

# Universal Design Practices: Development of Accessible Cellular Phones

**Kei Tomioka**

**Human Centered Design Group, Design Center  
TOSHIBA Corporation, Japan**

**TOSHIBA**



# What is Universal Design?

*Universal design is the design of products and environments to be usable by all people, ..... (Ron Mace)*

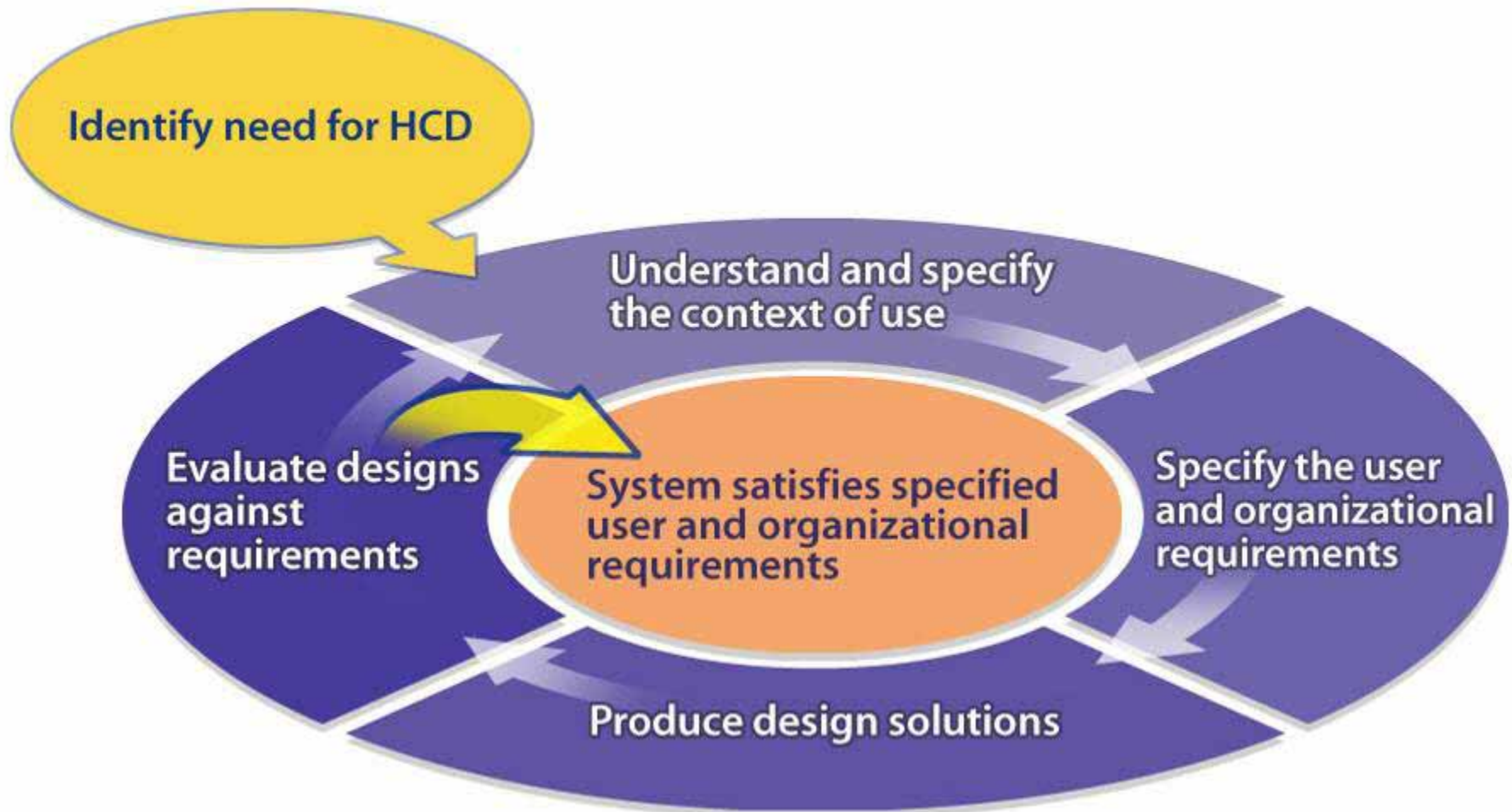
*Practice of designing products or environments that can be effectively and efficiently used by people with a wide range of abilities ..... (Vanderheiden)*

**Universal Design is design activities to make products / environments usable for a greatest number of users**

# How practice Universal Design?

- **Human Centered Design processes**

**A series of design activities that makes products or systems usable, grounded on users perspective.**



## Benefit

- make products or systems easier to understand and use
- improve user satisfaction and reduce discomfort and stress

## Essential

- the active involvement of users
- a clear understanding of user and task requirements
- the iteration of design solutions

**Applying HCD for products involving various users  
= Practicing Universal Design**

# Practical Design Processes

## HCD processes defined in ISO 13407

Understand and specify  
the context of use

Specify the user and  
organizational requirements

Produce design solutions

Evaluate designs  
against requirements

## More practical design processes

User requirement capture  
user needs, context of use, .....

Prototyping  
deliberation on design specifications,  
making prototype, evaluation

Determining design specifications

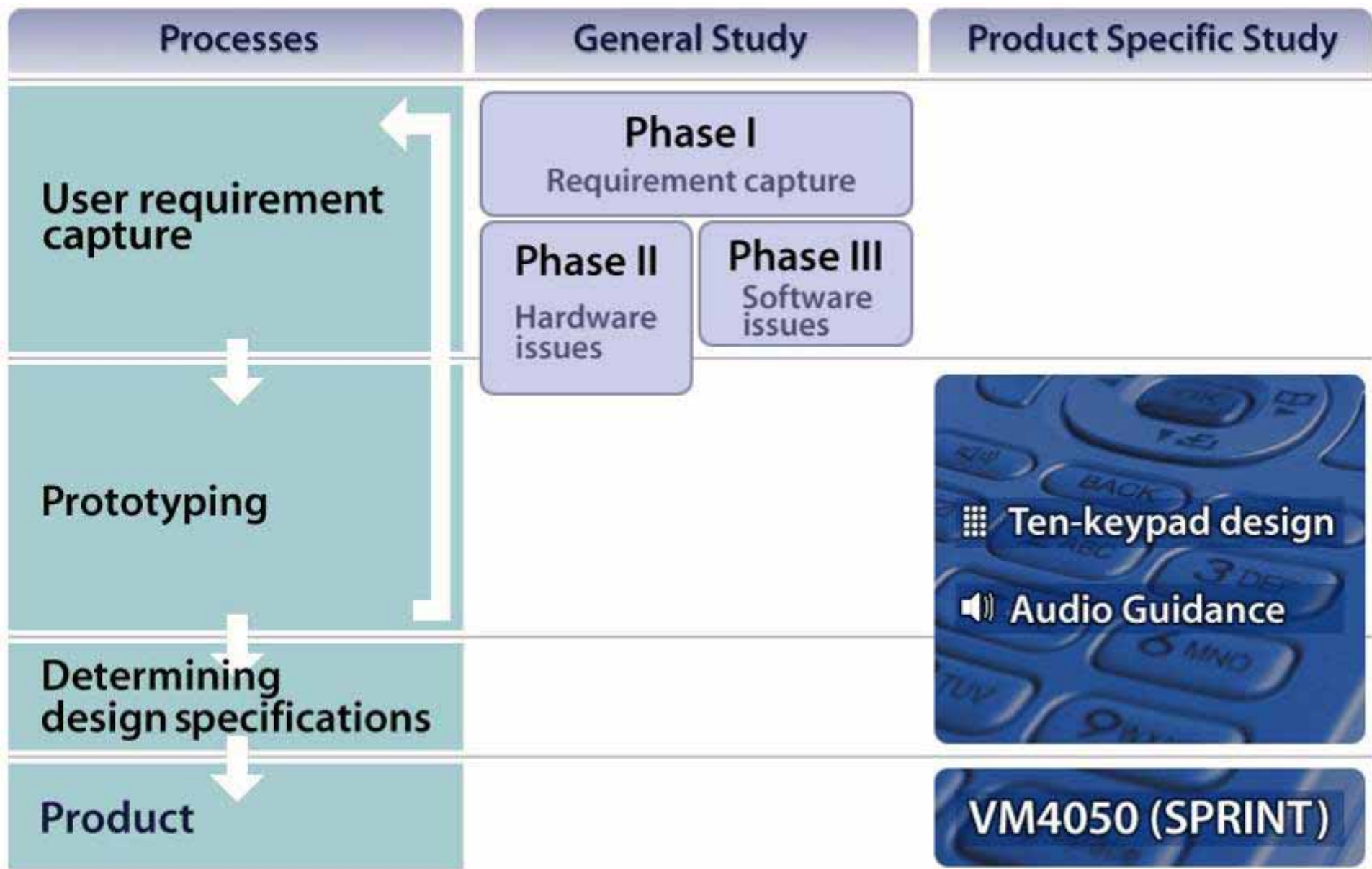
# Case Example: Cellular Phone

- **Rapid penetration of cellular phones**
  - Japan 85 million (as of October, 2004)
  - USA 172 million (as of November, 2004)
  - Brazil 4.4 million in 1977 to 35 million by 2002
- **Enhanced functions**
  - SMS, E-mail, Web (Internet access), 3G phones
- **Regulations**
  - Telecommunication Act of 1999 (in the USA)

**Cellular phones are;**

- becoming a common tool for daily communication tasks.
- becoming an indispensable tool for improving QOL of users with disabilities

# Overview of Accessibility Study



# User requirement capture (Phase I study)

- Elicitation of information regarding needs, context of use, and other data to support requirements capture
  - **Methods**
    - Individual Interviews (Semi-structured)
    - Focus Groups
  - **Identified needs and user requirements**
    - Needs (Features)  
Keypad design, Phone size, Audio display, Letters on display, Instruction Manual, Limited functions, .....
    - A part of requirements regarding keypad design
      - Key pitch must increase
      - Key protrusion must be sufficient to allow user orientation
      - Users require kinesthetic feedback of key clicks
      - .....



# User requirement capture (Phase II study)

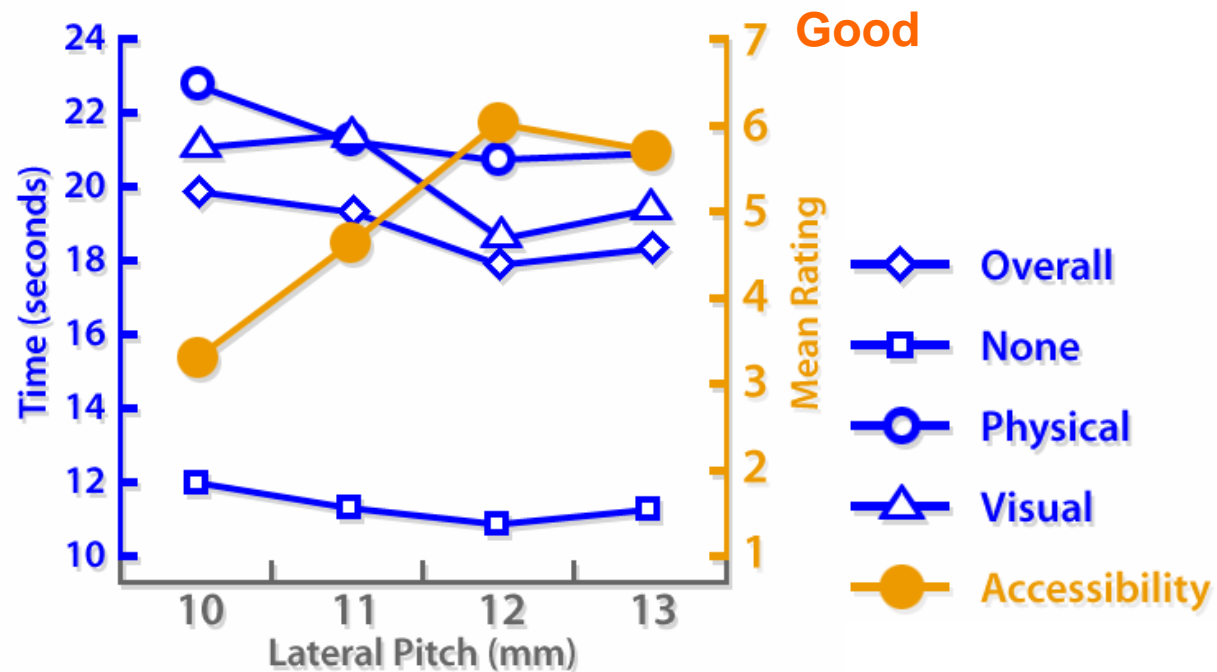
- Experiment to capture user requirements for keypad design

- **Methods**

- Performance testing using low-fi mockups



mockups



# User requirement capture (Phase III study)

- Usability testing of cell phone user interfaces

- **Methods**

- Usability testing with retrospective think aloud method (RTA)  
: Users with physical, cognitive, no apparent disabilities
- Modified usability test with the coaching-learning method  
: Users with visual impairments

- **Outcomes**

- General user requirements for cellular phone user interfaces (RTA & Coaching-learning)
- User interface guideline (23 guidelines) (RTA)
- Design specifications for some features (RTA)
- Usability problem list (29 problems) (Coaching-learning)

# Prototyping (Product specific study)

- Determining design specification of keypad
  - **Methods**
    - Product Interactive Focus Group

Phone A



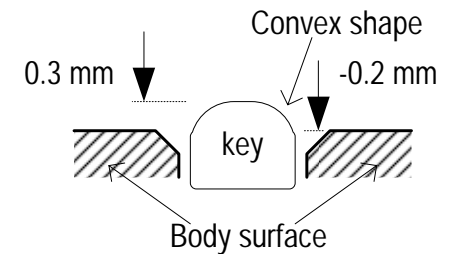
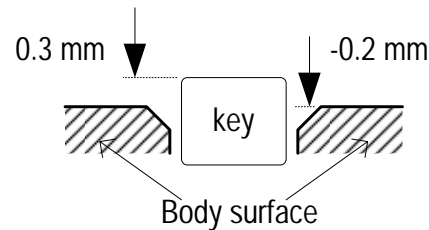
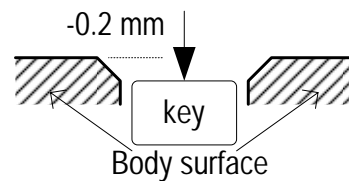
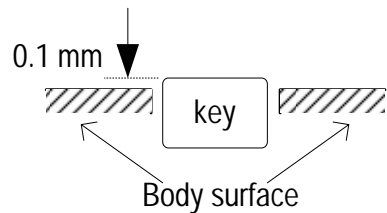
Phone B



Phone C



Phone D



Key protrusion

Key shape

# Product Interactive Focus Group



# Prototyping

(Product specific study)

- Mean ratings of “Ease of identifying the keys”



# Prototyping

## (Product specific study)

- Determining specification of audio guidance

- **Methods**

- Focus group

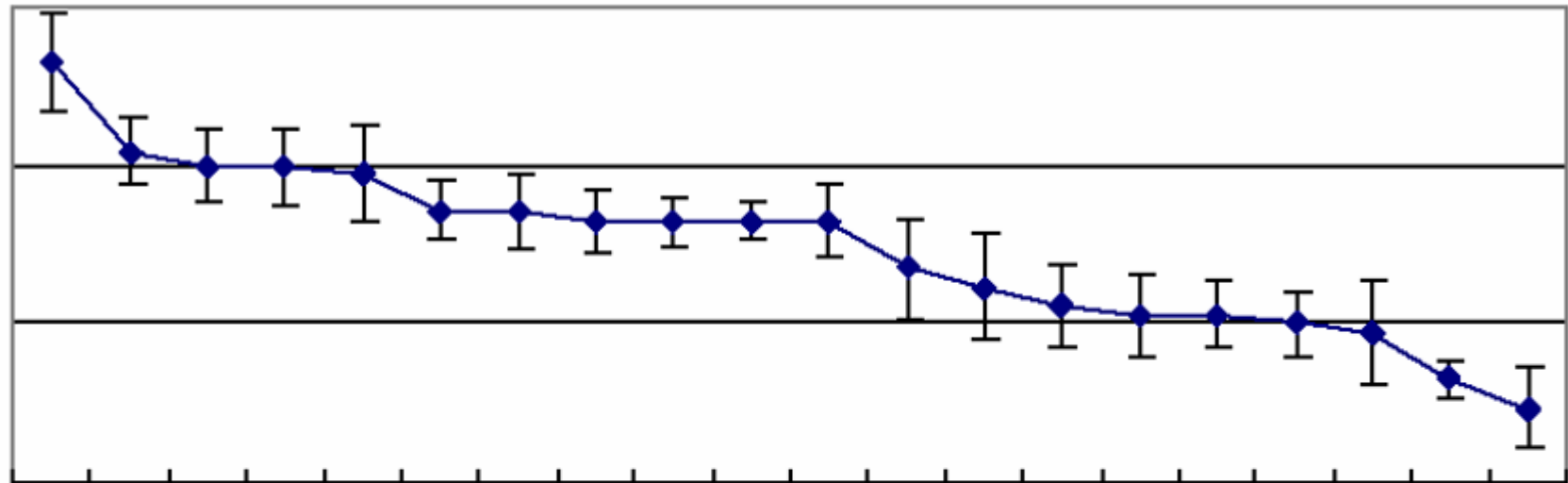
- **Items prioritized**

1. Battery charge, 2. Battery level, 3. Signal strength
4. Roaming status, 5. Date and time,
6. Missed call / New message indication,
7. Opening / Closing alarm, 8. Idling confirmation,
9. Key guidance, 10. Outgoing call confirmation, 11. Ringer type,
12. Call-history (outgoing), 13. Call-history (incoming),
14. Call-history (voice mail), 15. Phone book, 16. Quick dial,
17. Speed dial, 18. Accessibility mode,
19. Phone book (navigation), 20. Alarm (navigation)

# Prototyping (Product specific study)

- Mean ratings of necessity of audio feedback (Overall)

Strongly Necessary



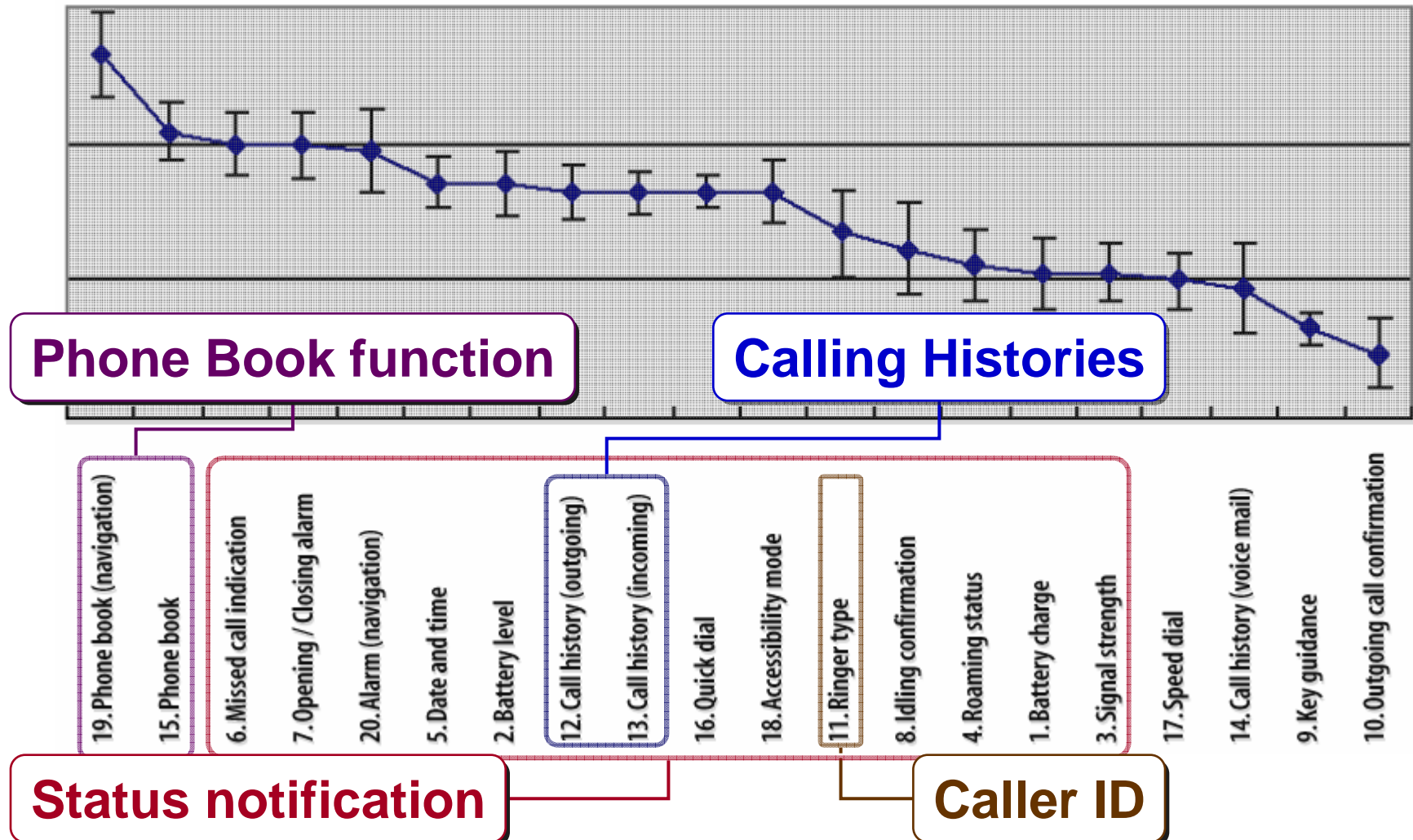
Not Necessary

19. Phone book (navigation)  
15. Phone book  
6. Missed call indication  
7. Opening / Closing alarm  
20. Alarm (navigation)  
5. Date and time  
2. Battery level  
12. Call history (outgoing)  
13. Call history (incoming)  
16. Quick dial  
18. Accessibility mode  
11. Ringer type  
8. Idling confirmation  
4. Roaming status  
1. Battery charge  
3. Signal strength  
17. Speed dial  
14. Call history (voice mail)  
9. Key guidance  
10. Outgoing call confirmation

# Prototyping (Product specific study)

- Mean ratings of necessity of audio feedback (Overall)

Strongly Necessary





# Product

- Actual product (Sprint VM4050 by Toshiba)



*“it is certainly the most accessible phone that can be purchased off the shelf.” (Access world Vol 5, 4, 2004 May)*

## ■ Keypad

Although there is still room for slight improvement, the keys on the VM405 are relatively easy to identify by touch.

## ■ Audio feedback

....., the fact that they do provide some limited speech output without the need to purchase expensive add-on software is important.

	Toshiba VM 4050				
Keys easily identifiable by touch	■	■	■	■	■
Access to screen information	■	■	■	■	■
Accessible documentation	■	■	■	■	■
Speech quality	■	■	■	■	■

# Conclusion

## HCD Processes

Understand and specify  
the context of use

Specify the user and  
organizational requirements

Produce design solutions

Evaluate designs  
against requirements

## Development Processes for VM4050

### Phase I


Requirement capture

### Phase II

Hardware  
issues

### Phase III

Software  
issues



☰ Ten-keypad design

🔊 Audio Guidance

**VM4050 (SPRINT)**

- **Applying HCD processes to product development involving users with a wide range of abilities would be able to enhance accessibility and usability of products.**
- **HCD processes are effective for practicing universal design, and also efficient for product development.**