ELSEVIER

International Journal of Industrial Ergonomics 27 (2001) 271–283

International Journal of
Industrial
Ergonomics

www.elsevier.nl/locate/ergon

# High Touch – an innovative scheme for new product development: case studies 1994–1998

Myun W. Lee[a], Myung Hwan Yun[b,*], Sung H. Han[c]

[a] *Department of Industrial Engineering, Seoul National University, Seoul 151-742, South Korea*
[b] *Department of Industrial Engineering, Pohang University of Science and Technology, San 31 Hyoja Dong, Pohang, 790-784 South Korea*
[c] *Department of Industrial Engineering, Pohang University of Science and Technology, Pohang, 790-784 South Korea*

Received 31 March 1999; accepted 30 October 2000

**Abstract**

Although many product developers may have high hopes for developing a new product in their respective domains, most product development efforts focus on incremental innovations. Accordingly, most research on the product development process focuses on the development of evolutionary products. In a project seeking the means for achieving breakthrough innovations, the fundamental question is: How do we integrate the innovative ideas into the product development process? To provide an answer to the question, the concept of High Touch is presented with case studies conducted between 1994 and 1998. This study also presents a systematic model for identifying the consumer needs and for generating new product 'ideas' based on the identified needs. High Touch is a product development strategy initiated and promoted by the first author since the 1980s. The insight gathered from the model and case studies of High Touch showed that the process for innovative product development should allow exploration and diversion of the project team facilitated with heavily consumer-driven development process. The key success factor for all the case studies presented in this study seems to come from the systematic convergence of technological competence and the visionary role of the development team. In the front end of the successful new product development, the vision and implicit potential of the product should sometimes override the typical feasibility analysis, market assessment, and financial analysis of the product.

**Relevance to industry**

New product development is a key factor to the successful product strategy and thus, one of the most important components of a firm's competitiveness. The method and case studies presented in this paper will be useful to any industry that designs and produces consumer products. Especially, the case studies are very well suited to the manufacturers of consumer electronic products. 

*Keywords:* High touch; New product development; Product design; Idea generation; Consumer needs; Innovative design

## 1. Introduction

Product development is an interdisciplinary activity requiring contributions from nearly all the functions of management systems. Because of this, many firms adopted the concept of

*Corresponding author. Tel.: +82-562-279-2207; fax: +82-562-279-2870.
*E-mail address:* mhy@vision.posetch.ac.kr (M.H. Yun).

0169-8141/01/$ - see front matter 
PII: S0169-8141(00)00056-1

"concurrent engineering" or "cross-functional team approach" of product development (Andreasen et al., 1987). In the past, typical product development process consisted of several processes organized sequentially. Therefore, a process is thrown into the next process unidirectionally (Fig. 1, Ulrich and Eppinger, 1995).

Although different organizations have different structures, roles, and responsibilities among product development teams, this 'sequential' phenomenon is often noted as the major huddle to overcome in successful product development. Another important point to note in this type of product development is that heavy emphasis is placed on variables that are related to the efficiency and performance of manufacturing/production functions such as ease of design, ease of manufacturing, manufacturing cost, and materials requirement. Important concepts such as consumer needs, potential demand, product usability are often discounted and reduced in consideration.

The process of identifying consumer needs is an integral part of the larger product development process and most closely related to the conceptual design, design selection, competitive benchmarking and the establishment of product specifications. Needs are largely independent of any particular product while the concept of specification is heavily dependent upon the product itself. Because of this characteristic, although manufacturers argue that they fully recognize the importance of consumer needs, systematically including a process that incorporates user's viewpoint and implicit needs on a product has been difficult to realize (Nagamachi, 1994).

High Touch is an approach to systematically identifying the consumer's needs and implementing them those needs into product design. The term High Touch has been originally used by Naisbitt (1984) to express human needs towards more personalized products and services. High Touch is redefined and developed as an ergonomic design strategy by the first author from the 1980s (Lee, 1994). Since then, High Touch has been applied to the development of various consumer electronic products in Korea with great success (Lee, 1995). From 1988 to 1992, High Touch product development projects were carried out with the joint effort of a leading consumer electronics manufacturer. Seventeen High Touch products were developed during the period (12 of those are shown in Fig. 2). The Universal Remote Controller and the computer for pre-school children (labeled as KOBO in Fig. 2) were introduced to the market successfully.

The projects have received a wide attention. "More Future Stuff: Over 250 Inventions That Will Change Your Life by 2001" (Abrams and Bernstein, 1991) featured three High Touch products such as voice-activated microwave oven, remote-controlled vacuum cleaner and

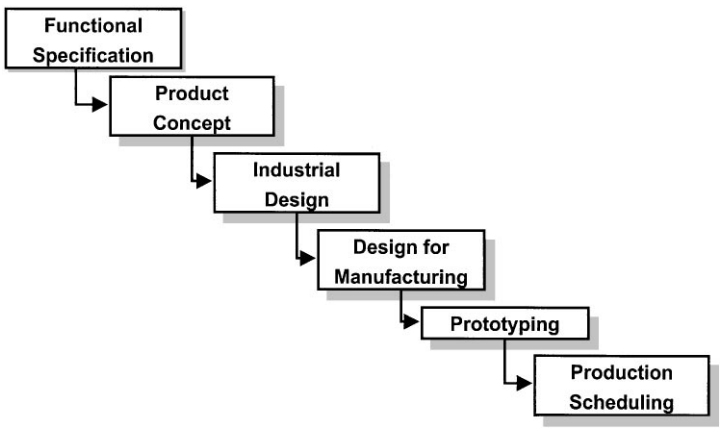


Fig. 1. Typical process of product development (Ulrich and Eppinger, 1995).

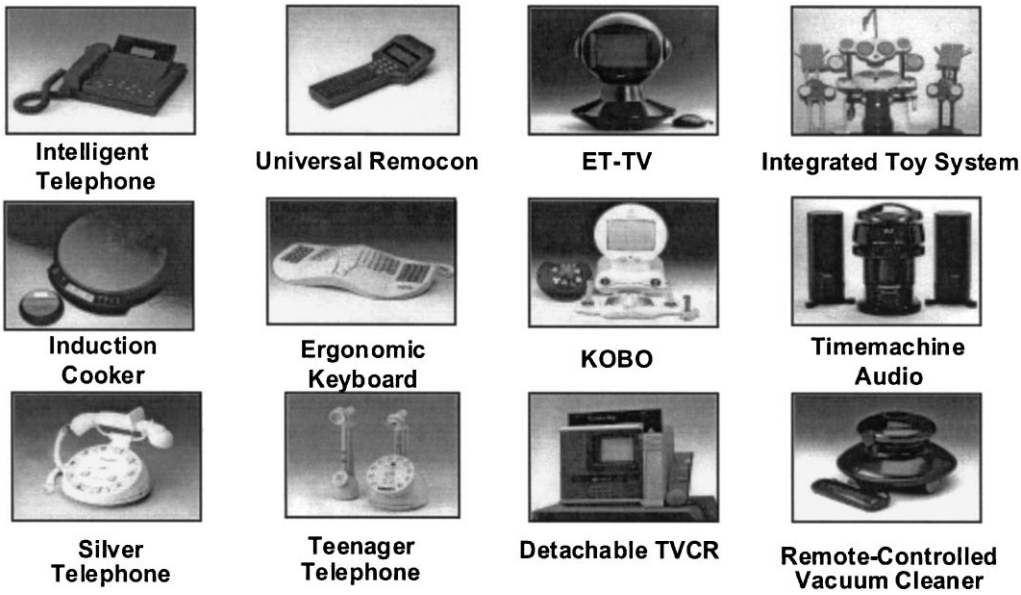


Fig. 2. High Touch products developed between 1988–1992.

walking–talking television. The New York Times (New York Times, 1991) called the High Touch idea, a new concept for the information era. In a US consumer survey made in New York (Lee et al., 1991a, b) consumers were willing to pay High Touch products 30–50% more than the leading high-end models.

With respect to the development process, High Touch can be defined as the integration of the initial stage of a product development such as conceptual design, functional analysis, and prototype construction. High Touch process consists of a series of systematic evaluation of the product by a product development team to transfer the consumer's implicit needs and potential demand into specific product functions. It puts emphasis on product development by a multi-functional team in the framework of concurrent engineering. In the multi-functional task force, various designers and engineers including electronics engineers, mechanical/chassis engineers, marketing specialists, industrial designers, and human factors specialists work together in a common workplace with special emphasis on extensive communication opportunities between members.

With respect to the methodology, High Touch is defined as "the transformation of the consumer's implicit needs and potential demand on a product into design details". To realize this, a systematic step by step design procedure is established as shown in Fig. 3. The procedure consists of a series of analyses of a product. A group of expert ergonomists systematically examines the product through focused group interviews, task analysis, and field test. Based on the result, an ergonomic evaluation including variables such as human characteristics, product functions, and human–product interfaces is performed using a systematic checklist. By analyzing the evaluation result, new High Touch ideas (new product ideas, new product functions, and design improvements) are generated.

A clear distinction exists between the High Touch process and a typical design process conducted in the field. First, the conceptual design is approached from the hierarchical breakdown of design variables. Second, the hierarchical structure of the ergonomic variables is used extensively to evaluate product functions from the ergonomic standpoint.

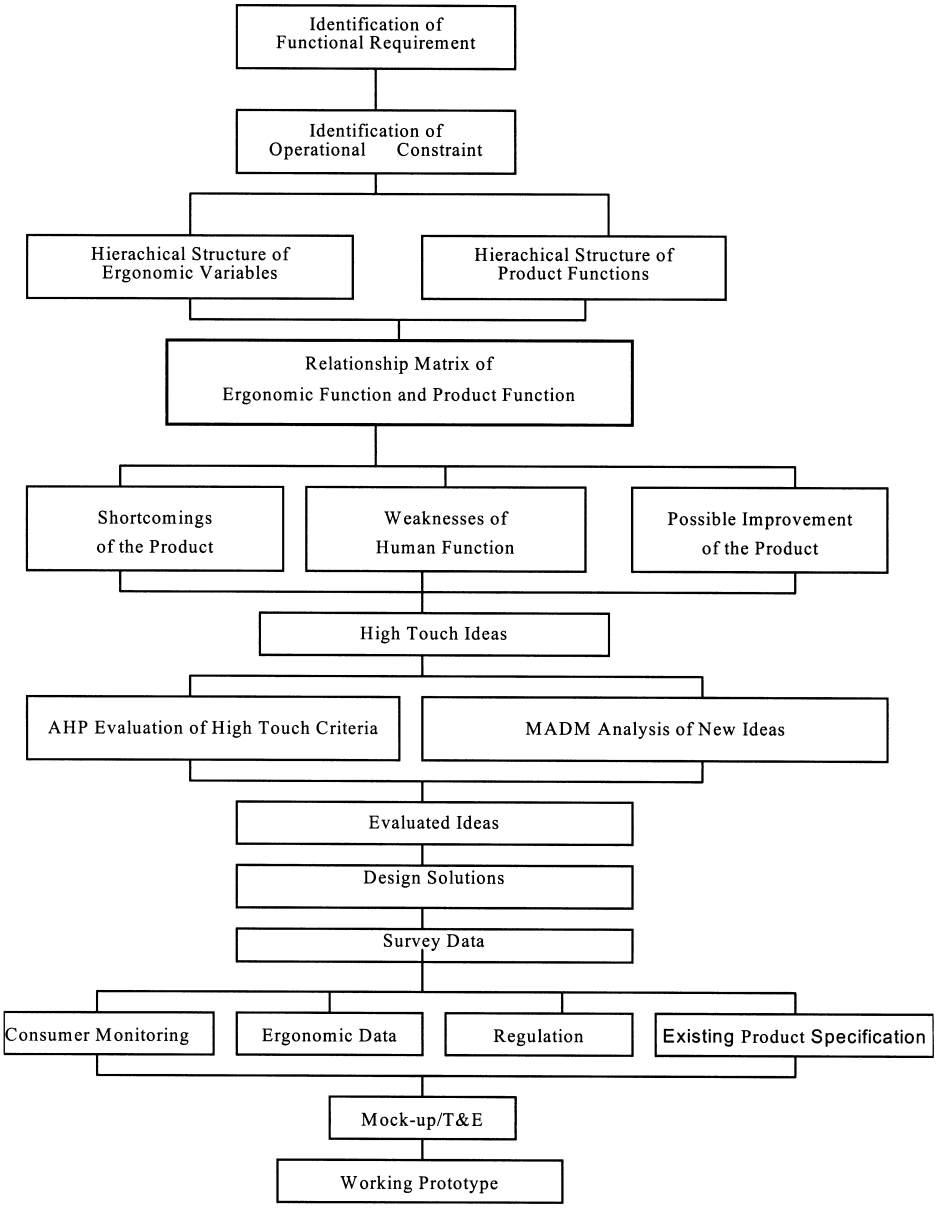


Fig. 3. High Touch design process.

Various aspects of human capability and functional limits are formulated into the hierarchical structure. Similarly, a product of concern is also expressed as a hierarchical structure of various sets of product functions. From these two hierarchies, a matrix of (Human Characteristics vs. Product Function) is formed and analyzed. Given a product, the matrix analysis provides shortcomings, weaknesses, and necessary implementations of the product. Trying to supplement these shortcomings and weaknesses generates many unique High Touch functions or new ideas.

A list of these High Touch ideas is evaluated systematically using the analytical tools such as

(Analytic Hierarchy Process (AHP), Saaty, 1980) and (Multiple Attribute Decision Making-Technique for Order Preference by Similarity to Ideal Solution (MADM-TOPSIS), quoted in Chen and Ko, 1994). These analyses produce a priority list of High Touch ideas (new ideas ranked by their importance). Based on the result, corresponding design solutions are discussed between ergonomists and product designers. The focus is usually given to the feasibility of implementing the new 'ideas'. From the final list of the ideas selected, a conceptual design of the prototype is made. Values such as consumer taste and aesthetic fidelity are emphasized in the design prototype. After the selection and consumer monitoring of the new ideas, a working prototype is made to demonstrate the feasibility of the product design. Then, the typical process of product design such as analysis of business opportunity, market assessment, and financial analysis is followed together with manufacturing studies.

## 2. Idea generation in high touch design process

In order to identify the implicit needs of consumers and the areas of potential demand on a product, several analysis schemes have been developed. The analysis schemes include several means to apply human factor disciplines to generate new ideas. Variables that tax heavily on user convenience become the primal target of High Touch design. Several articles have been published to explain the concept of High Touch design in the past (Lee et al., 1991a, b, Kim et al., 1990, Lee, 1994). Details of these idea generation schemes are explained in the following.

### 2.1. Trend analysis

By observing the evolution of a renowned product systematically, one can identify the future evolution of a newly emerging product. Thus, a proposition can be made as follows:

**Proposition 1.** *By analyzing the development pattern of an existing product, identification of potential improvement for another product can be made.*

Table 1 shows an example of trend analysis. As shown in Table 1, by analyzing the trend of a familiar product (e.g., automobile), the probable trend of a newly emerging product (e.g., computer

Table 1
Example of the trend analysis – automobile vs. computer[a]

| Category | | Automobile | Computer |
|---|---|---|---|
| Performance criteria | (Past) | Power, speed | Speed (CPU), memory |
| | | ↓ | ↓ |
| | (Present) | Safety comfort | Software usability |
| User population | (Past) | Driver | Programmer, operator |
| | | ↓ | ↓ |
| | (Present) | Whole populatio | Whole population |
| High Touch | (Past) | (Driver seat) | (Workstation) |
| | ↓ | Fixed seat | Fixed workstation |
| | (Present) | Adjustable seat | Interchangeable |
| | ↓ | ↓ | Workstation, |
| | | | ↓ |
| | Trend | Power seat | Multi-media |
| | ↓ | ↓ | Multitasking |
| | | | ↓ |
| | Future | Computerized memory seat | Customized workstation, |
| | | Intelligent seat | Information center |

[a] Dotted box represents projected trend.

workstation) can be projected. As speculated in Table 1, an analogous comparison between automobile seat and computer workstation can provide a direction for future product development for both products.

### 2.2. Functional transitivity

Another method to identify new product functions is to adopt a new technology of an advanced product into another product. Application of this principle is defined as functional transitivity as expressed in the following proposition:

**Proposition 2.** *By transferring new functions of an advanced product to the product of concern, desirable functions can be visualized.*

In Fig. 4, the concept of functional transitivity is explained using the functions of TV, VCR, and Audio as examples. Considering the 'sound equalizer' function of an audio, functional transitivity shows that the concept of equalizer that adjusts the amplitude of sound spectrum can be adopted to video products for a new product function that adjusts video spectrum (Lee, 1994). For example, the concept of a pre-programmed audio equalizer which recommends the best sound spectrum based on user's choice of music can be transferred to new video functions that display pre-set video effects based on the nature of the video program.

### 2.3. Potential demand

Potential demand is operationally defined as 'the expanded demand of a product', i.e. sum of the existing demand and the additional demand generated by adding new functions to the product. Thus, potential demand of a product can be estimated by identifying implicit needs of consumers:

**Proposition 3.** *Potential demand of a product can be estimated by analyzing the implicit needs of consumers.*

Table 2 shows an example of finding the areas of implicit human needs related to a telephone use. Since the functions of a product reflect the ever-increasing nature of consumer needs, many new functions can be conceptualized following the areas of implicit needs.

### 2.4. Hierarchical analysis

Various human aspects such as capability, capacity and functional limits can be represented by a hierarchical structure. Similarly, functional aspects of a product can be represented by a hierarchy. From these two hierarchies, a matrix of (Human × Product) can be formed. Given a product, the matrix locates probable areas of implicit needs. Once the area of implicit needs is

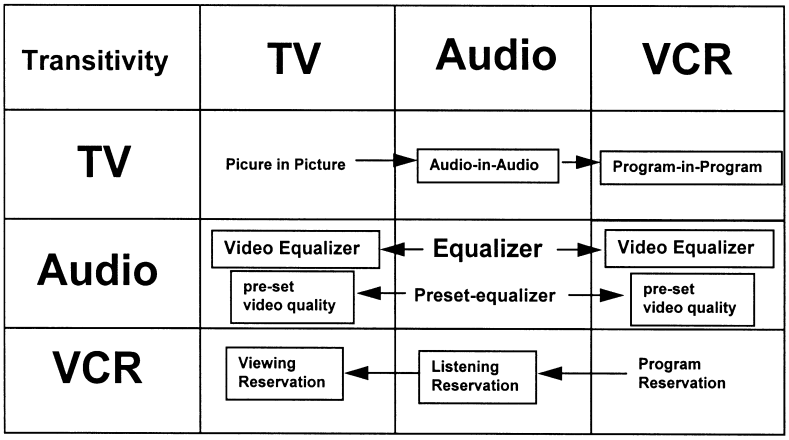


Fig. 4. Concept of transitivity matrix (Audio–VCR–TV).

Table 2
Example of the analysis of potential demand – telephone

| Needs | Description | Potential new function |
|---|---|---|
| Calling | Time check | World time |
| | Directory search | Alarm check |
| | Select caller | Computerized directory |
| | Auditory monitor | Auto call setting |
| | Dialing and monitorig | Reservation call |
| | Lifting multiple handset | Sequence call |
| | Memo | Auto-hook |
| | Schedule record | Schedule record |
| | Phone number record | Phone number record |
| | | Alarm setting |
| | | Auto schedule setting |
| | | Record and play |
| Answering | Handset up | Auto response |
| | Courtesy answering | Auto call setting |
| | Person searching | Schedule record |
| | Memo | Phone number record |
| | Exchange answer | Auto schedule setting |
| | Auditory monitor | Record and play |
| | Memo | |
| | Schedule record | |
| | Phone Number record | |

identified, further analysis follows to implement shortcomings, weaknesses, and necessary functions of the product.

**Proposition 4.** *By analyzing the relationship between human variables and product functions, targets for High Touch design can be systematically identified.*

Table 3 shows an example of hierarchical analysis applied to the design of a new remote controller for a VCR. Even these days, product design is heavily inclined to an engineer's viewpoint rather than the user's viewpoint. For example, a remote controller of a leading VCR model had 125 control buttons. Imagine a typical user who has to struggle with 100 page manuals (Lee, 1994). Table 3 shows the approach used in the design of a new remote controller using an onboard LCD screen.

## 3. Case studies between 1994 and 1998

Following the success of the High Touch products and the favorable response on the High Touch method both from the industry and academia, expanded efforts were made to apply the concept to other category of products. During the period of 1994 and 1998, several projects to apply High Touch to home appliances, personal computers and educational toys were conducted with leading manufacturers in South Korea. The summary of the projects conducted during the 4 years is presented in Table 4.

### 3.1. Project 1: the '*hand wash*' home electric washer

As in any other product, home appliance products have distinct characteristics of their own. Table 5 shows the conceptual differences in consumer's perception of home appliances products from typical consumer electronic products.

Following the process of High Touch, 28 new ideas are selected as shown in Table 6. Based on the AHP/MADM evaluation and focused group interviews, eight ideas were selected and implemented in the final prototype design. Those were combination pulsator, pulsator elevation, ergonomic handle grip, power door, self-learning display, personal wash programming, tub lighting, and wash progress display.

The mass production of the washer began in June 1995. The first model sold 50,000 units increasing the domestic market share of the manufacturer from 34% to 42%. It was awarded as the product of the year by several newspapers in Korea. The second model with power door and tub lighting was introduced in 1996 and recorded a strong sales. Fig. 5 shows the prototype and the final production model.

### 3.2. Project 2: the '*elevator*' microwave oven

Microwave oven was approached by using the hierarchical analysis method. The new ideas generated were: automatic door, automatic tray in/out, vertically elevating tray, odor removal system, interior lighting, and progress monitoring. The prototype and final production model are shown in Fig. 6. With the help of the new model, the manufacturer was able to dominate the microwave market in 1996. It also became the best-selling model in 1996.

Table 3
Example of the hierachical analysis – ergonomic remote controller[a]

| | Product variable | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Grip | | | | | Control button | | | | | | Display | | | |
| | | | | | | Primary control | | | | Secondary control | | | | | |
| Ergonomic variable | Grip length | Grip breadth | Grip thickness | Grip shape | Power | Mute | Mode | Volume | Device select | Channel | Display button | Display type | Display size | Display angle | Display location |
| *Visibility* | | | | | | O | | O | O | O | O | O | O | O | O |
| Visual field | | | | | O | O | | O | O | O | O | | O | O | O |
| Visual angle | | | | | | O | | O | O | O | O | | O | O | O |
| Glare effect | | | | | | | | | O | O | O | O | | O | O |
| Eye mov't | | | | | O | | O | O | O | O | O | | O | | O |
| Color percept. | | | | | O | | O | | O | | | | | | |
| *Anthropometry* | | | | | | | | | | | | | | | |
| Finger size | O | | | | O | O | O | O | O | O | O | | | | |
| Finger angle | | O | | O | | | | O | | O | O | | | | |
| Hand grip | O | O | O | O | O | O | O | O | O | | | | | | |
| *Spatial compatibility* | | | | | | | | | | | | | | | |
| Motion economy | | | | O | O | O | O | O | | O | | | | | |
| S-R compa'ty | | | | | | | O | O | O | O | O | | | | |
| Control priority | | | | | O | O | | O | O | | O | O | | | |
| *Cognitive compatibility* | | | | | | | | | | | | | | | |
| Infor'n loa0d | | | | | | | | | O | | O | O | O | | |
| S-R comp'ty | | | | | | | O | O | | | O | | | | |
| Kinethetic feedback | | | O | O | | O | | | | | | | | | |
| Signal redundancy | | | | | O | | | O | | | | | | | O |

[a]O: consumer needs.

Table 4
Summary of the case study

| Project No. | Category | Product, model name | Key features | Project year |
|---|---|---|---|---|
| 1 | Home appliances | The 'Hand Wash' electrical home washer | Elevating pulsator<br>Auto door | 1995 |
| 2 | Home appliances | The 'Elevator', Microwave oven | Elevating tray<br>Auto door and tray | 1996 |
| 3 | Home appliances | The 'Double Compressor', Refrigerator | Auto tray, lighting<br>Double compressor | 1996 |
| 4 | Home appliances | The 'High Fill', Water Purifier | Faucet attachment<br>Replace timber | 1997 |
| 5 | Education/toy | PaperMagic™, Paper Assembly | Cultural product<br>World heritage series | 1998 |
| 6 | Personal computer | 'N$^{2}$' Next Generation, PC | (On-going project) | N/A |

Table 5
Characteristics of home appliances product design strategy

| Product | Home electronics | Home appliances |
|---|---|---|
| Category | | |
| Usage | Leisure | Task |
| User | All families | Housewife |
| Image | Enjoy, fun | Uncomfortable,<br>Difficult |
| Operation | Remote | Physical work<br>Movement, load |
| Enviornment | Clean, open | Noisy, dark |
| Purchase point | New product,<br>New function,<br>Frequent change | Long life cycle<br>Long term usage |

Table 6
List of potential functions considered in the washer project

| Major component | Design variable |
|---|---|
| Controls | Switch shape redesign (size coding) |
| | Braided control button |
| | Hidden/open control selection |
| | Water supply selection |
| | Sloping of the control section |
| | Choice/taste selection |
| Displays | Touch screen operatioin |
| | Warming signal improvement |
| | Task guidance system |
| | Automatic lighting adjustment |
| | Voice instruction |
| Wash tub | Interior lighting |
| | Self-cleaning |
| | Heat blower pre-drying |
| Pulsator | Combination pulsator |
| | Raised pulsator |
| Water supply | Controllable water outlet |
| | Auto detergent input |
| | Optimum course selection |
| | Water supply buffer |
| | Waterfall supply |
| Case | Ergonomic grip |
| | Power cord reel |
| | Clothes sorting station |
| | Pre-wash/utility basket attachment |
| | Detachable hangers |
| Door | Transparent door |
| | Auto-door |

### 3.3. Project 3: the '*double compressor*' *refrigerator*

Hierarchical and task analyses of the refrigerator showed wide cultural differences in the product use. The use of refrigerator as food storage was vastly different between countries. Many new ideas were generated focusing on the characteristics of the Korean food and its use. Those were: separate storage for food containers, automatic tray in/out, separate cooling system for freezers and refrigerator section, ergonomic door grip, out board display and storage information system. The prototype refrigerator is shown Fig. 7.

### 3.4. Project 4: the '*high fill*' *water purifier*

The water purifier market in Korea was dominated by expensive electrical purifiers. The High Touch purifier was designed for faucet attachment and targeted consumer needs in purifying water for use in the kitchen sink. The model was also fitted with a convenient

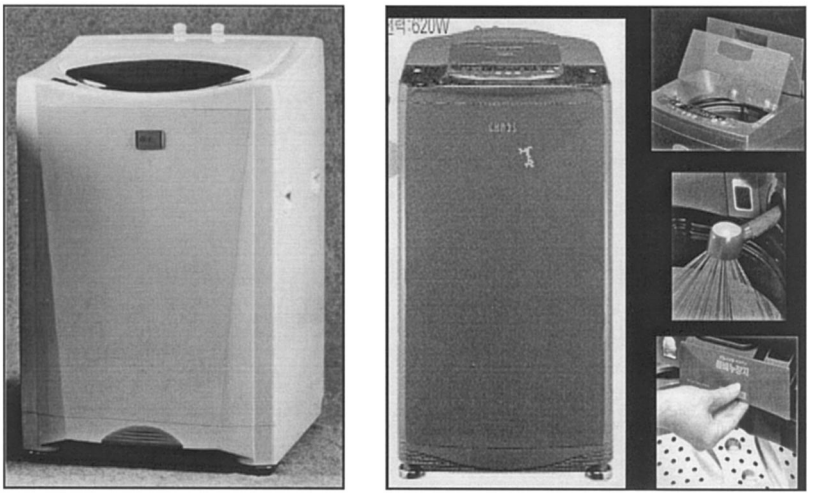

Fig. 5. Home electric washer prototype and production model.


Fig. 6. Prototype and final production model of microwave oven.

filter replacement sensor to notify the replacement time to the user. It became one of the products of the year in 1996 and the best-selling water purifier in 1996 and 1997 (See Fig. 8).

### 3.5. Project 5: the '*PaperMagic*$^{TM}$' paper assembly kit

The project undertaken is motivated by exchanging culture and cultural products of different


Fig. 7. Prototype and final production model of the refrigerator.

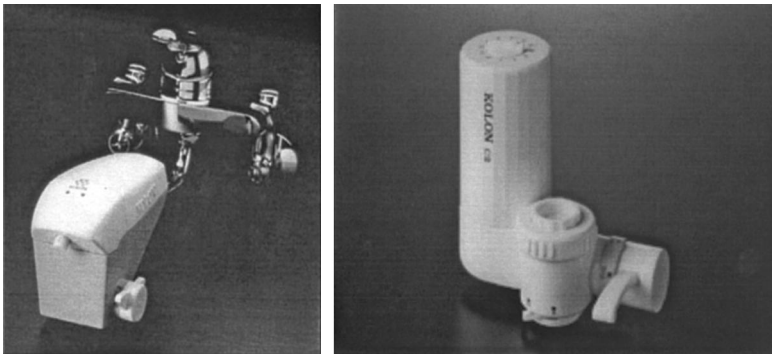


Fig. 8. Prototype and final production model of the water purifier.

countries in a universal platform. It was aimed at the integration of cultural heritage with education and fun. Based on highly detailed paper assembly kit, the PaperMagic™ produces a series of cultural products. It will eventually cover all of the UNESCO's world heritage sites when completed. At present, the world heritage sites in Korea are being manufactured (Fig. 9). PaperMagic™ is showing a strong sales record internationally as well as domestically.

### 3.6. Project 6: the '$N^2$' next-generation PC

This project is undertaken to configure the PC for the next generation. While the PC and TV markets have geared toward an integration, many PC–TV (as conceptualized by Microsoft®) or TV–PC (as conceptualized by SONY®) did not show promising results up to now. The next-generation PC is being targeted at the second generation of the digital PC–TV format. The focus is on human

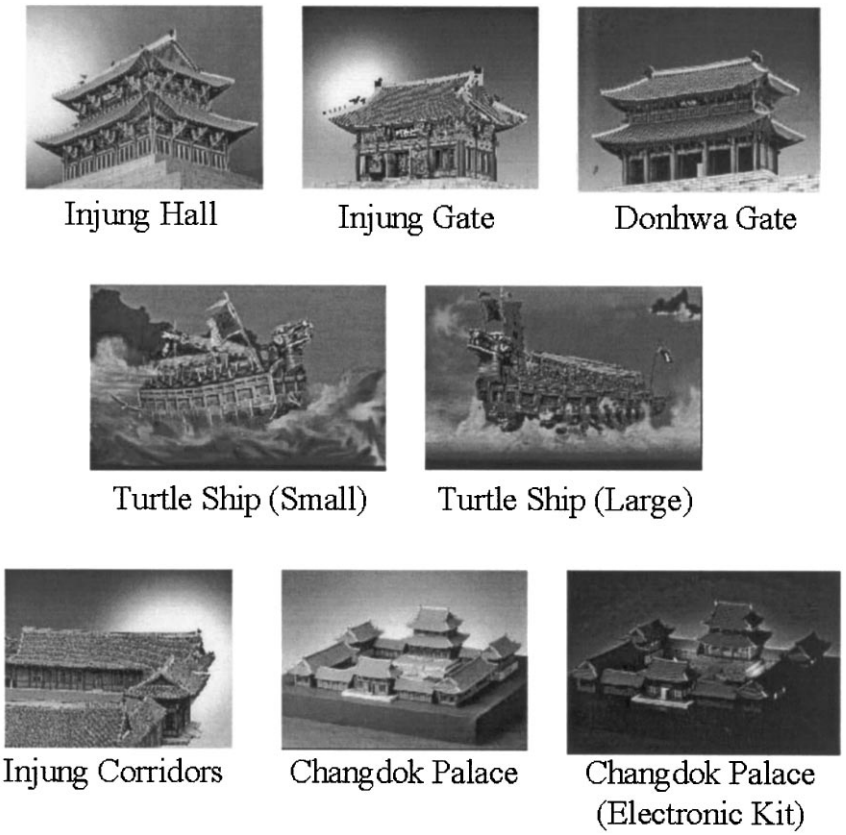


Fig. 9. The PaperMagic$^{TM}$ World Heritage Series.

needs and characteristics of the PC usage in 5–10 years ahead from now. Many new ideas are being generated and implemented in the design which is still in progress. The success of the project so far shows that the concept of High Touch can be applied to PCs with great potential.

## 4. Conclusion

The case studies and the framework of High Touch showed the need for the systematic approach in the front end of the new product development process. Although there is a distinct difference in each of the projects explained, there are common components that can be outlined; (1) a strong dependence in the formal analysis procedure in the very initial stage of the process; and (2) the success of a collaborative team approach matched with special expertise to facilitate the identification of the 'implicit need of the consumers' which can be well-hidden in the shadow of the development process.

We live in a period of transition – a transition to the information era and global economy. The traditional role of product development process has to be reinvented to prepare for the paradigm shift. User-oriented design strategy and the visionary role of the development team will be a key success factor in any new product development project. Knowledge of human capabilities, physical limits, personal habits, cultural characteristics and individual preference will be an essential part of new product ideas. At the same time, mass customization, personalized products, consumer taste and tailored media will be dominant in most

markets. The concept of High Touch may soon become a requirement for any new product development.Lee, 1993; Brown, 1991.

## References


Abrams, M., Bernstein, H., 1991. More Future Stuff: Over 250 Inventions that will change your Life by 2001. Penguin Press, New York.

Chen, J.J., Ko, M., 1994. The disability index analysis system via an ergonomics, expert systems, and multiple criteria decision making process. International Journal of Industrial Ergonomics 13 (4), 317–335.

Kim, Y.W., Lee, M.W., Freivalds, A., 1990. EYES — An expert system for the development of High-Touch consumer electronic products. In: Das, B. (Ed.), Advances in Industrial Ergonomics and Safety II. Taylor & Francis, London, pp. 339–346.

Lee, M.W., 1994. Theory W – A new vision for human factors. Proceedings of the Third Pan-Pacific Conference on Occupational Ergonomics. Seoul, Korea, pp. 16–21.

Lee, M.W., 1995. High touch – human factors in new product design. Engineering Design and Automation 2 (2), 1–10.

Lee, M.W., Freivalds, A., Park, D.H., Yun, M.H., 1991a. An identification and evaluation of the high touch consumer electronic products. Unpublished Research Report, Department of Industrial and Manufacturing Engineering,. Penn State University, University Park, PA.

Lee, M.W, Yun, M.H., Park, D.H., Chun, Y.H., Jung, E.S., Freivalds, A., 1991b. EYES – ergonomics in a conceptual design process for consumer electronic products. Proceedings of 35th Annual Meeting of the Human Factors Society. San Francisco, CA, pp. 1101–1105.

Nagamachi, M., 1994. KASEI Engineering: An ergonomic technology for a product development. Proceedings of 12th Triennial Congress of the International Ergonomics Association. Vol. 4, pp. 120–121.

Naisbitt, J., 1984. Megatrends: Ten Directions Transferring Our Lives. Warner Books, New York, NY.

Saaty, T.L., 1980. The Analytic Hierarchy Process. McGraw-Hill, New York.

Ulrich, K.T., Eppinger, S.D., 1995. Product Design and Development. McGraw-Hill, New York.