the subjective kansei evaluations to propose, for example, new shirt and suiting cloths. One new shirt material, a mixture of kenaf (Hibiscus cannabinus L), cotton and polyester was said to be a commercial success for the University.

**Key Points from the Visit**

- Shinshu University’s Faculty of Textile Science and Technology demonstrates the integration of kansei studies with traditional materials and engineering skills.
- Industrial collaborations and commercial exploitations are growing from the kansei studies.
- Shinshu’s researches demonstrate clearly that human assessment of a product’s physical attributes (e.g. weight, warmth, feel) is coloured by subjective assumptions.

Figure 13. Which balls feel heavier [all balls have the same weight]?
FUTURE DIRECTIONS

This section of the report is based on information from a seminar organised by Professor Harada at Tsukuba University, 1-1-1 Ten-no-dai, Tsukuba-shi, Ibaraki 305-8574, on 2 December 2002. Professor Harada is a member of the University’s Graduate School of Comprehensive Human Sciences and its Research Institute of Art and Design. The Graduate School is responsible for PhD programmes across education, psychology, disability and human-care sciences, kansei and cognitive brain sciences, sports medicine, a range of applied medical sciences, as well as art and design, while the Institute’s main fields are Philosophy of Art, Fine Art, Constructive Art, and Design. Currently 13 students are admitted annually to the doctoral programme in kansei and cognitive science and 7 to art and design. Professor Harada was Director of the Japanese Ministry of Education’s Kansei Special Research Project, that ran from 1997 to 2002. This project had three main strands all related to kansei issues in an Information Society Technology context: 1) measurement and understanding of users’ appreciation responses, a large part of which was responses to aesthetic objects viewed remotely by a user-controlled robot; 2) the development of multi-media data bases, network programming and user interfaces to support item 1; and 3) the development of tele-control robots initially also to support item 1. Future research is planned on ‘kansei and inspiration’. One goal of the research is to build an appreciation attitude model, with interdisciplinary collaboration between art, psychology, cognitive and neuro science, information engineering and robotics, to provide a framework for evaluation of art and design work. This goal is not yet achieved.

A key difference between activities at Tsukuba and those which we saw elsewhere was that the research was driven by a prime interest in the people rather than the products, in the human-product relationship. Professor Harada reported a Kansei Engineering statistical analysis on how different groups of (Japanese) researchers understood the meaning of kansei itself. Information scientists emphasised subjective reactions to stimuli from the external world. Designers thought of it as the embodiment of intuition based on experience. Researchers in linguistics thought of it as an interaction between intuition and intellectual activity. Arts researchers felt it was a capability reacting intuitively to features and evaluating them. He also showed results of personality tests (Maudsley Personality Inventory plots on neuroticism-stability and extraversion-introversion axes) that showed...
differences between the different groups of researchers. This thrust to place kansei within a framework including personality is clearly a step towards a more fundamental understanding, in contrast with current engineering applications where a user group may be ‘males between 18 and 25 years old’.

A common theme of the presentations made to us was ‘new research methods’. Professor Harada (with his co-workers) has concentrated his kansei researches on people’s reactions to art. A main experiment has been monitoring appreciation of pictures and sculptures in art galleries. To overcome interference of gallery surroundings on reactions, and also to overcome difficulties of monitoring reactions within galleries, he has designed an ‘art appreciation robot’. The movement of this roving vehicle within a gallery, including panning, tilting and zooming of a camera on-board the robot, is controlled remotely by a user asked to follow his or her interests in what to direct the robot to look at. The robot’s camera image is viewed on a screen by the user. The user’s decisions on where to move the robot, eye tracking on what is viewed on the screen, accompanying brain wave signals, are all recorded with the purpose of elucidating how the user’s appreciation is achieved. In other experiments, subjects were asked to recall, by drawing or making models, their perception of objects viewed either as 2D images, as 3D objects, or viewed as 3D objects and also handled. Recall was related to personality. In contrast to activities elsewhere, the clear input of psychologists / behavioural scientists into the planning of experiments was evident. Interpretation at a neuro-science level seemed still to be for the future. But the understanding that had been gained was being used to programme robots with ‘artificial behaviour’.

In summary, we saw at Tsukuba the start of an approach to developing an understanding of emotional and subjective feelings from a psychological and neuro-sciences viewpoint, with a goal of translating that understanding into an information society application context. At some stage in the future, such work will undoubtedly become applicable more generally to emotionally enhanced product and packaging design.
KANSEI ENGINEERING IN JAPAN - ANALYSIS & OPPORTUNITIES FOR THE UK
**DEVELOPMENT.** Kansei Engineering in Japan owes its origin to an academic decision of the Engineering Faculty of Hiroshima University, in the early 1970s, to conduct research into emotional technology within its Engineering Management Group. From the start it has been design focussed, in collaboration with companies, aiming to find ways to translate customers’ emotional feeling requirements into a product’s (or packaging’s) assembly of features. From early application in building product and clothing fashion industries, it has spread across at least automotive, electronic home and office products, cosmetics, food and drink and packaging industry sectors. There is now a Japan Society of Kansei Engineers. It has forty member groups and publishes an English language journal Kansei Engineering International.

**CURRENT STATUS.** Companies use Kansei to minimise intuition in design decisions. The main established tool of Kansei Engineering is the analysis of users’ self-report reactions to product or prototype variations, although there is a growing use of subconscious psycho-physiological testing. Self-report analysis can range from qualitative consumer research focus groups and semantic mapping activities at a level familiar to UK industry (e.g. Asahi), through much more detailed statistical and trend analyses (e.g. Toppan), to a level of detailed product decomposition and analysis unseen in the UK (e.g. Mazda). A specific implementation protocol known as Kansei Category Classification has proved itself to be extremely effective (observed by us at Milbon and Mazda). Other more niche tools are known as Kansei Engineering System and Hybrid Kansei Engineering System.

**IMPACT.** In a product evolutionary journey, from creating interest and excitement firstly by a high degree of functionality, then by excellent usability and finally by strong cognitive and emotional appeal, the companies that we visited are using Kansei Engineering towards gaining commercial impact at that final level. Generally functionality and acceptable cost are now taken as basic ‘must have’ attributes. Usability is a differentiator of satisfaction. Delight is the emerging frontier. Asahi’s brand concept of ‘Expecting New Things’, Shiseido’s ‘Customer Quality = Physical Quality times Kansei Quality’, Toppan’s image of ‘Leadership in Information Synthesis’, Seiko Epson’s integration of human life aspects into their products, M.E.W’s ‘Total Integration’ brand image and M.azda’a ‘Zoom Zoom’ are all in their different ways expressions of this movement. All the companies think that Kansei will become more important in the future.

**IMPLEMENTATION.** We saw that Kansei Engineering could fit well into a Total Quality Management Quality Function Deployment approach to decision taking and planning. There is a general Japanese company culture, technology led, of deep understanding of their products, of all stakeholders working together, leading to a confidence in successful innovation.

**IMMEDIATE RESEARCH ISSUES.** Some companies expressed the view that, even at the self-report level of investigating feature-affect relationships, there is a need for more robust methodology. This is clearly a topic for further study. A short-term research by case study question for the UK is the extent to which the tools that have been established in Japan are effective in the UK, both inherently and within a Western business culture, and whether they can regularly lead to market successes at an acceptable cost, in the manner that Milbon found.

**LONGER-TERM RESEARCH.** A goal is the integration of engineering led, design focussed, kansei or affective design studies with a new wave of psychology / neuro-sciences / artistic research more deeply seeking an understanding of the human-product interface. Such new studies are established in Japan (as elsewhere), linked to information society technology rather than to more traditional product and packaging applications. How to harness new understanding generally to create new, satisfying, products and packaging is the question.
The following points of view are those of individual members of the mission. They do not necessarily represent those of the companies for whom they work.

**A FOOD INDUSTRY PACKAGING AND RETAILING VIEW**

The burning question is can Kansei work in the food industry? The answer is not certain, but it must be worthwhile to find out. Traditionally the industry has relied on the products selling themselves, whether that is through the freshness of unpacked fruit or the high quality photography on the front of a ready meal pack. Little thought has gone into the emotional impact the design has on the potential consumer - normally saying “roast duck with an orange and brandy sauce” has been enough to get the emotional juices flowing and achieve a sale. Further, the plethora of legal text (in many languages), cooking instructions and nutritional values (also in many languages) has meant the space for extra “emotionally inspired” text has been very limited.

That was then and this is now. The global marketplace is a very crowded street indeed. There are many players: the big brands, niche products, own label products and brands, organic products, not to mention the back to basics approach of farmers' markets. The need to stand out and make an immediate impact to an increasingly discerning and sceptical consumer must now be greater than ever. Imagine, if you could emotionally “get under the skin” of the consumer, persuade them to buy your product and before they know it your pack is in their basket and on the way to the checkout. Would that be a powerful tool? The answer to that must be yes.

That is where Kansei might come in. Work on the way that individual aspects of packaging design influence purchase decisions and back up the eating experience that the product and marketing have developed has never really been carried out in the UK / European food industry. Most food design work looks at the holistic approach of the total design. It is not known what are the contributions of the individual parts. Maybe a subtle change of colour, logo shape or pack shape could have a far greater influence than current designs? By Kansei principles, the brand insights, product concepts or marketing plan for a range of products could be applied to the individual parts of the brief and individual parts of the design. The result could be something that more attracts the consumer emotionally to pick up the pack. If this could then be reinforced through some other pack design aspect (texture, sound, etc?) a winner might well be then created.

Of course the garden is not full of roses and there is considerable risk in adopting Kansei. This technique has not really been tried outside Japan and we all know there are considerable differences between the Japanese culture and that of Europeans or Americans. Even the Europeans who have studied with Professor Nagamachi realise this and feel the techniques will need adapting to the European palate. In addition, the study of Kansei is in its infancy in this country with, for example, the laboratory in Leeds only being opened this month (February) and a considerable amount of work is needed to research this further.

Finally, we all saw in Japan that Kansei worked best in engineering industries (motor manufacturing in particular) where large projects and long development programmes are accepted and encouraged. This approach gives Kansei the time to look into the detail of each process and understand the large number of consumer responses generated. The food industry has neither of these approaches and a considerable step change will be needed to take in Kansei with open arms and make it work. So, can Kansei work in the food industry? The answer is probably, but there is a need to start now and be committed to its principles to find out.
A PHARMACEUTICAL INDUSTRY VIEW

Where is the industry in the journey from satisfying customers by function, usability and affect? From an ethical pharmaceutical point of view, the answer to this question would be that function must be satisfied to a high level, optimising packaging usability is a current topic and whether or when affective or kansei design will become relevant for prescription medicines is a matter for speculation. Over the counter (OTC) medicines are a different issue. For these the design process is more advanced in the journey. Changes in the packaging of OTC medicines are clearly influenced to a greater extent by consumer trends in food, personal care, etc. Affective design is going to be relevant in this area much sooner, as a differentiator between the huge ranges of conventional and alternative treatments.

What could affective design achieve for pharmaceuticals? With fewer truly unique chemical entities to discover, many companies are marketing treatments from the same chemical product family and competition is becoming fiercer. Affective packaging may help create advantage, especially if it offers some greater assurance that the patient will complete the course as prescribed, or if it aids the delivery of the product. Patient and customer needs are becoming of increasing importance. Within ethical medicines patients are expected increasingly to influence the doctor to prescribe the drugs they prefer or perceive to be more effective. Then affective design could create opportunities if directed to appealing to senses of vision, hearing, smell, taste, touch, skin and ‘inner sensation’ or ‘gut feel’, or to enhancing feelings of well being, satisfaction or quality of life. In support of its therapeutic benefits, the product might win higher regard, if the packaging ‘image’ were well thought out, the graphic design matching exactly the psychological perception of the product attributes. The relationship between mind and skin could be further exploited, given the belief that well-being of the skin is linked to the health of the nervous and immune system. A greater number of pharmaceutical products could be imagined delivered through the skin, the products and their packaging, thus being perceived as closer to the patients ‘kansei’. In all these ways, there could be pharmaceutical opportunities for affective or kansei design.

What can be learned from Japan? It is clear that there the Kansei approach is highly analytical and rigorous. This would fit well in the pharmaceutical industry with its heavy emphasis on science and in-depth research. However, considering the huge databases of kansei words and information that have been developed for consumer products in Japan, it would take a reasonable length of time to develop this base line of knowledge. On the other hand, the rigorous basis of Kansei ensured, to a higher degree, right first time development. This is directly relevant to pharmaceutical products where success is very dependent on reception at launch. Of further interest is the combination of ergonomic and Kansei approaches, particularly relating to Universal Design with its emphasis on use by anyone in any environment, simply and intuitively, with tolerance to mistakes during use, resulting in fewer accidents or injuries. These principles reflect some of the aims of pharmaceutical product and packaging design, especially given the current ageing population and the need for senior-friendly designs. Tools such as the Package UD Diagnostic System (Toppan) could be directly applicable to tracking trends and development of new pharmaceutical and OTC packaging. Use by anyone, however, conflicts with the requirements to make some medicine packaging child resistant.

A HOME AND PERSONAL CARE PRODUCTS VIEW

Brands are made in the mind, products are made in the factory, design connects the two. Well-designed branded products that meet the functional and emotional needs of the consumer will be successful products contributing to the growth of the business. As brands become global it is important that the deep-seated unarticulated needs of the customer are discovered and translated from ill-structured
Kansei Engineering has the potential to do this. It is a systematic approach to collecting, collating, mining and understanding customer and user information so that it can be understood and acted upon in a structured way. It is said that around 85% of new products in our supermarkets are ultimately unsuccessful. Could the reason be that we do not as New Product Developers really understand the needs of our customers? Kansei Engineering addresses the need to understand the customer and so even a small change in the success rate of new products could make the investment in Kansei worthwhile – understanding it and translating it into a viable methodology within the organisation’s culture could reap handsome rewards.

A CONSULTANT’S VIEW

Kansei Engineering is particularly interesting as a mechanism that could consistently achieve high quality packaging design that delights the customer. There are many aspects of packaging design that must be considered by the designer, including technical, practical and commercial aspects of protection, containment, compatibility, performance, production efficiency, cost, distribution, cube, storage, etc. Further considerations such as sustainability and environment have a growing influence in addition to the key aspects for consumer packaging of customer needs, visual impact, shelf presence, originality, etc. All these and many more already play an important part during the design process and various tools and techniques are employed to achieve the final design and ensure the design parameters are all met. However, the structural aesthetics of the design are still largely subjective and down to the creativity and skill of the designer to get into the mind of the customer and deliver a stunning pack design.

Kansei Engineering can be seen as a way to quantify and qualify this process, helping and directing a designer to the perfect solution that will delight the customer. It also enables the designer to support, otherwise subjective evaluations of designs to the client, to aid the selection process. Whilst for many clients, the cost of employing kansei techniques may be too prohibitive at present, there are many big brands and challenging markets where this process could dramatically increase the products’/packs’ chance of success. Particularly in the case of the larger brands, it could provide a significantly increased level of security that a particular change is right for their customer / market. Where Kansei techniques have been employed thoroughly to product development, the benefits and results are obvious and clearly attributable. However, most of the use so far has been directed at products and not packaging. There is a clear need to assess its benefits of risk reduction in new packaging releases against its overhead of extra activity. For the future, it will be particularly interesting to see whether the new direct measurements of subjects’ emotional responses, in contrast to the self-report methods, will improve the balance of reward to cost in the UK market.
APPENDIX – THE MISSION MEMBERS
(AND AUTHORS OF THIS REPORT)

**Tom Childs** is Professor of Manufacturing Engineering, School of Mechanical Engineering, University of Leeds and leading Affective Engineering research for the Faraday Packaging Partnership. He has an international research reputation, with strong links with Japanese researchers that have supported the development of this mission.

**Alan de Pennington OBE** is Professor of Computer Aided Engineering, School of Mechanical Engineering and Director, Keyworth Institute, University of Leeds, responsible for research and teaching in design and specialist research interests in CADCAM Data Exchange; Modelling in the Design Process; Product Data Engineering; Business Process Engineering; and Enterprise Integration.

**Jim Rait** is Manager, Design Technology and Strategy within Unilever’s Home and Personal Care Port Sunlight Packaging Design Technology Centre, responsible for discovering, demonstrating and deploying world-class design technologies and improved design processes that enable globally dispersed teams to work together to deliver bold innovative products to Unilever’s customers.

**Terry Robins** is Packaging Innovations Manager, Sainsbury’s Supermarkets Ltd., responsible for overall technical and legal issues with packaging but with a focus on new development throughout the entire company. In recent years this has included guiding introduction of a new code of practice on hygiene and technical issues for the packaging industry that has since become a European Standard.

**Karen Jones** is Packaging Projects Manager in the Packaging Development Group at AstraZeneca’s Macclesfield site, responsible for projects relating to packaging and labelling, on both a local and international scale, including co-ordination of packaging related activities on site for new product launches and the continuous improvement of business processes in the printing and labelling area.

**Chris Workman** is Packaging Technology Manager – Product Bank at Boots plc, responsible for assessing and facilitating development of new and emerging technologies that could enhance the packaging of Boots Product Portfolio in Europe and Asia, with a brief spanning beauty, personal care and healthcare product ranges.

**Sean Warren** is Packaging Technology Research Manager, Masterfoods, a division of Mars UK Ltd., responsible for fundamental and applied packaging research into new machines, materials and methods, and creation and co-ordination of European PhD research programmes in packaging. He is also responsible for development of virtual packaging and innovation process management systems.

**James Colwill** is Head of Packaging Development at Pira International, with over fifteen years experience as a packaging consultant. For the past five years he has specialised in packaging innovation and design, undertaking numerous projects for leading household and brand names.
Further copies of this Report and information on the Faraday Packaging Partnership are available from:

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