

THE INCLUSIVE I.C.E. CUBE : New dimensions and approaches for design inclusion

Asst. Prof. Paima ISRASENA NA AYUDHYA (Ph.D)
Department of Industrial Design
Faculty of Architecture
Chulalongkorn University
Email: Paima.C@chula.ac.th

ABSTRACT

 Inclusive design is an evolving and complex concept, the definition of which can be extended to address not only age and disability, but also race, income, education, and culture. As most of products are originally designed in developed countries, conventional elder-care products present serious difficulties and exclude users with different cultural customs and lower economic status. There is an urgent need for design methods, based on an expansive understanding of not only age and disability, but also income, education and culturally related factors, which will lead to a minimizing of the impact of these differences and thereby extend the effectiveness of “inclusive design”. Through a case study of Thai elder care product development, this paper aims to extend the understanding of inclusive design dimensions across capability, cultural and economic diversity. Techniques for this research include contextual interview and observation as well as self-documentary study of 50 pairs of elderly and caregivers enabling us to identify the details of inclusive design barriers. We have developed population profiles based on three expanded design dimensions for greater inclusion: individual incapability, cultural specificity and economic limitation. Analyzing the design development processes, a pattern of design approaches suitable for each target group was identified. The findings enable the development of the “Incapability-Cultural - Economic Cube” (I.C.E Cube), an active inclusive design framework for all ranges of users with different capability, culture and purchasing power. The model is also illustrated in this paper by a range of product examples from Thai elder-care case studies.

Keywords: *Inclusive design dimension / cultural factors / economic factors / elder care*

1. INCLUSIVE DESIGN DIMENSIONS AND APPROACHES

Inclusive design is an approach to the design of all products and environments to be as usable as possible by as many people as possible regardless of age, ability or situation. It accommodates people with disabilities, older people, children, and others who are non-average in a way that is not stigmatizing and benefits all users. Designing for a broad range of users from the beginning of the process can increase usability of an environment or product without significantly increasing its cost. It results in easier use for everyone and it reduces the need for design modifications later when abilities or circumstances change. Other terms for Inclusive design used around the world include Design for All, Universal Design, and Barrier-Free Design. Terminology and meanings differ from one country to another and often reflect each nation's societal values. Significant cultural differences between countries have influenced how the movement has been adopted and evolved in each location but the common goal of social inclusion transcends national laws, policies, and practices.

During the past 25 years, considerable advances have been made in the fields of designing for disabled and elderly user. Many design approaches were proposed focusing on the suitability of users' capabilities. The User Pyramid design approach (Benktzon, 1993) reflects the wide range of user capabilities and their impact on the design process by categorizing the target user capabilities: able-bodied, moderately impaired and severely impaired (Figure 1). Building on Benktzon's User Pyramid, Keates et al (2000) have developed the 'Inclusive Design Cube' model that relates capability level, population profile and suitable design approaches consisting of: user-aware design, modular/customizable design, and special purpose design (Figure 2).

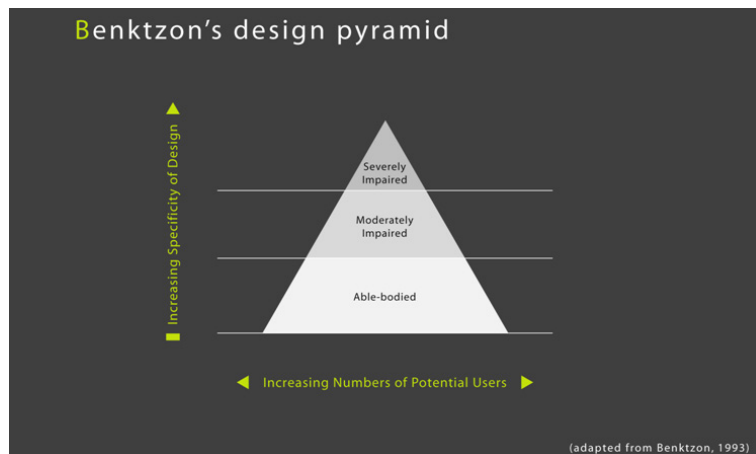


Figure 1: The Design Pyramid (Benktzon, 1993)

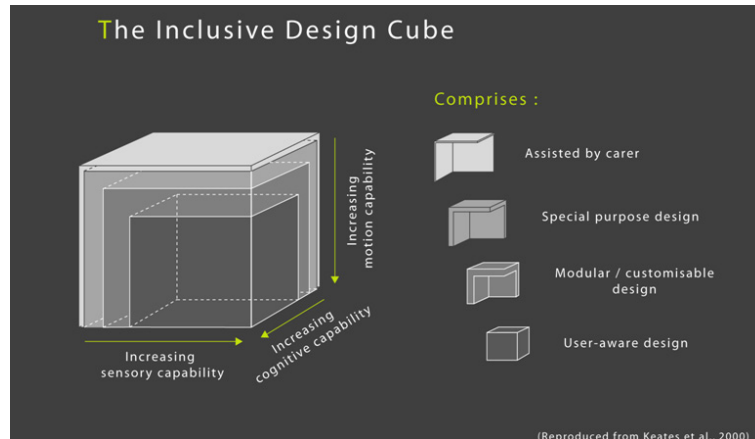


Figure 2: The Inclusive Design Cube (Keates et al, 2000)

However, “Inclusive design” is an evolving and complex concept the definition of which can be extended to address not only age and disability, but also race, income, education, and culture. Design can exclude and discriminate against certain groups in society with different cultures and economic status. As most of products are originally designed in developed countries, the market sector in the developing world is being ignored and large sections of the population are being excluded. Thus, conventional products present serious difficulties and exclude users with limited capability, different culture and lower economic status. There is an urgent need for the development of design methods, based on a comprehensive understanding of not only age and disability, but also income, education and culture related factors. Through a case study of Thai elder care product development, this paper aims to extend the dimensions of inclusive design and to present a methodological design approach for implementing inclusive design across incapability, cultural and economic diversity.

2. THAI ELDERLY CARE GIVING AND WESTERN DESIGN ADOPTION

The demographic trends of the past decades are leading to unprecedented increases not only in the absolute numbers of older persons but also in the relative share of the population that belong to the elderly age groups. The countries of the Asian region, without exception, will experience a rapid growth of their aged populations and an overall ageing of their national populations over the next few decades. This will occur in a context where the extent to which family resources, which have traditionally been the major source of support for the aged, are likely to be diluted. The dilution will occur due to the higher ratio of older people to economically active people, to greater female workforce participation outside of the home, and to fundamental changes in the structure and functioning of the family (Hugo, 1996). In Thailand the elderly population increased from 1.21 million in 1960 to 4.02 million in 1990 and will reach 10.78 million in 2020. However, the matter which is seriously considered is population aging. Population aging means an increase in the elderly share of the total population. In 1960 only 4.6% of the whole population was elderly people aged 60 and over. In 1990 the elderly population share in Thailand was 7.36% of the total population. They will represent 15.28% by 2020. In 1960, the total dependency ratio was 91.55%, of which almost all of the dependent populations were children. During the process of population aging, aged

dependency ratio increases. The aged dependency ratio will be inevitably higher than the child dependency ratio (Jitapunkul and Bunnag, 1999).

While much design and research related to elder care has been carried out in the West, only a portion of it can be applied to the Thai context. Besides the difference of elder care by untrained family caregivers in Thailand, the culture and ways of life are also different from the West. There are still specific problems and unmet needs in Thailand that have not been studied, such as the fact that Thais are used to sleeping on the floor, and also think it is safer than sleeping in a bed. Suitable equipment that has not been produced in the West, is thus needed. Moreover, economy is also an important barrier to the application of western design guidelines. In some cases, it creates an even greater problem, for example, some are unable to afford adult disposable diapers and/or do not understand the proper sanitary treatment of them. They try washing, reusing, or extending the usage of each diaper, which causes health problems. These barriers are left unexplored, negatively affecting the lives of both the caregivers and the elderly (Israsena & Boonvong, 2007).

3. RESEARCH OBJECTIVE

- 1) to uncover inclusive design barriers in Thailand, through the exploration of Thai elder-care problems and limitations in applying products, originally designed in the developed countries, in Thai context.
- 2) to explore the relations among inclusive design barriers, dimensions and suitable design approaches across capability, cultural and economic diversity.

4. RESEARCH METHODOLOGY

4.1 Subjects

Fifty pairs of elderly and caregivers were selectively chosen from Chulalongkorn Hospital, a public hospital in Bangkok, Thailand. The subjects were selected based on age, gender, length of dependency, their relationships such as being family members, a maid, or a trained caregiver, the elderly's level of self-reliance, the elderly's functional dependency in ADL, the types of caring activities demanded, the living condition, and equipment for elder care.

4.2 Data collecting methods

In the first phase of this research, in order to closely study inclusive design barriers, two data collecting techniques were employed in this study: self-documentary study and contextual interview & observation.

4.2.1 Self-documentary study: In order to collect information of real daily activities, subjects were asked to record details of challenges in a diary with questions for the causes of the elderly's dependency, the schedule of daily activities of the elderly and the caregiver in 24 hours, and details on mobility, bathing, toileting, feeding, uses of medication, sleeping

and monitoring. The caregiver was to record the steps in each elder care activity, problems in each step, the advantages and disadvantages of the environment and products used, using either a disposable camera or a digital camera to record pictures, and provide a description attached to the pictures.

4.2.2 Contextual interview and observation: To get information in the real context, researchers went in to observe and interview elderly and caregivers during daily care activities. The interview consisted of questions similar to the self-documentary study mentioned earlier.

4.3 Analysis methods

The information from the self-documentary study and contextual interview and observation is processed using qualitative analysis methods in the form of tables and diagrams to study inclusive design barriers, the relationships between the challenges in elder care and the living conditions as well as the equipment in the home.

In the second phase of the research, to better understand the relations among inclusive design barriers, dimensions and design approaches the process of elder care design development was analyzed. The problems and barriers found in the first part of the research were set as objectives for design development. Analyzing the design development processes employed, a pattern of design approaches suitable for each target group was identified. The findings enabled the development of the “Incapability-Cultural-Economic Cube” (I.C.E Cube), an active inclusive design framework for all ranges of users with different capability, culture and purchasing power.

5. RESULTS & DISCUSSION

5.1 Phase I: Inclusive design barriers in Thailand

The results to be discussed in the first part are from the self-documentary study and the contextual interview and observation, which explain the causes of inclusive design barriers in Thailand. The study found that most families with purchasing power in the city, where a primarily Western lifestyle is adopted, are using imported products and are facing only individual incapability (sensory, cognitive, motion) barriers similar to those of the West. On the other hand, low-income families who both live in the city and the countryside have to deal with problems that are specific to Thailand which are left unexplored and unsolved. With limited space, this paper will not describe or illustrating all the problems found in Thailand, but will focus only on the local-specific problems that have severe effects on the elderly and caregivers. The findings point out Thai barriers in applying products originally designed in the developed countries in 3 dimensions: cultural, economic and incapability.

5.1.1 Thai local cultural barriers: While much design and research related to elder care has been carried out in the West, only a portion of it can be applied to the Thai context. Besides the difference of elder care by untrained family caregivers in Thailand, Thai culture and ways of life also very different from those of the West. Thai cultural barriers in applying western products include:

- a) Lifestyle practices: sleeping on the floor, dining on the floor, wearing a wrap-around instead of pants, eating with one hand using a short spoon, showering using a bowl.
- b) Customs: respect for the elderly, the forbiddance of standing and passing things over the elderly's head, the importance of "low" and "high" parts of the body (e.g. using separate towels for the head, body, behind, and feet), and the importance of food arrangement for people of status.
- c) Preferences and attitudes: not favoring things to be permanently installed and things that need a technician to install (e.g. a grab bar), not favoring buying a whole product for elder care but preferring to buy parts to retrofit to existing products in the household, preferring to easily modify things or to find a short cut and save costs, but without considering the consequences.
- d) Information processing: Thai elderly and caregivers have a limited literacy level or do not like to read. They choose to remember things and pass them along, particularly the elderly's drug prescriptions and processes of elder care. Without writing them down, understanding them, or giving importance to processes that they view as complex, matters of hygiene and nutrition are missed.
- e) Environmental arrangement: As most houses are quite small, Thai people in the countryside choose to sleep on the floor while many urban inhabitants who have beds tend to place a side of the bed along the wall. A higher importance is given to social interaction with family members than for privacy, such as moving the elderly, who has difficulty in using the stairs, to sleep in the living room downstairs in order to be surrounded with family members. Thais tend to use a space for various functions by moving things in and out according to activities, so they do not like to install anything large permanently. Instead, Thais prefer foldable and mobile furniture, which are not so strong, such as foldable tables and chairs.

5.1.2 Thai local economic barriers: Financial limitations in Thailand make it difficult to afford costly equipment and disposable products such as adult diapers. This factor causes people to find other ways to solve problems, which have both good and bad results in elder care. The origins of Thai economic barriers include:

- a) Caregivers lack the opportunity to work and earn a living as many have to quit their jobs or take leave during the day to care for the elderly.
- b) Certain activities demand much more energy than family members, who are aging or have health problems, can handle. Thus, families resort to hiring maids, caregivers, or nurses.
- c) Certain activities in elder care require high expenses, particularly in toileting, where costly disposable items like adult diapers and catheters are needed.

5.1.3 Thai local incapability barriers: Local specific problems in Thai elder care arise from cultural origins mentioned earlier, Thai local incapability barriers will be detailed as follows under mobility, bathing, toileting, feeding, use of medication, sleeping and monitoring activities.

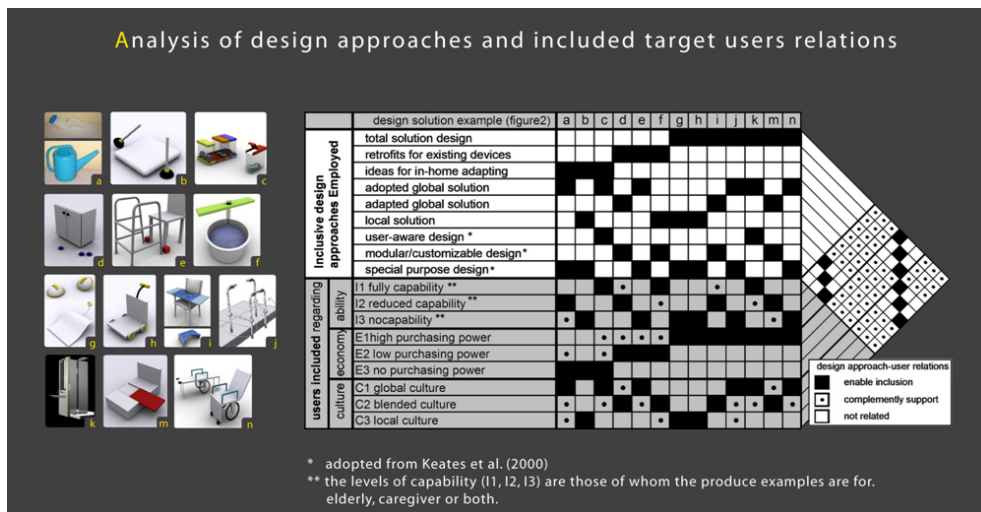
- a) **Mobility:** Thai houses are quite small and narrow. The use of walkers and wheelchairs is not always possible. The elderly have to hold on to foldable tables and wall-hung sinks which are not steady and unsafe. The narrowness of Thai houses also result in beds being placed along the wall or choosing to sleep on the floor. The elderly who sleep on the floor are unable to get up by themselves. Moving from the floor to sit in a chair or a wheelchair is very difficult while sliding seated on the floor is slow and problematic. Caregivers choose to pull them on the floor or not to move them at all. Instead, caregivers make room for the elderly to sit against the wall, stretching out their legs, for various activities such as eating.
- b) **Bathing:** Where many families move the elderly to sleep in the living room, the elderly has to use maid's or guest's bathroom. This type of bathroom has no space for a shower chair and requires the elderly to move in a longer distance to the bathroom. Without the installation of a grab bar, elderly have to stand holding on to the unstable wall-hung sink or sit on the toilet bowl to bathe. Both are difficult for them to maintain balance. In cases where the elderly sleeps on the floor, the caregiver pulls their mat outside to bathe them on the patio, forcing uncomfortable positions.
- c) **Toileting:** The problems of toileting inside the bathroom brought about by moving the elderly to sleep in the living room are: lack of privacy, narrow bathrooms far from the sleeping area without separate wet and dry areas, the risk of slipping, the difficulty of moving, and lack of appropriate ergonomics. Toileting outside the bathroom by using an adult diaper is very problematic due to hot climate and unaffordable expense. Some have the wrong idea that disposable diapers can be reused, which lead to health risks. Some Thais try to find cheaper solutions such as modifying a plant watering can into a bigger urinal container so the caregiver does not have to take it out to empty as often. As the catheter is costly, wastefully, and requires a caregiver with skills, some have tried using in-house items such as a tube connected to a liquid soap dispenser or a soap bar sharpened into a cone shape, or a finger without wearing a glove. Some of these modified items are usable, whereas others pose health risks.
- d) **Feeding:** Most low-income people in the countryside eat on the floor, either at a small low table or on their lap. This forces them to be in a bending position for long periods. Thais are used to eating with a short spoon using only one hand. With age, the elderly loses energy and precision in cutting and spooning the food, leading to leaks and spills. Another difficulty with elderly food is tube-feeding, which requires expertise and skill. There is a lack of knowledge, understanding of the correct way of sterilizing and properly organized environment. Most Thais do not invest in modern devices such as equipment steamer specifically for the elderly. Instead, they try modifying the process and make use of existing in-home items, such as immersing the feeding devices into an electric water boiler.
- e) **Use of medication:** Most Thais do not have the basic language skills to be able to read and write Thai and English. Caregivers and the elderly try to remember what doctors and pharmacists prescribe, without reading or noting it down. In preparing medicine, most Thais use in-home items in cutting and crushing pills, such as a knife, a cutting board, and a spoon, or even cutting with their fingernails. These methods are sometimes unhygienic. Pills often bounce away and get lost. The limited knowledge and understanding in the use of medicine put the elderly at risk.

- f) Sleeping and monitoring: As mentioned earlier, Thai houses are usually very small and narrow, causing people to place the bed along the wall or sleep on the floor. The hot weather, the use of mosquito nets, plastic sheets for urine spills, and adult diapers contribute to sleeping discomfort. Thais give great importance to social ranking and seniority, so caregivers cannot sleep higher than elderlies. Most caregivers sleep on the floor and become a barrier in the walking path.

5.2 Phase II: Inclusive design dimensions and approaches

Setting design objectives based on the problems and barriers discovered in real Thai elder care practice, the design team has developed more than 150 design solutions suitable for all user groups in Thailand. Examples can be seen on figure 3.

Table 1: The analysis of inclusive design approaches and included target users relations



In order to develop the design solutions, the team has employed various design approaches, namely total solution design, retrofits for existing devices, ideas for in-home adapting, global solution design, adapted solution design, local solution design, user-aware design, modular/customizable design, and special purpose design. Analyzing the relationship between design approaches and the included user groups, a pattern of suitable approaches could be identified. Some examples are illustrated on table 1. Derived from a better understanding of barriers, design approaches and their relations to target users, the 'I.C.E. Cube' model (Figure 4) was developed. It is represented in simple graphic form to communicate the finding and guide the inclusive design process in the future.

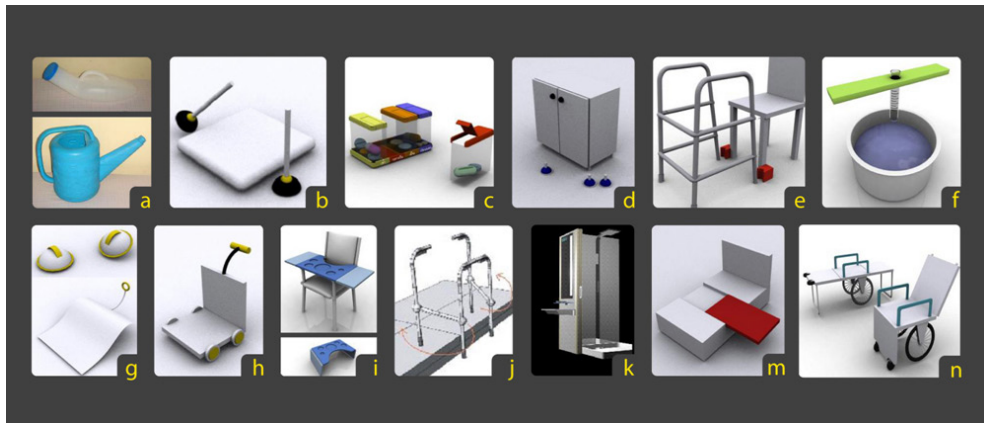


Figure 3: Examples of product solutions generated from integrated inclusive design approaches

Building on the concept of the User Pyramid (Benktzon, 1993) and the Inclusive Design Cube (Keates et al, 2000), the authors have developed ‘The Inclusive ICE Cube’ to model the whole population in three dimensions (3 axes), with regard to individual incapability, cultural specificity, and economic limitation. Figure 4 (left) presents the whole Thai population as profiles divided horizontally in three layers ranging from the bottom layer which represents users with lowest risk of exclusion to the top layer which represent users with highest risk of design exclusion according to three dimensions of barriers: individual incapability, economic limitation and cultural difference.

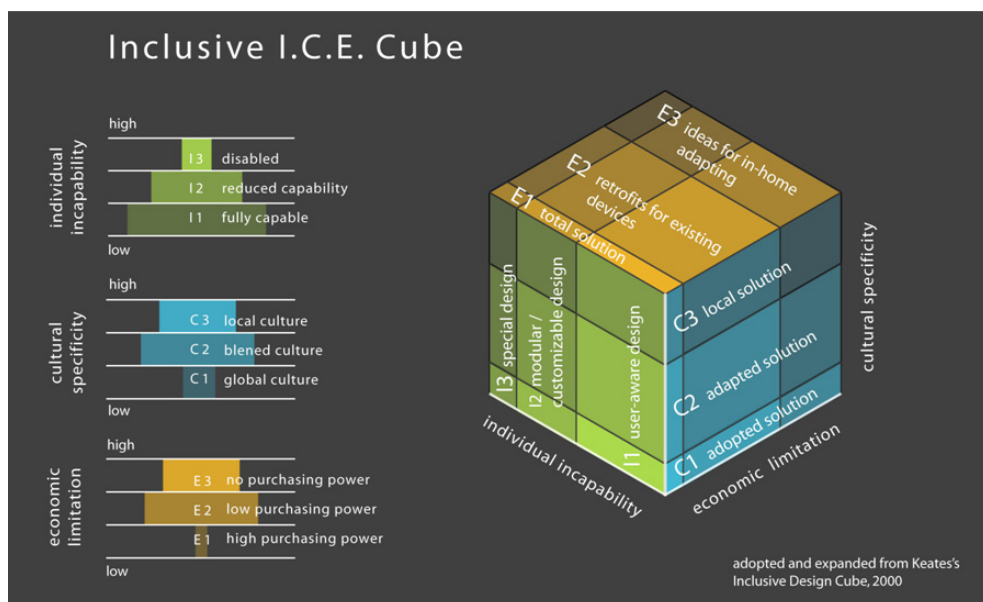


Figure 4: [left] profiles of Thai population at risk of design exclusion as a result of individual incapability, economic limitation and cultural different barriers; [right] The Inclusive Incapability-Culture-Economy (I.C.E.) Cube

The ‘Inclusive ICE Cube’ relates the three dimensions to population (included in the enclosed volume) and suitable design approaches that can be used in conjunction: total solution design (E1), retrofits for existing devices (E2), ideas for in-home adapting (E3), adopted solution design (C1), adapted solution design (C2), local solution design (C3), user-aware design (I1), modular/customizable design (I2), and special purpose design (I3). For example, ideas for in-home adapting (E3), local solution design (C3), and user-aware design (I1) approaches should be used in combination for low-income users with specific culture.

5.2.1 Individual Incapability Dimension: Adopted from Keates’ Inclusive Design Cube, the capability axis represents cognitive, motor and sensory capabilities of individuals ranging from full capability to no capability. At the low capability end, it is likely that many of the needs of daily living will be met by care givers. As capability increases, special purpose design (I3) will provide products to suit specific needs, wheelchairs for example, where such products are not intended for general use by the whole population. Modular or customizable design (I2) allows for variations in products to accommodate a wider range of abilities. Finally, user aware design (I1) is intended to result in products with appeal to as wide a range of capability as possible.

5.2.2 Economic limitation Dimension: The economic axis represents the users’ purchasing power ranging from unlimited/full purchasing power to limited/no purchasing power. At the no purchasing power end, the suitable approach would be designing creative ways for users themselves to adapt household items or environment (E3). Appropriate technology design will provide solutions with no financial barrier. For instance, making a mitten from a wash cloth and modifying a plant watering can into a bigger urine container (figure 3-a). As purchasing power increases, designing low-cost retrofits for existing devices in the home (E2) provides greater value from a smaller investment and extends the life of existing equipment, such as, metal cup placed in an electric water boiler to warm up liquid food or sterilize feeding equipment (figure 3-f). Finally, total design solutions (E1), by either product redesigning or creating a new product class, will enable more efficient solutions for users with higher purchasing power. A two layer adult diaper allows the elderly to remove a layer during the night by themselves or an easy-to-install bathroom can be placed near sleeping area. As most of the Thai population has limited purchasing power, ideas for in-home adapting (E3) and retrofits for existing devices (E1) are most useful. Interestingly, while the two approaches are essential for the low-income users, they are preferred for the whole population as well.



Figure 5: Degree of design inclusion along each inclusive design dimension: individual incapability, cultural specificity and economic limitation

5.2.3 Cultural Specificity Dimension: The cultural axis represents lifestyle practice, customs, preference, information processing, and environmental arrangement related to users' culture. The range of cultural specificity is from global culture, to blended culture, and to local culture. To overcome the culture barriers several design approaches can be used. At the local culture end, local solution design for specific culture practice and customs (C3) will provide products to suit specific needs, for example a softer mat could be designed to have a pulling handle and body strap for safely sliding the elderly across the floor, as was discovered to be a practice of convenience (figure 3-g), or lower wheelchairs to allow users who lie on the floor to move around without having to pull themselves up (figure 3-h). Such products are not intended for general use by the whole global population. Adapted solution (C2) allows a global product concept and technology to accommodate a wider range of users within different cultures. For example a foldable food tray with cup and plate holders that can be used both with a chair and on the floor (figure 3-i). Finally, adopted global solution (C1) is intended to result in products with appeal to as wide a range of users in global culture as possible.

To optimize inclusive design effectiveness, design approaches in the three dimensions of the I.C.E. cube should be used in combination. Results from in-depth interviewing and observation pointed out that design solutions and approaches intended for users with reduced capability (I2) are also preferable for fully capable users (I1). Similarly, solutions and approaches intended for users in blended culture (C2) are acceptable in global culture (C1), while those intended for low-income users (E2) are applicable for high-income users as well. On the other hand, solutions and approaches intended for users who are disabled (I3) or in local culture (C3) are so specific that they are usually not applicable for other user groups (figure 5). Interestingly, many design solutions intended for no-income users (E3), if done well, can be preferred by higher income users (E2, E1) as well (figure 3-c). Making a mitten from a wash cloth is a good example.

6. RESEARCH APPLICATION

The “Incapability-Cultural -Economic Cube” (I.C.E Cube), in the second phase of this paper, could be used as an active inclusive design framework for all ranges of users with different capability, culture and purchasing power. The detail findings in the first phase of this research can also be applied to other contexts, with the consideration of the following:

- a) Excluding the problems specific to Thailand, the general problem findings and solutions can be applied to any other country. Solutions through design can be carried out in a more innovative level in countries with financial and technological advantages,
- b) For the problems specific to Thailand, in terms of culture, the findings and solutions can be applied to countries with similar cultural characteristics and behaviors, such as sitting and sleeping on the floor. These similar cultures would be in East Asia, namely, Japan and the neighboring countries of Thailand.
- c) For the problems specific to Thailand, in terms of limitations in purchasing power and literacy, the findings and solutions can be applied for other developing countries with similar limitations.

Nevertheless, the context in each country varies, so further research should study specific problems locally.

7. FURTHER RESEARCH

This research, in the 1st phase, aimed to study the broad problems covering all the elder-care activities. Further research for product development could be more in-depth. Behavioral prototypes can be used as a tool to collect information on each device, involving experts from other fields. A multi-disciplinary teamwork would provide the most useful information in developing elder care products.

The 'Inclusive I.C.E. Cube' is only a starting point for inclusive design across capability, cultural and economic diversity. Further work could be done to develop this concept in terms of dimensions and user ranges in order to turn it into a more completed framework and set of design principles.

8. CONCLUSION

Elder care in Thailand has specific problems rooted in cultural, economic and physical factors. The adoption of methods and devices from abroad has limitations in application, and some even lead to more complex problems. Therefore, problem-solving through design in elder care should start at the root causes with an in-depth understanding of problems and preferences in purchasing or using devices. The design approaches should be compatible with the local lifestyle and economic status. This research proved that the adoption of conventional products from the developed countries present serious difficulties and exclude users with limited capability, specific culture and lower purchasing power. The understanding of the problems and barriers enable the I.C.E. Cube to be developed. The concept of the I.C.E. Cube intended to provide a framework for active design guidance for all range of users with different capability, culture and purchasing power. Lastly, although similar problems in the Thai context can be found in similar cultures and developing countries with economic limitations, but each country has specific needs and requires the study of local problems in order to achieve the best solutions.

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REFERENCES

- Benktzon, M. (1993). Designing for our future selves: the Swedish experience. *Applied Ergonomics*, 24 (1), 19-27.
- Jitapunkul, S., & Bunnag, S. (1999). Ageing in Thailand FACT SHEET - Family Planning and Population, *Thai Society of Gerontology and Geriatric Medicine*, 2 (6)
- Hugo, G. (1996). Over to the Next Century: Continuities and Discontinuities, Added years of life in Asia: current situation and future challenges. *Asia Population Studies Series*, 140, 179-209.
- Israsena, P., & Boonvong, N. (2007). Caregiving for the Elderly in Thailand. Proceedings of the 8th Pan-Pacific Conference on Occupational Ergonomics.
- Keates, S., Clarkson, P.J., Harrison, L.J., & Robinson, P. (2000). Towards a practical inclusive design approach. *Proceedings of the 1st ACM Conference on Universal Usability (CUU 2000)*, 45-52.